HEAT EXCHANGE GARMENT

The invention relates to a garment to be worn by a wearer and particularly a garment capable of changing the temperature of the body of the wearer. More particularly, but not exclusively, the invention relates to a protective garment comprising body armour which is capable of heat exchange with at least a portion of the body of the wearer. Such protective garments may especially but not exclusively be useful for members of the armed forces and law enforcement organisations.

Protective garments incorporating hard armour plates, soft armour, anti-trauma padding and stab-resistant material comprising breathable fabrics are known. The purpose of breathable materials is to promote heat dissipation from the body of the wearer, thereby keeping the wearer cool, for example during physical activity. However, the effect of such garments may be dependent on the surrounding climate, and may therefore be inadequate under some conditions for ensuring the comfort of the wearer.

It is also known to provide a garment comprising cooling packs, wherein the cooling packs are generally adapted to be pre-cooled, for example by placing them in a fridge or freezer, and subsequently placed in pockets of the garment. Whilst such arrangements may provide sufficient heating or cooling, the heat exchange rate is dependent on the temperature difference between the wearer and the cooling garment. Such an arrangement may provide either excessive or insufficient cooling to the body of the wearer, thereby compromising his or her comfort. Further, the duration of use that is possible from such a system may be limited, as the temperature difference between wearer and garment decreases with use.

There also exist temperature conditioning garments in the prior art which comprise an array of pipes for carrying heat exchange fluid adapted to pass heat to, or accept heat from, a wearer. Such garments may be adapted to connect to a supply of conditioned heat exchange fluid, for example a glycol-and-water mixture from a liquid conditioning supply system installed in an aircraft. Whilst this arrangement is suitable for the applications for which it was intended, it is limited to situations where the wearer remains stationary.

Furthermore, the construction of a garment with an array of pipes is complicated.

It is an object of the heat-exchange garment of the present invention to seek to overcome, or at least to mitigate, the problems associated with the prior art. It is a further non-exclusive object of the invention to provide a multi-use heat transfer unit.

According to a first aspect of the invention there is provided a heat transfer unit comprising a receptacle and a heat exchange bladder, the bladder comprising a heat transfer surface, a fluid inlet port and a fluid outlet port positioned remotely from the fluid inlet port to enable a heat transfer fluid to pass through the bladder, wherein the heat transfer surface of the heat exchange bladder is in thermal contact with the receptacle such that heat transfer fluid passing, in use, through the bladder extracts or imparts heat from the heat exchange fluid to the receptacle

A second aspect of the invention provides a bladder for use in a heat transfer unit comprising a heat transfer surface, a fluid inlet port and a fluid outlet port positioned remotely from one another to enable fluid to pass through the bladder, wherein the bladder is formed from inner and outer sheets of flexible plastics material secured together along a common outer edge, the inner and outer sheets being secured together at spaced intervals thereby to disrupt fluid flow through the bladder.

Preferably, the inner and outer sheets are secured together at spaced intervals by means of a plurality of spot welds.

A third aspect of the invention provides a heat transfer unit comprising a bladder connected to a closed fluid supply and pump for pumping the fluid though the bladder, which unit further comprises a receptacle for receiving a fluid which receptacle is in contact with the heat transfer surface to extract or impart heat from the bladder to the fluid in the receptacle.

Preferably, the bladder is shaped to surround the receptacle and wherein there further comprises an insulating layer enclosing the bladder.

The receptacle may be an ice pack or a drinks container.

According to an optional feature of this aspect of the invention, the insulating layer is foam.

According to a further optional feature of this aspect of the invention, there is provided a heat transfer unit wherein the heat exchange fluid comprises water. Preferably, the heat exchange fluid comprises an anti-freeze component. Preferably, the anti-freeze component comprises a diol.

A fourth aspect of the invention provides a temperature conditioning garment comprising an inner layer, an outer layer and a bladder, which bladder is positioned intermediate the inner and outer layers and is shaped to conform the shape of the garment.

Preferably, the body armour material is incorporated in the outer layer. The insert may be integrally formed within the garment. The garment may further comprise a heat transfer unit.

Preferably, the control means controls a pump for generating the flow of heat exchange fluid.

Preferably, the pump means comprises motor controlled pump means adapted to variably control the flow of heat exchange fluid.

Preferably, the control means comprises a microcontroller for controlling the motor controlled pump means.

According to an optional feature of this aspect of the invention, the control means further comprises temperature sensing means for measuring the temperature of at least a portion of the body of a wearer.

Preferably, the control means further comprises temperature sensing means for measuring the temperature of the heat exchange fluid.

A fifth aspect of the invention provides a bladder for use in a heat transfer unit comprising a heat transfer surface, a fluid inlet port and a fluid outlet port positioned remotely from one another to enable fluid to pass through the bladder. The bladder is formed from inner and outer sheets of flexible plastics material secured together along a common outer edge. There further comprises an outer layer of foam applied to the outer surface of the bladder to insulate the bladder.

In one class of embodiments, the bladder is shaped to provide a band around a user's limb. Alternatively, the bladder further comprises an adhesive layer to secure the bladder to a user.

There may further comprise a heat transfer unit with a bladder connected to a closed fluid supply and pump for pumping the fluid though the bladder, which unit further may comprise a receptacle for receiving a fluid. The receptacle may be in contact with the heat transfer surface to extract or impart heat from the bladder to the fluid in the receptacle.

Preferably, the bladder is shaped to surround the receptacle and wherein there may further comprise an insulating layer, e.g. foam, enclosing the bladder.

According to another aspect of the invention, there comprises a temperature conditioning garment comprising a heat transfer unit and a plurality of heat transfer bladders applied to the outer limbs of the user wherein the heat transfer bladders are connected together in series to the heat transfer unit.

A further aspect of the invention comprises a temperature conditioning garment comprising a heat transfer unit and a plurality of heat transfer bladders applied to the outer limbs of the user wherein the heat transfer bladders are connected together in parallel to the heat transfer unit.

It will be appreciated that outer limbs may include arms, legs, neck, hands, feet, etc.

The invention and its preferred embodiments will now be described, by way of example only, with reference to the accompanying diagrammatic drawings, in which:

Figure 1 is a front view of a temperature conditioning garment according to one aspect of the invention;

Figure 2 is a front view of the garment in open condition and exposing the inner layer;

Figure 3 is a front view of a bladder for inserting into the garment of Figure 1;

Figure 3a is a cross section of the bladder through section A-A shown in Figure 3;

Figure 4 illustrates a bladder adapted to be used in conjunction with a heat transfer unit;

Figures 5 and 6 illustrate examples of a receptacle for use with a heat transfer unit;

Figure 7 illustrates the layer of insulating material that surrounds the bladder shown in Figure 4;

Figures 8A, 8B, 8C illustrate the bladder of Figure 4 and the insulating layer of Figure 7 being wrapped around the receptacle of Figure 5.

Figure 9 illustrates the back pack into which the heat transfer unit and pump are inserted;

Figure 10 illustrates the schematic diagram of the heat transfer unit and bladder arrangement;

Figure 11 illustrates the back pack and vest worn by a user;

Figure 12 illustrates a schematic diagram of a cooling unit according to a further embodiment of the invention;

Figure 13A and 13B illustrate cross-sections of a cooling band applied to a user; and

Figure 14 illustrates the cooling unit of Figure 12 applied to a user.

According to a first embodiment of the present invention, as shown in Figures 1 and 2 of the accompanying drawings, there comprises a temperature conditioning garment 10. The garment is formed from two front panels 12, a rear panel 13, Velcro straps 15 and a zip fastener 16. Each of the front panels 12 and the rear panel 13 comprises an outer layer 17 and an inner layer 18. The outer layer 17 is of known construction and, in some embodiments, incorporates body armour material (not shown) to provide resistance to bullets and stabs or to reduce trauma.

In this embodiment, the rear panel 13 is generally rectangular in shape with its top edge comprising an arcuate portion and side edges comprise opposing arcuate portions abutting its top edge, defining part of the opening for a user's arms. The front panels 12 are mirrored in shape. Each front panel 12 is generally rectangular in shape with its top edge comprising an arcuate portion abutting a straight side edge and its side edge comprising an arcuate portion abutting its top edge, defining part of the opening for a user's arms.

The front panels 12 of the garment 10 are connected to the rear panel 13 at the top by shoulder portions 14 and at the sides by the Velcro straps 15, which provide adjustment means to accommodate a variety of waist sizes. The two front panels 12 are connected together by the zip fastener 16 wherein complementary sides of the zip fastener 16 are secured to opposing sides of the front panels 12. In assembled condition, the garment 10 comprises holes for the head, arms and body of the wearer as defined by the aforementioned arcuate shapes in the front and rear panels 12 and 13.

Intermediate the inner and outer panels 17, 18 of the front panels 12 and, preferably rear panel 13, there is provided in insert 20. The insert 20, illustrated in Figure 3, is in the form of a bladder insert 22 that is shaped to define two front panel portions 24 and a rear panel portion 26. The two front panel portions 24 are similar in shape to the front panels 12 of the garment 10 and consequently these will not be described. In this embodiment, the rear panel portion 26 is a "crescent" shape and comprises an arcuate first edge corresponding to the arcuate portion of the top edge of the rear panel 13 of the garment 10. Of course, in other embodiments, the rear panel is shaped to conform to the rear panel of the garment 10.

Referring in detail to Figures 3 and 3A, the bladder 22 is inserted into the garment 10 to regulate the wearer's temperature, and comprises two sheets 28, 30 of flexible plastics material which are secured together at their corresponding outer edges 32, 34 preferably by thermally bonding or ultrasonic welding. As shown in Figure 3A, the sheets define inner and outer surfaces 28, 30 for the bladder. The inner surface is a heat transfer surface as it is positioned adjacent the wearer.

The inner and outer surfaces 28, 30 are further connected at spaced intervals 36, for example by spot welding, to create obstacles 38 within the bladder that impede fluid flow thereby to disrupt fluid flow through the bladder 22. Such an arrangement improves the

heat transfer process by creating turbulent flow resulting in more fluid coming in contact with the heat transfer surface.

The bladder further comprises a fluid inlet port 40 to which a first flexible hose (not shown) is connected. The inlet port 40 is bonded to one of the sheets of plastics material in one of the front panel portions 24A of the bladder 22. An outlet port 42 is connected to the bladder 22. The position of the outlet port 42 is on the other front panel 24B, and remote from the inlet port 40 to enable fluid to pass through the bladder 24. The outlet port 42 is connected to a second flexible hose (not shown). The outlet port 42 is bonded to the same sheet of plastics material in the opposing front panel portion of the bladder 22.

The bladder chamber thus defines a tortuous path 29 between the inlet and outlet ports. The path extends from the first front panel portion 24A, through the rear panel portion 26, into the second front panel portion 24B.

The cross-sectional profile of the bladder 22 shown in Figure 3A is defined in such a way as to maximise the surface area disposed against the user-directed surface of the bladder 6 within the garment 10. An advantage associated with such an arrangement is that by maximising the surface area of the heat transfer surface defined within the bladder the efficiency of heat transfer between the heat transfer fluid and the user is greatly improved. Particularly, in prior art systems, the tubes (or pipes) have a substantially circular cross-section, having contact with the user-directed surface along only a very small fraction of its circumference. In contradistinction, the bladder 22 as according to the present invention, is characterised by a plurality of high-eccentricity elliptical cross-section as illustrated in Figure 3A. In this configuration, a significantly greater fraction of its circumference is substantially in contact with the user-directed surface of the insert 4 for the vest 1. As such, heat exchange between the user and the heat-exchange fluid flowing through the bladder 22 is made more efficient.

The garment bladder 22 is connected to a heat transfer unit 60 by means of a closed fluid supply 62, shown in Figure 10. Thus, the garment bladder 22 is connected to a heat transfer unit 60 via a pump 64. The fluid within the closed fluid system may be water or a water based antifreeze.

Figures 4 to 9 illustrate the heat transfer unit 60 according to one embodiment of the invention. The unit comprises a heat transfer bladder 50 connected to the closed fluid supply 62 and pump 64 by means of inlet and outlet ports 66, 68 shown in Figure 4. The

heat transfer bladder 50 is constructed in a similar manner to the garment bladder 22, so is not described in any more detail, like numbers are used to identify common parts of the bladders 22, 50. The shape of the heat transfer bladder 50 is such as to be capable of being wrapped around a receptacle 54, shown in Figures 5 and 6. Figure 5 shows an ice pack 55, having a drinking tube 57 connected to a fluid outlet port 59 positioned at the base of the pack. The pack is shaped to conform to the shape of the heat transfer surface of the bladder 50. The ice pack 55 is preferably loaded with ice made from a liquid such as water which is drinkable. The outlet port 59 and drinking tube 57 can be used to permit the wearer to drink the contents of the ice pack 55 when the ice has melted, thereby increasing the usefulness of the heat transfer unit.

Figure 6 illustrates an alternative receptacle 56, having a drinking tube 57A connected to a fluid outlet port 59A. The pack is shaped to conform to the shape of the heat transfer surface of the bladder 50.

In use, the receptacle 54 holds a fluid, for example water, which receptacle is in contact with the heat transfer surface to extract or impart heat from the bladder to the fluid in the receptacle.

In the embodiment described above, the receptacle holds cooling means provided by the ice pack or by chilled water. The receptacle is adapted to be detached from the unit 60 to be placed in a freezer to cool the fluid, prior to use.

The heat transfer unit 60 may further comprise insulating means to insulate the bladder 50 and receptacle 54. In the embodiment illustrated in Figures 7 and 8 the insulating means is provided in the form of a pouch 70, formed from suitable insulating material, for example foam. The pouch includes securing means, for example Velcro to be secured to the bladder 50. The insulation means is provided to maintain the temperature of the cooling means and other components of the heat exchange fluid unit 35 or to minimise unwanted heating (or cooling) of the heat exchange fluid.

Figures 8A, 8B and 8C illustrate the construction of the heat transfer unit 60, in which the ice pack 55 is placed on the bladder 50, which is wrapped around the ice pack, as shown in Figure 5B, to reveal the inlet and outlet pipes 66, 68 of the closed fluid supply 62 and the drinking tube 57. Thereafter the pouch 70 is folded around the bladder 50, as shown in Figure 8C. The heat transfer unit can be secured to the garment 10 or placed in a

backpack 100, as shown in Figure 9. In the illustrated embodiment, the back pack 100 is provided with strapping 102 to hold other items of equipment.

Figure 11 illustrates the back pack and garment in use. In use, the heat exchange fluid flows around at least part of the receptacle so as to impart or extract heat. Thus, the heat is transferred from the wearer of the garment to warm the content of the receptacle, or vice versa.

In tests, it has been found that this arrangement is highly effective at maintaining the body temperature of a wearer in the desired range of about 20 C for a period in excess of 6 hours at 30°C in high humidity. Such performance is significantly better than other known systems.

Furthermore, the closed fluid supply minimizes the risk of contamination of a water based system. A second benefit is that the contents of the receptacle can be used as a drinks container. The arrangement offers a low weight alternative to systems currently on the market.

In some embodiments, the pump 64 may include a pump motor, a controller, a user interface and temperature sensors. The control housing is of known design, is portable, light weight and releasably attached to a back pack. Any suitable pump and pump motor means may be employed within the scope of the present invention. Preferably, they will be lightweight and suitable for accurately pumping water at flow rates appropriate for this purpose.

In other embodiments, the vest or jacket may comprise sleeves and other changes to the style without departing from the scope of the present invention. The heat exchange fluid may be water and anti-freeze component mixture, or any fluid suitable for application to a heat-exchange system.

A further embodiment of the invention is shown in Figures 12 to 14 which show a further temperature conditioning garment 210. The temperature conditioning garment comprises one or more bladders 222 in close proximity to a wearer to regulate the wearer's temperature. The bladder 222 and cooling unit are described more generally in co-pending UK patent application 0709797.5 which is repeated in this application and is not therefore described in any greater detail. The bladder(s) 222 comprises two sheets of flexible plastics material which are secured together at their corresponding outer edges

preferably by thermally bonding or ultrasonic welding. The sheets define inner and outer surfaces for the bladder. The inner surface is a heat transfer surface as it is positioned adjacent the wearer.

In the embodiment illustrated in Figure 14, the temperature conditioning garment comprises a plurality of bladders applied to various parts of the body, for example wrists, the neck and feet. Each bladder is shaped to conform to the shape of the part of the body to which it is applied. As shown in Figure 13A, the bladder 222 is applied to a wrist 24. Preferably, a foam layer 223 is applied to the exterior of the bladder to minimize heat loss from the outer surface of the bladder. Thus, the bladder is formed as a band 228 and applied to the wrist in a conventional known manner, for example by the use of Velcro securing means.

In alternative embodiments, shown in Figure 13B, the bladders 222 are shaped as patches 229 to be applied to very specific parts of the body, for example feet. In such embodiments, the patches may be secured to the body by an adhesive layer 226.

In Figure 14, there is shown a user and bands are applied to those parts of the body where heat exchange is important to control the body temperature of the limbs. Thus the heat exchange bands 223 are applied to the wrists and the neck and the patches are applied to the feet. The patches 229 and bands 228 are connected together by means of tubes providing an inlet and outlet thereby providing a closed circuit through which heat exchange fluid passes. In the illustrated embodiment, a bladder is applied to the torso in the form of a patch secured directly to the user or contained in a garment as described in co-pending UK patent application 0709797.5.

Turning again to Figure 12, there is illustrated a heat transfer unit 260 according to one embodiment of the invention. The unit comprises a bladder 250 connected to the closed fluid supply 262 and pump 264 by means of inlet and outlet ports 266, 268 shown in Figure 4. The bladder 250 is constructed in a similar manner to the garment bladder 222, so is not described in any more detail, like numbers are used to identify common parts of the bladders 222, 250. The shape of the bladder 250 is such as to be capable of being wrapped around a receptacle 254. The receptacle may comprise an ice pack. The pack is shaped to conform to the shape of the heat transfer surface of the bladder 250.

The or each bladder 222, 222A further comprises a fluid inlet port 240 to which a first flexible hose 262A; 262B is connected. The inlet port 240 is bonded to one of the sheets

of plastics material in one of the front panel portions 224A of the bladder 222. An outlet port 242 is connected to the bladders 222j, 222A. The position of the outlet port 242 is remote from the inlet port 240 to enable fluid to pass through the bladder. The outlet port 242 is connected to a second flexible hose.

The garment bladder 222 and outer bladders 228, 229 are connected to a heat transfer unit 260 by means of a closed fluid supply 262, shown in Figure 10. Thus, the garment bladder 222 is connected to a heat transfer unit 260 via a pump 264. The fluid within the closed fluid system may be water or a water based antifreeze.

In use, the receptacle 254 holds a fluid, for example water, which receptacle is in contact with the heat transfer surface to extract or impart heat from the bladder 250 to the fluid in the receptacle.

In the embodiment described above, the receptacle holds cooling means provided by the 215 ice pack or by chilled water. The receptacle is adapted to be detached from the unit 260 to be placed in a freezer to cool the fluid, prior to use.

The heat transfer unit 260 may further comprise insulating means to insulate the bladder 250 and receptacle 254. In one embodiment, the insulating means is provided in the form of a pouch, formed from suitable insulating material, for example foam. The pouch includes securing means, for example Velcro to be secured to the bladder 250. The insulation means is provided to maintain the temperature of the cooling means and other components of the heat exchange fluid unit or to minimise unwanted heating (or cooling) of the heat exchange fluid.

In use, the heat exchange fluid flows around at least part of the receptacle so as to impart or extract heat. Thus, the heat is transferred from the wearer of the garment to warm the content of the receptacle, or vice versa.

The closed fluid supply minimizes the risk of contamination of a water based system. A second benefit is that the contents of the receptacle can be used as a drinks container. The arrangement offers a low weight alternative to systems currently on the market.

In some embodiments, the pump 264 may include a pump motor, a controller, a user interface and temperature sensors. The control housing is of known design, is portable, light weight and releasably attached to a back pack. Any suitable pump and pump motor

means may be employed within the scope of the present invention. Preferably, they will be lightweight and suitable for accurately pumping water at flow rates appropriate for this purpose.

It will be understood that directional terms such as "inner," "outer," "front," "rear", "top", and "side" and the like serve, where used herein, merely to differentiate components of the present invention from one another; their respective components should not be considered to be limited to those orientations, and other reasonable orientations may be adopted without departing from the scope of the present invention.

CLAIMS

1. A portable heat transfer unit comprising a receptacle and a heat exchange bladder, the bladder comprising a heat transfer surface, a fluid inlet port and a fluid outlet port positioned remotely from the fluid inlet port to enable a heat transfer fluid to pass through the bladder, wherein the heat transfer surface of the heat exchange bladder is in thermal contact with the receptacle such that heat transfer fluid passing, in use, through the bladder extracts or imparts heat from the heat exchange fluid to the receptacle.

2. A heat transfer unit according to claim 1, wherein the bladder is formed from inner and outer sheets of flexible plastics material secured together along a common outer edge, opposed portions of the inner and outer sheets being secured together at spaced intervals thereby to disrupt fluid flow through the bladder.

3. A heat transfer unit according to claim 1 or claim 3, wherein the inner and outer sheets are secured together at spaced intervals by means of a plurality of spot welds.

4. A heat transfer unit according to any preceding claim, wherein the bladder is connected to a closed fluid supply and pump for pumping the fluid though the bladder.

5. A heat transfer unit according to claim 4 further comprising a microcontroller for controlling the pump.

6. A heat transfer unit according to any preceding claim, wherein the bladder is shaped to surround the receptacle and wherein there further comprises an insulating layer enclosing the bladder.

7. A heat transfer unit according to claim 6, further comprising a pouch incorporating the insulating layer.

8. A heat transfer unit according to claim 7, wherein the pouch is wrapped around the bladder.

9. A heat transfer unit according to any one of claims 6 to 8, wherein the insulating layer comprises a foam.

10. A heat transfer unit according to any preceding claim, wherein the receptacle is an ice pack.

11. A heat transfer unit according to any preceding claim, wherein the receptacle is a drinks container.

12. A heat transfer unit according to any preceding claim, further comprising the heat exchange fluid, wherein the heat exchange fluid is or contains water.

13. A heat transfer unit according to any preceding claim, wherein the receptacle comprises a drinking tube connected to a fluid outlet port positioned at the base of the pack.

14. A temperature conditioning garment comprising a heat transfer unit according to any preceding claim.

15. Temperature conditioning garment according to claim 14 further comprising an inner layer, an outer layer and a bladder positioned intermediate the inner and outer layers and is shaped to conform the shape of the garment, the bladder including a fluid inlet port and a fluid outlet port positioned remotely from one another to enable fluid to pass through the bladder, wherein the bladder is formed from inner and outer sheets of flexible plastics material secured together along a common outer edge, the inner and outer sheets being secured together at spaced intervals thereby to disrupt fluid flow through the bladder.

16. Temperature conditioning garment according to claim 14 or claim 15, wherein body armour material is incorporated in the outer layer.

17. A temperature conditioning garment as claimed in anyone of claims 14 to 16, further comprising temperature sensing means for measuring the temperature of at least a portion of the body of a wearer.

18. A temperature conditioning garment as claimed in anyone of claims 14 to 17, further comprising temperature sensing means for measuring the temperature of the heat exchange fluid.

19. A bladder for use in a heat transfer unit comprising a heat transfer surface, a fluid inlet port and a fluid outlet port positioned remotely from one another to enable fluid

to pass through the bladder, wherein the bladder is formed from inner and outer sheets of flexible plastics material secured together along a common outer edge and there further comprises an outer layer of foam applied to the outer surface of the bladder to insulate the bladder.

20. A bladder for use in a heat transfer unit comprising a heat transfer surface, a fluid inlet port and a fluid outlet port positioned remotely from one another to enable fluid to pass through the bladder, wherein the bladder is formed from inner and outer sheets of flexible plastics material secured together along a common outer edge, the bladder being shaped to provide a band around a user's limb.

21. A bladder for use in a heat transfer unit comprising a heat transfer surface, a fluid inlet port and a fluid outlet port positioned remotely from one another to enable fluid to pass through the bladder, wherein the bladder is formed from inner and outer sheets of flexible plastics material secured together along a common outer edge, the bladder further comprising an adhesive layer to secure the bladder to a user.

22. A heat transfer unit comprising a bladder connected to a closed fluid supply and pump for pumping the fluid though the bladder, the bladder having a heat transfer surface, a fluid inlet port and a fluid outlet port positioned remotely from one another to enable fluid to pass through the bladder, the bladder being formed from inner and outer sheets of flexible plastics material secured together along a common outer edge, the unit further comprising a receptacle for receiving a fluid which receptacle is in contact with the heat transfer surface to extract or impart heat from the bladder to the fluid in the receptacle.

23. A temperature conditioning garment comprising a heat transfer unit as claimed in any of claims 1 to 13 and 22 and one or more heat transfer bladders applied to the outer limbs of the user wherein the heat transfer bladders are connected together in series to the heat transfer unit.

24. A temperature conditioning garment comprising a heat transfer unit as claimed in any of claims 1 to 13 and 22 and one or more heat transfer bladders applied to the outer limbs of the user wherein the heat transfer bladders are connected together in parallel to the heat transfer unit.