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(54) **AUTONOMOUS COOLING VEST**

(57) An autonomous cooling vest to cool its user by evaporating a coolant in contact with the user's skin surface is described. Multifunctional panels attached to the vest in the parts corresponding to the human body are permeable to ambient air and contain a liquid retaining screen kept in contact with the user's skin. The cooling support system automatically controls the transfer of the coolant liquid contained in a reservoir to each screen and allows the user to adjust the operation of the system to activate and deactivate the ventilation on the liquid retained in the screens and adjust the amount of liquid dispersed over the screens as needed. The flow of air ventilated by the fans and the air that permeates through the referred multifunctional panels favor the evaporation of the liquid retained in the screens, promoting the user's cooling.

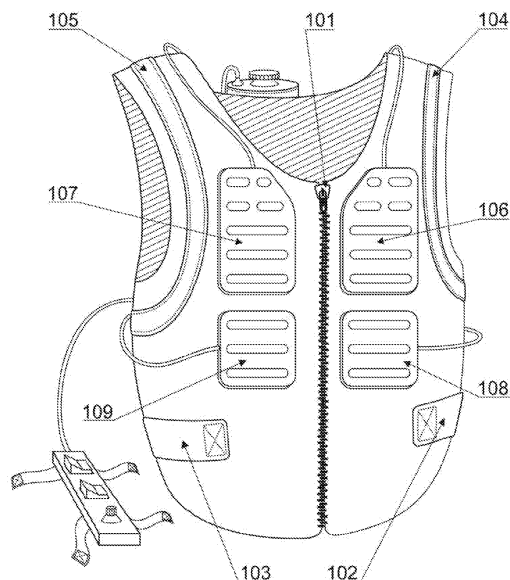


FIG. 1

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## Description

### Technical Field

**[0001]** The autonomous cooling integrated vest relates to the field of heat exchange systems, specifically systems to cool an individual. More specifically, the described invention relates to the cooling systems associated with the garments whose purpose is to maintain thermal comfort of the users in high temperature environments and to provide the user with protection against impacts.

### State of the Art

**[0002]** Certain branches of human activity are usually exercised using clothing that inhibits the exchange of heat between the human body and the environment, also, the natural means of cooling the human body can present unsatisfactory performance under certain specific environmental conditions.

**[0003]** There are several inventions proposing individual cooling solutions integrated with a vest, among which the following are pointed out.

US patent 4,580,408 of April 8, 1986, entitled "Water Vest For Motocross Riders", features a motorcycle vest composed of impact protection panels that are permeable to ambient air, and screens made of a water-retaining material that is in contact with the user's skin, the evaporation of water retained in the screens and intensified by the flow of ambient air that flows through the panels cools the user, wherein said screens must be soaked in water when wearing the vest;

US patent 5,415,222, of May 16, 1995, entitled "Micro-Climate Cooling Garment", presents a vest with bags permeable to ambient air, with an internal structure in the shape of a honeycomb. Adhered to this honeycomb structure there is a material that changes its physical state at certain temperatures;

US application US 2006/0191063, of August 31, 2006, entitled "Garment For A Cooling And Hydration System", presents a vest that has a closed circuit in which water flows, which is cooled when passing through a reservoir with ice, pressurized air is injected into the vest to increase the user's contact area with the vest;

US application US 2009/0165183, of July 2, 2009, entitled "Heat Exchange Garment", presents a vest with bags distributed inside the vest that are filled with a heat exchanger material, wherein these bags must be frozen before being used in the vest;

US patent 8,281,609, of October 9, 2012, entitled "Man Portable Micro-Climate", presents a vest to which a bundle of flexible tubes is juxtaposed, air dried and cooled flows through the tubes that are perforated in such that it allows the cold, dry air to

come out, and in its place enters hot and humid air that was in the interstice of the vest with the user, this hot and humid air is then treated so that it is dried and cooled and forced again to flow through the piping;

**[0004]** "MOMO ADC Pro Driver Cooling System" features a shirt with a water circuit juxtaposed to the shirt itself, wherein water chilled by an ice box flows;

**[0005]** "Macna Dry Cooling Vest" features a vest in which the inner part is made of a water-retaining material and the outer part is impermeable to water and has holes for the passage of ambient air. The vest is wetted so that the inside is soaked in water, the evaporation of this water promotes the user's cooling;

US patent 7,721,349, of June 25, 2005, entitled "Flexible personal evaporative cooling system with warming potential", presents a vest with small associated reservoirs from which a coolant permeates and contacts a heat conductive material that is in contact with the user skin and may contain a fan associated with the vest to ventilate and thus accelerate the evaporative process; and

US patent 5,775,590, of February 19, 1998, entitled "Portable mist cooling device", features a device composed of a manually pressurized reservoir that squirts a coolant close to the user skin surface, including a valve manually activated to control the amount of liquid used.

**[0006]** Considering portability as a common feature of the various inventions presented and that portable devices have limited autonomy, it is considered that the autonomy of the cooling effect is limited to the amount of heat exchanging substance or the amount of electrical energy that can be charged by the user of the presented inventions. About such inventions, it can be affirmed that:

Solutions that adopt a melting solid as a heat exchanger have the disadvantage that melting solid substances suitable for use as heat exchangers for cooling a person absorbs much less heat than the evaporation of these same substances;

Solutions that adopt a liquid-retaining fabric or screen to act as a coolant reservoir have the disadvantage of having its heat exchanger loading capacity limited to the amount of fabric or screen; and

Solutions that adopt the solution of cooling a gas through adiabatic expansion processes have the disadvantage of the high consumption of electrical energy necessary to provide the cooling of an adult individual.

**[0007]** Which results in little cooling autonomy or in excess weight that the user should support.

**[0008]** Considering the independence between the cooling effect and the user's performance as a very de-

sirable characteristic, systems that depend on the user to pump or manually activate a valve have the disadvantage of the lack of automation resulting in the dependence between obtaining the cooling effect and the performance of the user and resulting in a possible excess of workload for the user.

#### Disclosure of the Invention

**[0009]** The autonomous cooling vest is intended to:

- provide individual cooling for one person;
- provide cooling autonomy for at least one hour regardless of external resources;
- provide means for cooling to occur automatically;
- provide means for the user to adjust the use of the cooling resources in order to control the intensity of the cooling according to their needs; and
- be portable.

**[0010]** To provide individual cooling for a person, the present invention comprises a vest integrated with a cooling support system.

**[0011]** Evaporation of a liquid in contact with a person's skin surface causes a cooling effect. Based on this phenomenon, the present invention disperses a coolant liquid on liquid retaining screens which are kept in contact with the surface of the vest user in parts of the body corresponding to the chest, back, abdomen, arms or legs.

**[0012]** To have cooling autonomy for at least one hour regardless of external resources, considering that the said liquid coolant is mainly water, that 2.5L (liters) of liquid are needed to provide user cooling and that the said cooling support system consumes electricity at a rate of 15W (watts), then the cooling support system includes:

- a reservoir with a storage capacity of at least 2.5l (two and a half liters); and
- a battery of at least 1250mah (milliampere.hour) of electric charge capacity.

**[0013]** For the cooling to occur automatically, the present invention comprises a set of interconnected devices so that the dispersion of liquid over the screens and the ventilation incident on the same screens occurs without the need for user action.

**[0014]** To keep the screens in contact with the user skin surface, each screen is integrated with a multifunctional panel that is attached to the vest in the parts corresponding to the user's chest, back, abdomen, arms or legs, the multifunctional panel being permeable to ambient air and adapted to accommodate in its interstice the components of the cooling support system that act directly on the respective screen.

**[0015]** To distribute the liquid between the reservoir and the various screens located on the vest, a duct network connects the reservoir to the screens.

**[0016]** For the flow of liquid towards each of the screens to be compatible with the speed of its evaporation, a device called a calibrated orifice, which restricts the flow of liquid through it, is connected to each of the terminal branches of the duct network, so that the flow of liquid in each terminal branch is a function of the pressure of the liquid at the entrance of the calibrated orifice and also a function of the caliber of this calibrated orifice.

**[0017]** An air electropump pressurizes the reservoir and a pressure switch, connected to the electropump in order to control its activation, keeps the pressure inside the reservoir stable and, consequently, keeps the pressure stable at the entrance of each calibrated orifice.

**[0018]** For the user to be able to adjust the amount of liquid that is dispersed on the screens according to his needs, a device, hereinafter called a timer, is connected to a solenoid valve in order to open and close the flow of liquid in the solenoid valve repeatedly according to the opening and closing times adjusted by the user through a selector switch integrated in the timer. The inlet nozzle of the solenoid valve being connected to the liquid outlet nozzle of the reservoir and the valve outlet nozzle connected to the inlet of the duct network.

**[0019]** For the user be able to adjust the intensity of the ventilation on the screens, at least one fan installed in the interstice of each multifunctional panel ventilates the liquid retained on the respective screen of the multifunctional panel, and the wearer controls the activation of the fans through an electrical current switch button.

**[0020]** Considering that the solution adopted meets the proposed objectives, the present invention has an advantage over the state of the art by:

- having autonomy of at least one hour regardless of external resources;
- being able to use coolant liquids such as water with high energy absorption power during its evaporation;
- being automatic; and
- allowing the user to adjust its operation as needed.

#### Description of the Figures

**[0021]**

FIG. 1 shows a view of the front part of the vest, showing: the integration of the vest with the elements of the cooling support system and the layout and shape of the multifunctional panels located on the front of the vest.

FIG. 2 shows a view of the back of the vest, showing: the integration of the vest with the elements of the cooling support system, the layout and shape of the multifunctional panels located on the back of the vest and the location and shape of the reservoir.

FIG. 3 shows an example of a screen that comprises the innermost layer of the multifunctional panels.

FIG. 4 shows an example of the intermediate layer of the multifunctional panels showing the elements

of its conformation.

FIG. 5 shows a fan example.

FIG. 6 shows an example of the outermost layer of the multifunctional panels.

FIG. 7 shows an example of a multifunctional panel showing the integration: with a terminal branch of the duct network, with a calibrated orifice and with a fan.

FIG. 8 shows the second compartment.

FIG. 9 shows the arrangement of components of the cooling support system in the first compartment.

#### Best Mode for Reproducing the Invention

**[0022]** The vest, preferably:

is made from a vest with a fabric made of leather; has a zipper (101) sewn on the vest to connect the left and right sides of the front part of the vest that covers the abdominal and thoracic areas;

it has elastic straps (102 and 103) sewn on the edges adjacent to the front and back parts of the vest, between the armpits and waist areas, connecting the right and left front parts to the back covering the torso, the length of these straps being adjustable by a buckle; and

it has leather straps (104 and 105) of 2.0 cm wide and 2.5 mm thick sewn into the vest fabric in the form of straps surrounding the gap corresponding to the passage of the user arms, and in the form of two strips (208 and 209) that connect the two straps passing through the back below the cervical area and maintaining a distance of 30.0 cm from each other at the midpoint of the belts in form of strips; and has cutouts of parts of the original vest fabric on the right and left sides in the chest, abdomen, dorsal and lumbar area making a number of eight cutouts, made in the shape of the outline of the respective multifunctional panel that will be superimposed on each cutout, maintaining a 1.0 cm margin from the cutout to the projection contour.

**[0023]** The cooling support system that is integrated into the vest preferably consists of: a reservoir, multifunctional panels, a pressure switch, an air electropump, a solenoid valve, a timer, a calibrated orifice for each multifunctional panel, a fan for each multifunctional panel, one electric current supply, three electric current supply circuits, a duct network with a terminal branch for each multifunctional panel, two electric current switches and two compartments.

**[0024]** The reservoir (202), preferably:

is made of flexible 1.0 mm thick rubber wrapped in an inflexible nylon fabric; with internal volume of 2.5 liters;

has a cylindrical shape with an internal diameter of 10 cm and a height of 35 cm;

has an inlet nozzle (203) at the top of the reservoir with a diameter of 4.0 cm, with a 2.5 cm long threaded rod, with a screw cap and with a nut that fixes the inlet nozzle by pressing the rubber of the reservoir against the inlet nozzle flanges;

has an outlet nozzle (205) at the bottom of the reservoir with a spike connection for 1/8 in. diameter hoses, with a 1.0 cm long threaded rod and with a nut that fixes the nozzle by pressing the rubber of the reservoir against the outlet nozzle flanges;

has an air passage (204) at the top of the reservoir with a spigot connection for 1/8 in. diameter hoses, with a 1.0 cm long threaded rod with a nut that secures the nozzle by pressing the rubber of the reservoir against the flanges of the air passage itself; and

it is surrounded by two straps (206 and 207) 2.0 cm wide and 2.5 mm thick, sewn to the fabric surrounding the reservoir, one 3.0 cm from the top and another 3.0 cm from the reservoir bottom, such straps being sewn to the straps in the form of strips.

**[0025]** Each multifunctional panel (106, 107, 108, 109, 210, 211, 212 and 213), preferably:

is made in three juxtaposed layers, the outermost layer of resin being reinforced by aramid fibers 1.0 mm thick, the intermediate layer of ethylene vinyl acetate (eva) 13.0 mm thick, and the innermost layer, which includes the liquid-retaining fabric, made of 300g/m<sup>2</sup> grammage cotton fuzzy fabric;

has irregular trapezoidal, pentagonal or hexagonal contours, depending on the area of the body where the respective multifunctional panel is superimposed, with circular corners of 2.5 cm radius and with the outermost layer molded according to the area of the human body that each multifunctional panel overlaps;

has holes (601 and 401) that cross the outer and intermediate layers perpendicularly to the surface of the multifunctional panel, the holes having a rectangular profile with rounded edges, equally spaced from each other, maintaining a distance of at least 1 cm from the edges of the multifunctional panel, and covering one third of the surface area of the multifunctional panel;

has in the geometric center of the intermediate layer a cavity (402) in the form of a parallelepiped with a square cross section of 40.0 mm on the side and 10.0 mm in depth from the outermost surface, where, perpendicular to the plane formed by the bottom of the cavity, a 38.0 mm diameter circular and through hole (403) is drilled from the geometric center of the square in the plane formed by the bottom of the cavity;

has a first channel (404) open on the side of the intermediate layer with a diameter of 5.0 mm, with an axis of symmetry parallel to the surfaces of the

intermediate layer, starting on the side of the intermediate layer and directed to the geometric center in a straight line, with depth such that the bottom of the channel is positioned 5.0 mm away from the walls of the cavity in the form of a parallelepiped; has a liquid dispersing nozzle formed from a second channel (405) with 2.0 mm of diameter, opened in the intermediate layer from the surface contacting the screen and directed to the bottom of the first channel, intercepting it such that communicate the first channel to the interstice between the middle layer and the screen; and has a third channel (406 and 701) open in the intermediate layer from the contact surface with the outermost layer, perpendicular to this surface and surrounding the entire contour of the intermediate layer 5 mm away from the edge of this layer, being the rectangular cross sectional profile of the third channel 10 mm deep and 1 mm wide.

**[0026]** The multifunctional panels are attached to the vest, preferably:

superimposing the cutouts of the original vest fabric corresponding to each respective multifunctional panel;  
sewing each screen of the multifunctional panel directly on the vest fabric, occupying the area corresponding to the respective cutout of the original vest fabric;  
sewing each intermediate layer of the multifunctional panel directly onto the vest fabric, overlapping the respective screen, this sewing being made through the third channel opened in the intermediate layer; and  
gluing the outermost layer of the multifunctional panel with adhesive onto the respective intermediate layer.

**[0027]** The pressure switch (901), preferably:

has a normally closed configuration;  
has a switching pressure set to 5 psi; and  
has a pressure tap with spike connection for hoses with an internal diameter of 1/8 in.

**[0028]** The air electropump (902), preferably:

has a 12v direct current voltage supply;  
has a flow rate of 2l/min;  
has an outlet nozzle with spike connection for hoses with an internal diameter of 1/8 in; and  
is of the diaphragm pump type.

**[0029]** The solenoid valve (906), preferably:

has a 12v direct current voltage supply;  
has a normally closed type configuration; and

has inlet and outlet nozzles with spike connection for hoses with an internal diameter of 1/8 in.

**[0030]** The pressure tap socket and the outlet nozzle of the air electropump are connected by hose segments with an internal diameter of 1/8 in to a Y-shaped adapter (907) with spike couplings that is connected by another segment (908) from the same hose to the air passage nozzle (204) at the top of the reservoir.

**[0031]** The inlet nozzle (910) of the solenoid valve is connected to the outlet nozzle (205) of the reservoir through a hose segment with an internal diameter of 1/8 in.

**[0032]** The duct network with a terminal branch for each multifunctional panel, preferably:

connects, through a hose segment with an internal diameter of 1/8 in, the outlet nozzle 909 of the solenoid valve to a multiple tap (905) of spike couplings with outlets in an amount equivalent to the number of multifunctional panels; and  
connects, through segments and hose with an internal diameter of 1/8 inch and an external diameter of 1/5 inch, each outlet of the multiple branch 905 to a multifunctional panel.

**[0033]** The calibrated holes (702), preferably:

have adapters for insertion in flexible hoses with 1/8-inch internal diameter;  
are inserted at a depth of 2.0 cm from the outlet nozzle, one in each terminal branch of the duct network; and  
have a caliber of 0.008 in (inches).

**[0034]** The outlet nozzle of each terminal branch of the duct network must be inserted in the first channel (404) of a multifunctional panel at a maximum depth of 2.0 cm and fixed in this position with adhesive as shown in FIG. 7.

**[0035]** The electric current source (904), preferably: is a battery with three li-ion cells with a charge capacity of 2150 mah (milliampere-hour) each, nominal voltage of 3.6 v (volts) each, connected in series totaling 10.8 v (volts) of nominal voltage.

**[0036]** The timer (903), described as a device with means for repeatedly varying between an open and a closed state of an electrical current supply circuit, the duration of the opening and closing times of the circuit being controlled by the user, preferably:

has a 12v direct current voltage supply;  
it has a selector switch to control the duration of the opening time of the electric current supply circuit connected directly to the timer body;  
it has a selector switch (804) to control the duration of the closing time of the electric current supply circuit connected to the rest of the device through cables with 1m (meter) in length; and

it is capable of varying the duration of closing and opening time of the electric current supply circuit between 0s (second) and 60s (seconds).

**[0037]** The fan (703), preferably:

has a 12v direct current voltage supply;  
has a parallelepiped shape with a square cross section with 40 mm (millimeters) on its side and 10 mm (millimeters) in thickness;  
has the capacity to ventilate 4 cfm (cubic feet per minute).

**[0038]** The first electric current supply circuit, preferably:

connects in series the electrical contacts of the air electropump, the pressure switch, a first electric current switch (802) and the battery.

**[0039]** The second electrical current supply circuit, preferably:

connects in series the electrical contacts of the solenoid valve, timer, first power switch and battery.

**[0040]** The third electric current supply circuit, preferably:

connects in parallel the electrical contacts of all fans; and

connects in series the nodes resulting from the parallel connections of the fans to the electrical contacts of a second electrical current switch (803) and the battery.

**[0041]** The first compartment shown in FIG. 9, preferably:

is made of acrylonitrile butadiene styrene plastic;  
is made in the form of a parallelepiped with sides of 20.0 cm, 10.0 cm, 5.0 cm and 2.0 mm thick;  
it is attached to the reservoir at the height of the midpoint of the reservoir's axis of symmetry; and  
contains the air electropump, pressure switch, solenoid valve, timer, battery and multiple tap.

**[0042]** The second compartment shown in FIG. 8, preferably:

is made of acrylonitrile butadiene styrene plastic;  
is made in the form of a parallelepiped with sides of 6.0 cm, 3.0 cm, 1.5 cm and 2.0 mm thick;  
has two strips (806 and 807) of length adjustable by a buckle on each strip, which are fixed with adhesive to the second compartment at the ends of the surface formed by the 6.0 cm and 3.0 cm sides plane, such strips being used for fixing the compartment to the user's forearm;  
is connected to the first compartment by a 1m long conduit (805); and  
it contains the first and second electric current

switches and the timer selector switch, whose electric current conduction cables pass through said conduit.

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## Claims

1. Autonomous cooling vest intended for the cooling of a person, comprising:

- a) at least one screen capable of retaining liquid;
- b) at least one reservoir (202) of liquid;
- c) a duct network that connects the reservoir to each screen;

the autonomous cooling vest being additionally **characterized by** comprising:

- d) at least one fan for each screen;
- e) means for automatically controlling the dispersion of liquid over each screen;
- f) means to actively ventilate each screen; and
- g) means for each screen to remain in contact with the user's skin surface.

2. Autonomous cooling vest, according to claim 1, **characterized by** the fact that the means for automatically controlling liquid dispersion include:

- a) at least one air electropump (902) connected to the reservoir in order to pressurize it and whose electrical contacts are connected to a first electric current supply circuit;
- b) at least one pressure switch (901) whose pressure tap is connected to the reservoir and which electrical contacts are connected in series to the first electric current supply circuit;
- c) at least one solenoid valve (906) whose liquid inlet nozzle (910) is connected to the bottom of the reservoir and whose electrical contacts are connected to a second electrical current supply circuit;
- d) at least one device, hereinafter referred to as the timer (903), with means for repeatedly varying the state of an electric current supply circuit between open and closed and which opening and closing times are controlled by the user, is connected in series to the second electrical current supply circuit;
- e) the duct network inlet nozzle connected to the outlet nozzle (909) of the solenoid valve;
- f) at least one hydraulic component, hereinafter called calibrated orifice (702), provided with means to restrict the flow of liquid through itself, connected to each terminal branch of the duct network (FIG. 7);
- g) at least one electrical current switch (802) whose electrical contacts are connected in se-

ries to the first and second electrical current supply circuits;

h) at least one electrical current source (904) connected in series to the first and second current supply circuits; and

i) means for each terminal branch of the duct network to have the outlet nozzle located in an area proximal to each screen.

3. Autonomous cooling vest, according to claim 1, **characterized by** the fact that the means to actively ventilate each screen include:

a) at least one fan, whose electrical contacts are connected in series to a third electrical current supply circuit;

b) at least one second electrical current switch (803) whose electrical contacts are connected in series to the third electrical current supply circuit;

c) the electrical current source connected in series to the third electrical current supply circuit; and

d) means for the ventilation produced by each fan to affect each respective screen.

4. Autonomous cooling vest, according to any of claims 1, 2 or 3, **characterized by** the fact that the means for each screen to remain in contact with the user's skin surface, so that each terminal branch of the duct network has the outlet nozzle located in an area proximal to each screen and so that the ventilation produced by each fan affects each respective screen, are supported by at least one multifunctional panel that:

a) is attached to the vest in parts corresponding to the user's chest, back, abdomen, arms or legs;

b) is composed of juxtaposed layers, the outermost layer being made of predominantly rigid materials, the intermediate layer made of predominantly elastic materials and the innermost layer comprising said at least one screen capable of retaining liquid;

c) has perforations (401) and (601) in the outer and intermediate layers;

d) contains in the intermediate layer a channel (404) with a diameter equal to the outer diameter of the terminal branch of the duct network;

e) contains at least one dispersion nozzle (405) in the intermediate layer, which connects the interstice between the inner and intermediate layers to the channel (404);

f) contains at least one cavity (402) in the intermediate layer, with a perforation (403) that trespasses through the entire intermediate layer; and

g) contains in the cavity the fan positioned so as to ventilate towards said at least one screen.

#### 5 Amended claims under Art. 19.1 PCT

1. Vest integrated with a cooling support system intended for the cooling of a person, comprising at least one reservoir (202) of liquid, a duct network, at least one liquid retaining screen, at least one fan for each liquid retaining screen, at least one propellant pump, means for automatically controlling the functioning of said cooling support system, means for maintaining each liquid retaining screen in contact with the user's skin surface and means for irrigating each liquid retaining screen with the liquid contained in at least one reservoir; the vest integrated with a cooling support system **characterized by** further comprising:

a) at least one hydraulic device comprising means for restraining the flow of liquid which flows through itself;

b) at least one pressure sensor comprising means for sensing the pressure of the liquid;

c) at least one valve comprising means for opening and closing the flow of liquid; and

d) means for the ventilation produced by at least one fan to effect on each liquid retaining screen.

2. Vest integrated with a cooling support system, according to claim 1, **characterized by** including:

a) each reservoir connected to the outlet nozzle of said at least one propellant pump for pressurizing each reservoir, each air pump comprising an air electropump (902) whose electrical contacts are connected in series to a first electric current supply circuit;

b) each reservoir connected to the pressure tap of said at least one pressure sensor for sensing the pressure inside each reservoir, each pressure sensor comprising a pressure switch (901) whose electrical contacts are connected in series to the first electric current supply circuit;

c) the outlet nozzle of each reservoir connected to the inlet nozzle of said at least one valve for collecting the liquid drained of each reservoir, each valve comprising a solenoid valve (906) whose electrical contacts are connected in series to a second electrical current supply circuit;

d) the outlet nozzle (909) of the solenoid valve connected to the inlet nozzle of the duct network;

e) the outlet nozzle of each terminal branch of the duct network connected to said at least one hydraulic device for restraining the flow of liquid in the respective terminal branch of the duct network, each hydraulic device being hereinafter

referred to as calibrated orifice (702), comprising an orifice in the tubule whereby the liquid flows, which dimensions make the amount of liquid ejected as a function of the pressure of the liquid in the terminal branch of the duct network; 5

f) the second electric current supply circuit connected in series to at least one electrical device comprising means for repeatedly varying the state of the second electric current supply circuit between open and closed, each said electric device, hereinafter referred as timer (903), also comprising at least one potentiometer (804) through which the user selects the opening state and closing state times; 10 15

g) the first and second electric current supply circuits connected in series to an electric current switch (802);

h) the first and second electric current supply circuits connected in series to at least one electric current supply (902); 20

i) each fan, comprised by a fan powered by electric current, is connected in series to a third electric current supply circuit;

j) the third electric current supply circuit connected in series to a second electric current switch (803); and 25

k) the third electric current supply circuit connected in series to a second electric current switch (803). 30

3. Vest integrated with a cooling support system, according to any of claims 1 or 2, **characterized by** the fact that the means for maintaining each liquid retaining screen in contact with the user's skin surface, the means for irrigating each liquid retaining screen with the liquid contained in at least one reservoir and the means for that the ventilation produced by at least one fan effects on each liquid retaining screen, are supported by a panel, hereinafter referred to as multifunctional panel, which: 35 40

a) is fixed to the vest in parts corresponding to the user's chest, back, abdomen, arms or legs; 45

b) is comprised of juxtaposed layers, the outermost layer being made of predominantly rigid materials, the intermediate layer being made of predominantly elastic materials and the innermost layer comprising said at least one screen capable of retaining liquid; 50

c) has perforations (401) and (601) in the outer and intermediate layers;

d) contains in the intermediate layer a channel (404) with a diameter equal to the outer diameter of the terminal branch of the duct network; 55

e) contains in said channel (404) a terminal branch of the duct network;

f) contains in the intermediate layer a dispersion

nozzle (405) which interconnects the interstice between the inner and intermediate layers to said channel (404);

g) contains in the intermediate layer at least one cavity (402) with a perforation (403) that transpasses through the entire intermediate layer; and

h) contains in said cavity a fan positioned so as to ventilate towards said at least one screen.

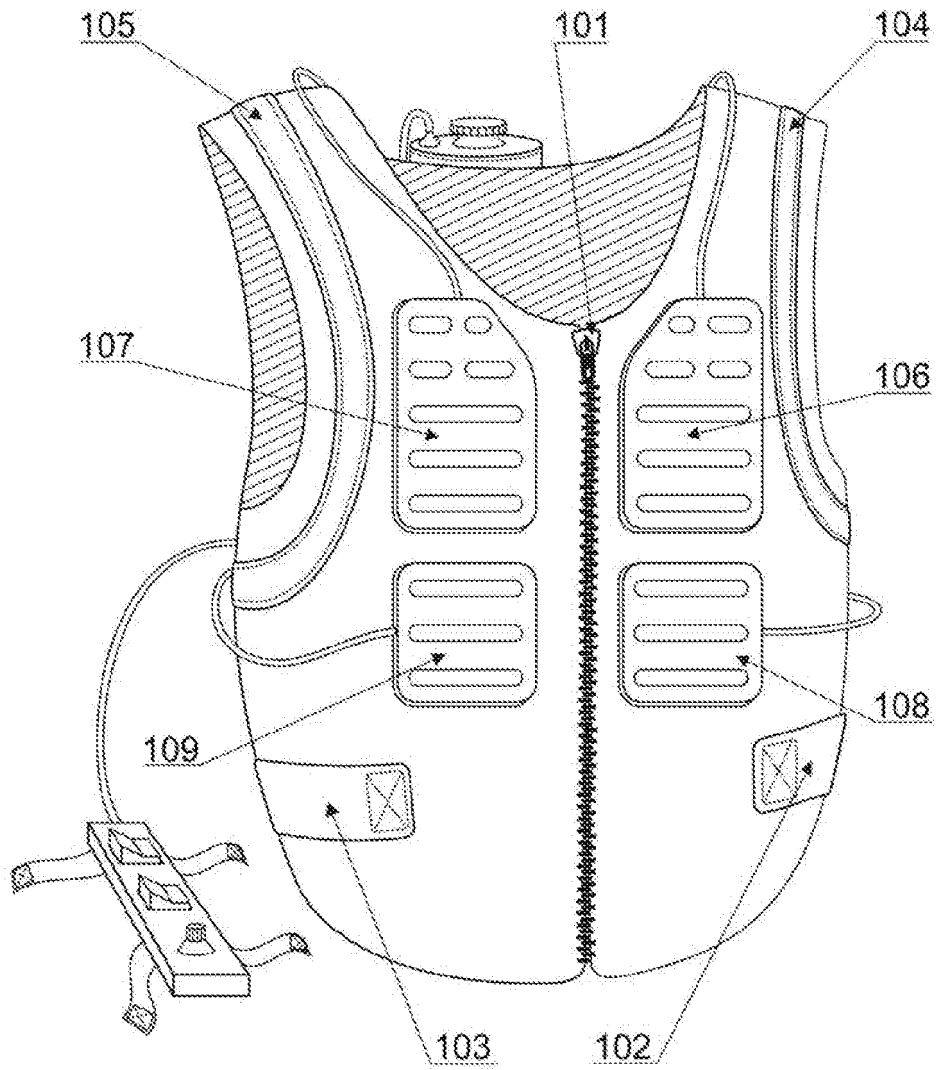


FIG. 1

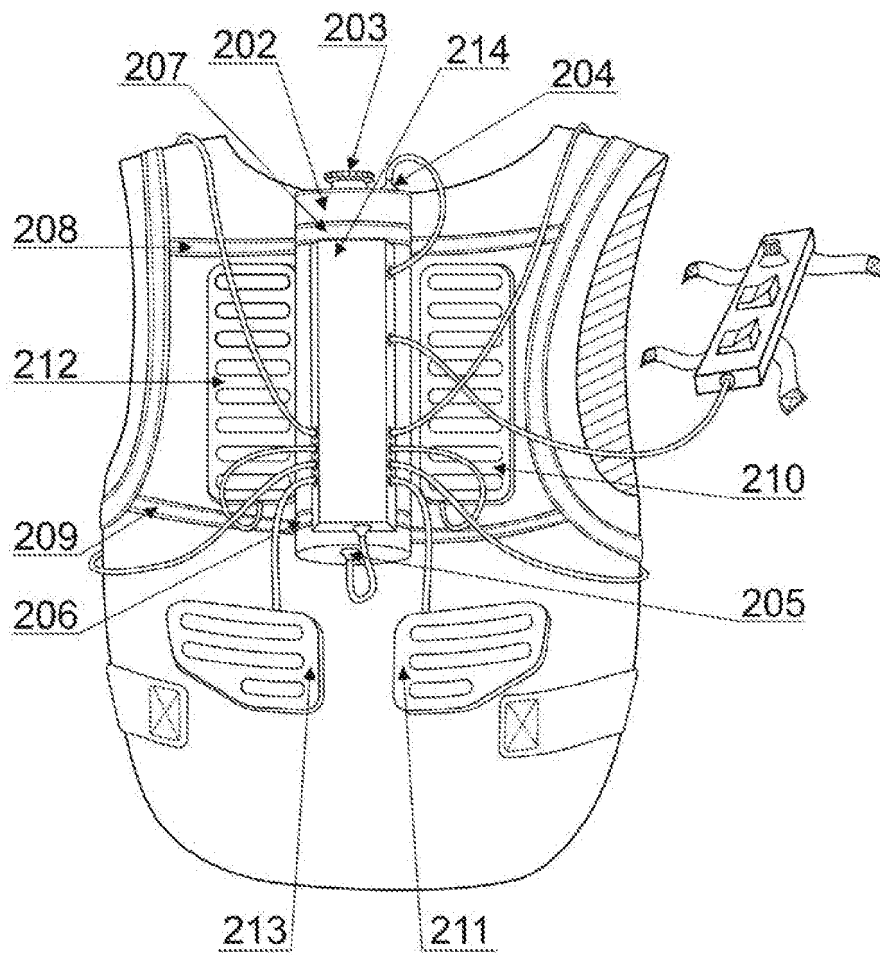


FIG. 2

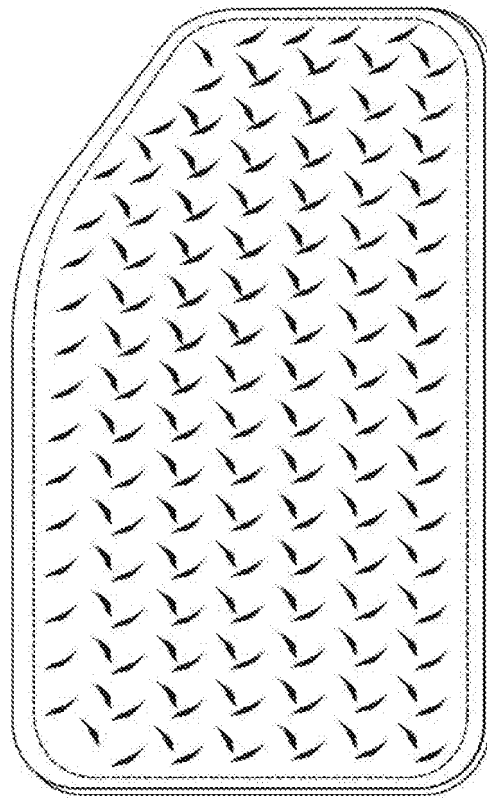


FIG. 3

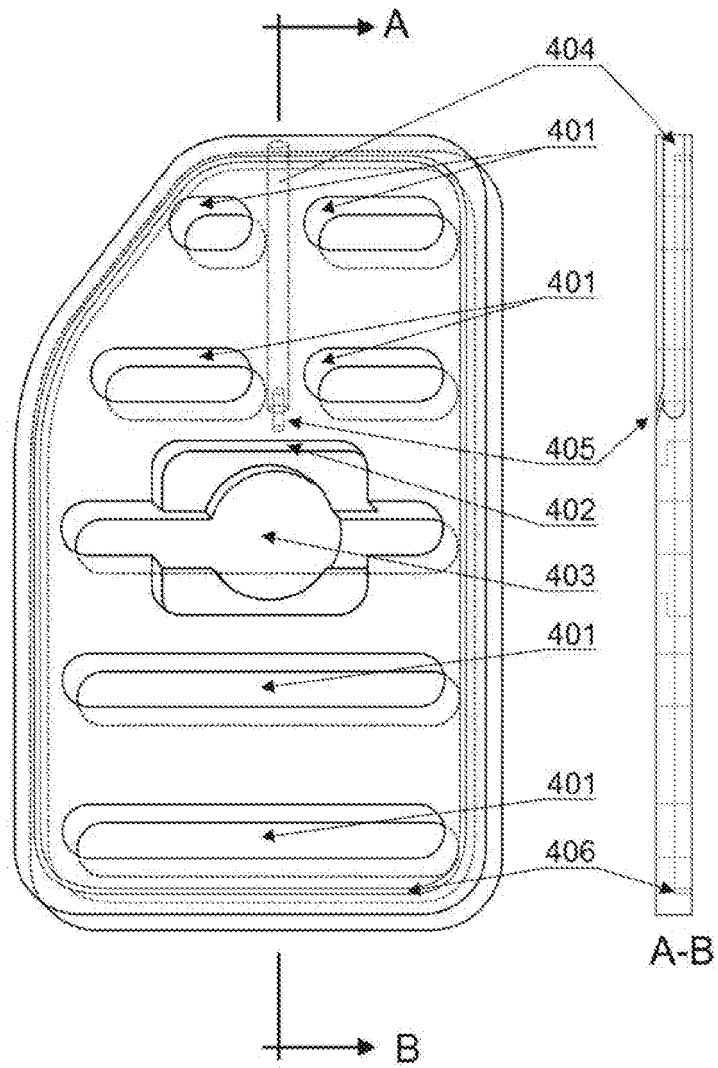


FIG. 4

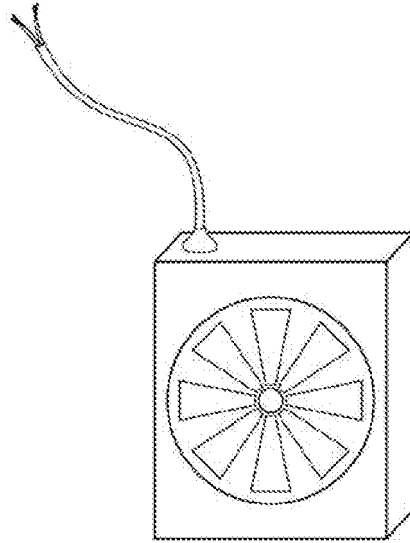


FIG. 5

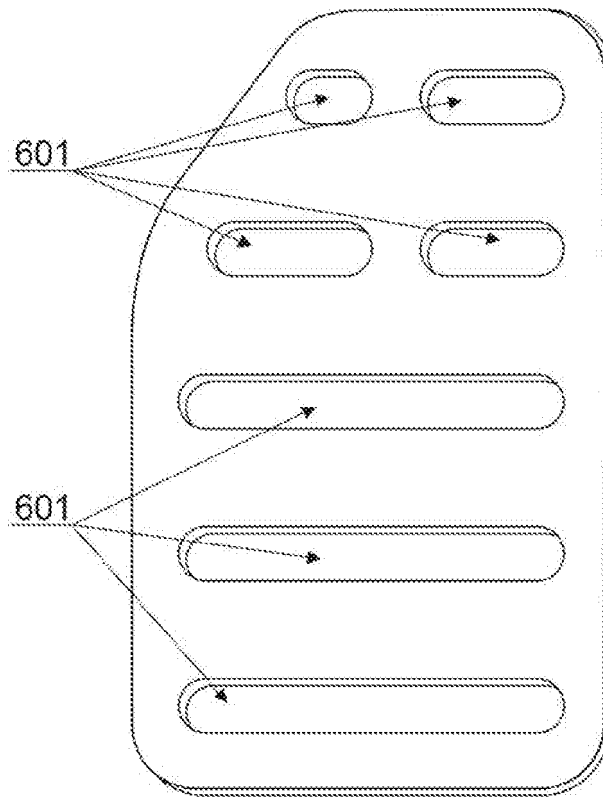


FIG. 6

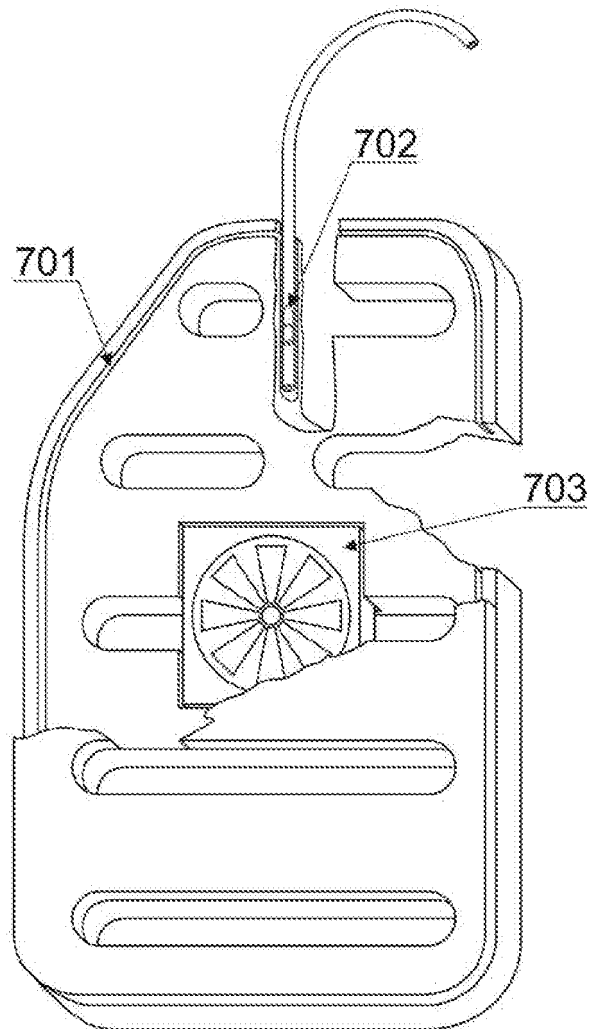


FIG. 7

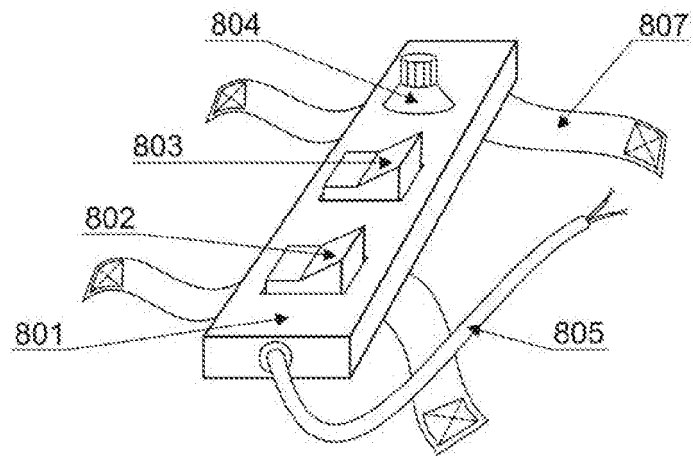


FIG. 8

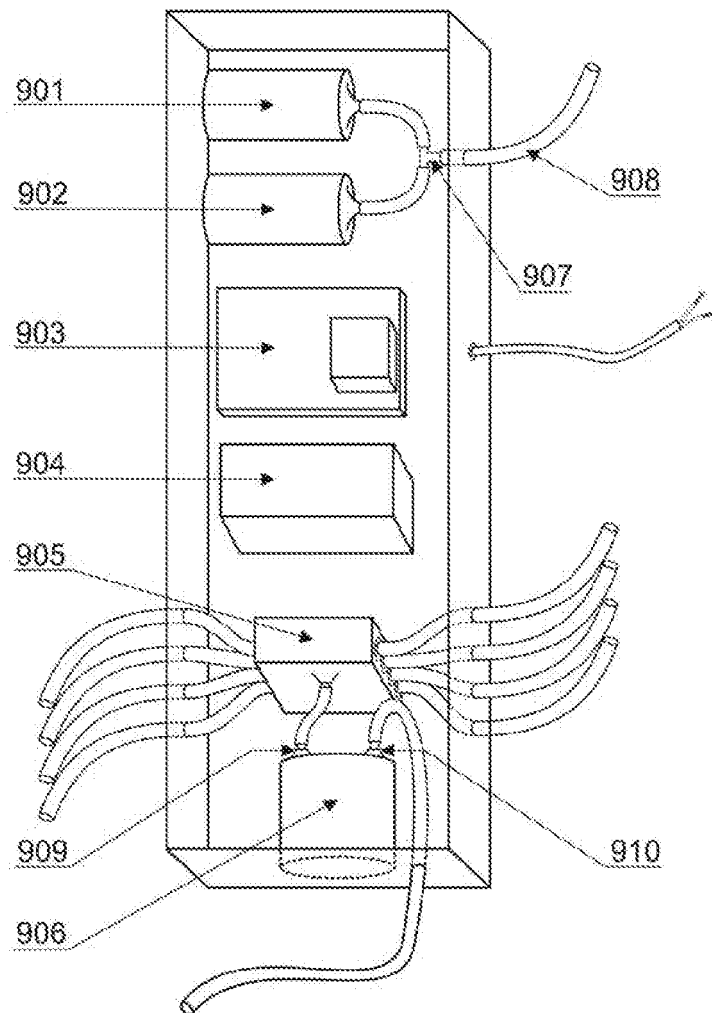


FIG. 9

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/BR2018/050112

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                 |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 5  | A. CLASSIFICATION OF SUBJECT MATTER                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                 |
|    | <b>A41D 13/005 (2006.01), A62B 17/00 (2006.01)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                 |
|    | According to International Patent Classification (IPC) or to both national classification and IPC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                 |
|    | B. FIELDS SEARCHED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                 |
| 10 | Minimum documentation searched (classification system followed by classification symbols)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                 |
|    | <b>A41D, A62B</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                 |
|    | Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                 |
| 15 | <b>Banco de Patentes do INPI-BR (SINPI)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                 |
|    | Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                 |
|    | <b>EPODOC</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                 |
| 20 | C. DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                 |
|    | Category*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Relevant to claim No.                                                                                                                           |
| 25 | <b>X</b><br><b>A</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>JP 2001040512 A (SEFT DEV LAB CO LTD)</b><br>13 February 2001 (13.02.2001)<br>Abstract, paragraphs [0016], [0023] and [0030] and figures 1-7 |
|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>1</b><br><b>2 – 4</b>                                                                                                                        |
| 30 | <b>A</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>US 7721349 B1 (STRAUSS TED NATHAN [US])</b><br>25 May 2010 (25.05.2010)<br>The whole document                                                |
|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>1 – 4</b>                                                                                                                                    |
| 35 | <b>A</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>US 2006191063 A1 (WINTERS DAVID [US])</b><br>31 August 2006 (31.08.2006)<br>The whole document                                               |
|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>1 – 4</b>                                                                                                                                    |
| 40 | <input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                 |
| 45 | * Special categories of cited documents:<br>“A” document defining the general state of the art which is not considered to be of particular relevance<br>“E” earlier application or patent but published on or after the international filing date<br>“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)<br>“O” document referring to an oral disclosure, use, exhibition or other means<br>“P” document published prior to the international filing date but later than the priority date claimed<br>“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention<br>“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone<br>“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art<br>“&” document member of the same patent family |                                                                                                                                                 |
| 50 | Date of the actual completion of the international search                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Date of mailing of the international search report                                                                                              |
|    | <b>09 May 2018 (09.05.2018)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>30 May 2018 (30.05.2018)</b>                                                                                                                 |
| 55 | Name and mailing address of the ISA/<br>INSTITUTO NACIONAL DA<br>PROPRIEDADE INDUSTRIAL<br>Rua Mayrink Veiga nº 9, 6º andar<br>cep: 20090-910, Centro - Rio de Janeiro/RJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Authorized officer<br><b>Walter Edgley de Oliveira</b><br>Telephone No. <b>+55 21 3037-3493/3742</b>                                            |

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**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

International application No.

**PCT/BR2018/050112**

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**REFERENCES CITED IN THE DESCRIPTION**

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