DOUBLE FLOW-CIRCUIT HEAT EXCHANGE DEVICE FOR PERIODIC POSITIVE AND REVERSE DIRECTIONAL PUMPING

BACKGROUND OF THE INVENTION

(a) Field of the invention

The present invention improves the conventional heat exchange device having pumping fluids in different flowing directions to have the double flow circuit heat exchange operating function for controllable periodic positive and reverse directional pumping thereby timely improving the temperature difference distribution between the fluid and the heat exchanger, and when the heat exchanger inside the heat exchange device is further interposed or coated with the desiccant materials using by permeation or absorbability type, or the heat exchanger itself is the total heat exchanger having concurrent moisture absorbing function, then it is through the double flow-circuit periodic positive and reverse directional pumping fluid and the heat exchanger being interposed or coated with desiccant material, and/or the heat exchanger itself having concurrent moisture absorbing function to constituted the dehumidification effect of total heat exchange function as well as to reduce the imperfections of dust accumulation production or pollutions at fixed flowing directions.

(b) Description of the Prior Art

For conventional heat exchange device or total heat exchange device for pumping fluid at different flowing directions, as its fluid flowing directions are fixed, the temperature difference distribution gradients between thermal exchange fluids and the internal heat exchangers are therefore unchanged; further beside of that distribution gradients of the temperature differences and humidity saturation degrees between fluids and internal heat exchanger are unchanged, the fluids in different flowing directions also form the differences of humidity saturation degrees at the two flow inlet/outlet ends and sides of the heat exchanger.

SUMMARY OF THE INVENTION

The present invention discloses that the conventional heat exchange device having pumping fluids in different flowing directions is made to have the double flow-circuit heat exchange device for periodic positive and reverse directional pumping thereby obtaining following one or more than one functions, including: **1)** to periodically change the fluid pumping direction of the two fluid circuits and further to change the

temperature difference distribution status at the two ends of the internal heat exchanger when passing through different directional fluids , thereby to increase the temperature difference conditions beneficial for heat absorbing and release of the internal heat exchanger, thereby promoting the heat exchange efficiency; **2)** for the applications of the heat exchanger being interposed or coated with desiccant material using by permeation or absorbability type, or the heat exchanger itself having concurrent moisture absorbing function, or in the application of the total heat exchange device with fluid piping being series connected with the moisture absorbing device, the fluid flowing rate, or the flowing direction, or both being periodically manipulated to change is used furthermore to change the humidity saturation degrees at the two inlet and outlet ports and two sides of the heat exchanger for passing through fluids in different flowing directions inside the heat exchanger device thereby promoting the dehumidification effect; **3)** The composition of the exchanging fluid is detected by installing the gaseous or liquid fluid composition detecting device for controlling the exchanging fluid flowing rate or direction or both; **4)** The impurities or pollutants brought in by the fluid flow at previous flowing direction are discharged by the double flow circuit for periodic positive and reverse directional pumping fluids thereby reducing the disadvantages of impurity accumulations at fixed flowing directions.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view showing operating principles of the conventional bi-directional heat exchange device or total heat exchange device.

FIG. 2 is the first structural block schematic view of the embodiment showing the double flow-circuit heat exchange device for periodic positive and reverse directional pumping of the present invention being applied in the heat exchanger.

FIG. 3 is the second structural block schematic view of the embodiment showing the double flow-circuit heat exchange device for periodic positive and reverse directional pumping of the present invention being applied in the heat exchanger.

FIG. 4 is the third structural block schematic view of the embodiment showing the double flow-circuit heat exchange device for periodic positive and reverse directional pumping of the present invention being applied in the heat exchanger.

FIG. 5 is the first structural block schematic view of the embodiment showing the double flow-circuit heat exchange device for periodic positive and reverse directional pumping of the present invention being applied in the total heat exchanger.

FIG. 6 is the second structural block schematic view of the embodiment showing the double flow-circuit heat exchange device for periodic positive and reverse directional pumping of the present invention being applied in the total heat exchanger.

FIG. 7 is the third structural block schematic view of the embodiment showing the double flow-circuit heat exchange device for periodic positive and reverse directional pumping of the present invention being applied in the total heat exchanger.

FIG. 8 is the schematic view showing operating principles of the conventional heat exchange device having pumping fluids in different flowing directions during simultaneous operation.

FIG. 9 is the schematic view showing the operation principles of the present invention.

FIG. 10 is the temperature distribution diagram of the heat exchange layer of the conventional heat exchange device having pumping fluids in different flowing directions during simultaneous operation.

FIG. 11 is the temperature distribution variation diagram of the heat exchange layer of the present invention during simultaneous operation.

FIG. 12 is the humidity distribution diagram of the total heat exchanger layer of the conventional heat exchange device having pumping fluids in different flowing directions during simultaneous operation being operated as the total heat exchange device having dehumidification function.

FIG. 13 is the humidity distribution diagram of the operating total heat exchange layer of the total heat exchange device having dehumidification function of the present invention.

FIG. 14 is the structural principal schematic view of FIG. 2 being additionally installed with the gaseous or liquid fluid composition detecting device.

FIG. 15 is the structural principal schematic view of FIG. 3 being additionally installed with the gaseous or liquid fluid composition detecting device.

FIG. 16 is the structural principal schematic view of FIG. 4 being additionally installed with the gaseous or liquid fluid composition detecting device.

FIG. 17 is the structural principal schematic view of FIG. 5 being additionally installed with the gaseous or liquid fluid composition detecting device.

FIG. 18 is the structural principal schematic view of FIG. 6 being additionally installed with the gaseous or liquid fluid composition detecting device.

FIG. 19 is the structural principal schematic view of FIG. 7 being additionally

installed with the gaseous or liquid fluid composition detecting device.

FIG. 20 is the embodied schematic view of the present invention showing that at least two fluid pumps capable of bi-directionally fluid pumping are installed between the fluid source and both ends of common inlet/outlet port of the first fluid circuit and the second fluid circuit.

FIG. 21 is the embodied schematic view of present invention showing that at least four bi-directional fluid pumps are installed, wherein two of the bi-directional fluid pumps are installed at the fluid ports (a), (b) of two ends of the first fluid circuit of the heat exchange device, while the other two of the bi-directional fluid pumps are installed at the fluid ports (c), (d) of two ends of the second fluid circuit.

FIG. 22 is the embodied schematic view of the present invention showing that at least four unidirectional fluid pumps are installed, wherein two of the unidirectional fluid pumps are installed at the fluid ports (a), (b) of two ends of the first fluid circuit of the heat exchange device, while the other two of the bi-directional fluid pumps are installed at the fluid ports (c), (d) of two ends of the second fluid circuit.

FIG. 23 is the embodied schematic view of the present invention showing that at least two unidirectional fluid pumps in different pumping directions are series connected to constitute the bi-directional fluid pumping set for being separately installed at one of the individual two fluid ports of two different fluid circuits.

FIG. 24 is the embodied schematic view of the present invention showing that at least two unidirectional fluid pumps in different pumping directions are series connected to constitute the bi-directional fluid pumping set, wherein two bi-directional fluid pumping sets are installed at the fluid ports on both ends of the first fluid circuit, while the other two bi-directional fluid pumping sets are installed at fluid ports on both ends of the second fluid circuit.

FIG. 25 is the embodied schematic view of the present invention showing that at least two unidirectional fluid pumps in different pumping directions are parallel connected to constitute the bi-directional fluid pumping set for being separately installed at one of the individual two fluid ports of two different fluid circuits.

FIG. 26 is the embodied schematic view of the present invention showing that at least two unidirectional fluid pumps in different pumping directions are parallel connected to constitute the bi-directional fluid pumping set, wherein two bi-directional fluid pumping sets are installed at the fluid ports on both ends of the first fluid circuit, while the other two bi-directional fluid pumping sets are installed at fluid ports on both

ends of the second fluid circuit.

FIG. 27 is the first embodied schematic view of the present invention showing that the bridge type bi-directional fluid pumping set is constituted by at least one unidirectional fluid pump and four controllable switch type fluid valves and at least two bi-directional fluid pumping sets are separately installed at one of the two fluid ports of each two fluid circuits in the heat exchange device.

FIG. 28 is the second embodied schematic view of the present invention showing that the bridge type bi-directional fluid pumping set is constituted by at least one unidirectional fluid pump and four controllable switch type fluid valves and at least four bridge type bi-directional fluid pumping sets are separately installed at the two fluid ports at two ends of each two fluid circuits in the heat exchange device.

FIG. 29 is the third embodied schematic view of the present invention showing that the bridge type bi-directional fluid pumping set is constituted by at least one unidirectional fluid pump and four controllable switch type fluid valves and at least four bridge type bi-directional fluid pumping sets are separately installed at the two fluid ports at two ends of each two fluid circuits in the heat exchange device.

FIG. 30 is the fourth embodied schematic view of the present invention showing that the bridge type bi-directional fluid pumping set is constituted by at least one unidirectional fluid pump and four controllable switch type fluid valves and at least four bridge type bi-directional fluid pumping sets are separately installed at the two fluid ports at two ends of each two fluid circuits in the heat exchange device.

DESCRIPTION OF MAIN COMPONENT SYMBOLS

11: Temperature detecting device

21: Humidity detecting device

31: Gaseous or liquid fluid composition detecting device

100: Heat exchanger

111, 112, 113, 114: Bi-directional fluid pump

120, 120', 120a, 120b, 120c, 120d: Unidirectional fluid pumping device.

123: Bi-directional fluid pumping device

126: Unidirectional valve

129a, 129b, 129c, 129d, 129a', 129b', 129c', 129d': Fluid Valve

140: Bi-directional fluid pump

200: Total heat exchanger

250: Periodic fluid direction-change operative control device

300: Power source

1000: Heat Exchange device

a, b, c, d: fluid port

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 is a schematic view showing operating principles of the conventional bi-directional heat exchange device or total heat exchange device; as shown in FIG. 1, the conventional bi-directional heat exchange device or total heat exchange device usually has two fluid pumping devices in different flowing directions and four fluid ports for two fluid circuits with temperature difference being pumped in different flowing directions to pass through the heat exchanger (100) inside the heat exchange device (1000) via the two sides thereof, wherein the two fluid circuits are respectively entered from the fluid ports at different sides and discharged out of the fluid ports at the other side; such as that for the example of the heat exchange device for indoor-outdoor air exchange in cold winter times, wherein the higher indoor temperature air flow is pumped through the heat exchange device (1000) via the fluid port (a) and is discharged to outdoors from the fluid port (b) via the fluid circuit at one side of the heat exchanger (100), and the lower temperature outdoor fresh air is pumped through the heat exchange device (1000) via the fluid port (c) at another side and discharge into indoors from the fluid port (d) via the fluid circuit at the other side of the heat exchanger (100), and that the fluid port (a) and the fluid port (d) are disposed at the side connecting to indoors while the fluid port (c) and the fluid port (b) are disposed at the side connecting to the outdoors; during stable operation, the side at the heat exchanger (100) inside the heat exchange device (1000) at positions between the fluid port (a) to the fluid port (b) is formed with a temperature distribution from higher temperature at fluid port (a) to the lower temperature at fluid port (b), and the other side of the heat exchanger (100) at positions between the fluid port (c) to the fluid port (d) is formed with a temperature distribution from the lower temperature at fluid port (c) to gradually rise to the higher temperature at fluid port (d), wherein the heat exchange efficiency is determined by fluid property, fluid speed and the temperature difference of the fluids at the two sides of heat exchanger of the heat exchange device; in case for the application of heat exchanger being interposed or coated with desiccant material using by permeation or absorbability type, or the heat exchanger itself is the total heat exchanger having concurrent moisture

absorbing function, then said two fluids at different flowing directions form temperature difference and humidity saturation degree difference at the two inlet and outlet ports and two sides of the flowing direction of total heat exchanger inside the heat exchanger device (1000) for passing through fluids in different flowing directions.

FIG. 2 is the first structural block schematic view of the embodiment showing the double flow-circuit heat exchange device for periodic positive and reverse directional pumping of the present invention being applied in the heat exchanger;

As shown in FIG. 2, for the double flow-circuit heat exchange device for periodic positive and reverse directional pumping, the conventional bi-directional heat exchange device (1000) is further installed with the bi-directional fluid pumping device (123) capable of positive and reverse directional pumping constituted by two bi-directional fluid pumps (140), and installed with the periodic fluid direction-change operative control device (250) for operatively controlling the bi-directional fluid pumping device (123) so as to change the flowing directions of pumping fluid by periodic change that is operated with the two bi-directional fluid pumps of the bi-directional fluid pumping device (123) driven by power source (300), and constantly maintain the fluids in two different flowing directions to pass through the heat exchanger (100) inside the heat exchange device (1000), wherein:

-- The two bi-directional fluid pumps capable of producing positive pressure to push fluids or negative pressure to attract fluids are installed, thereby to constitute bi-directional fluid pumping device (123) for the application of pumping gaseous or liquid state fluids, and four fluid ports are installed at the heat exchange device (1000) to drive the bi-directional fluid pump (140) at the two sides of the heat exchanger (100) inside the heat exchange device (1000) by the electric power from power source (300) through the control of the periodic fluid directional-change operative control device (250); furthermore, flowing direction said two fluid circuits are respectively fed or discharged from the fluid ports at different sides, and discharged or fed via the fluid port at the other side, including the fluid is pumped into the heat exchanger (100) of the heat exchange device (1000) through the fluid port (a), passes through the fluid circuit at one side of the heat exchanger (100) and is discharged to outdoors via the fluid port (b) as well as the fluid is pumped into the heat exchanger (100) of the heat exchange device (1000) through the fluid port (c), passes through the fluid circuit at the other side of the heat exchanger (100) and is discharged to outdoors via the fluid port (d), and that the

fluid port (a) and the fluid port (b) are disposed for connecting to the same space or object while the fluid port (c) and the fluid port (b) are disposed for connecting to the other space or objects with temperature difference, thereby to periodically change the flowing directions of the two fluid circuits;

-- The heat exchanger (100): It is the heat exchanger having two internal flow channels with heat absorbing/releasing capability, wherein the two flow channels are individually set with two fluid ports for separately pumping the fluid and is constituted by conventional heat exchange structure for the function of heat exchanging between two fluids;

-- The at least one temperature detecting device (11) is installed at position capable of directly or indirectly detecting the temperature variation of pumping fluid, wherein the detected signal is used as the reference to determine the periodic switching timing of fluid flowing direction change operation;

-- The bi-directional fluid pumping device (123): It is constituted by:

1) Two bi-directional pumps (140) capable of producing positive pressure to push fluid or negative pressure to attract fluid are pumped in opposite directions to constitute the bi-directional fluid pumping device (123) for pumping gaseous or liquid state fluids, wherein the two fluid pumps in opposite directions can be respectively equipped with an electric motor or share a common electric motor, thereby being subject to the operative control of the periodic fluid direction-change operative control device (250) to rotate positively or reversely to change the flowing direction of the pumping fluid;

2) It is constituted by fluid pumps capable of simultaneously pumping in opposite directions individually as well as periodically changing the pumping directions;

The above pumping methods include **1)** producing negative pressure to push the fluid; or **2)** producing positive pressure to attract the fluid;

Said bi-directional fluid pumping device (123) and said heat exchange device (1000) are in an integral structure or are in separated structures.

-- Power source (300): The device which provides the operating power source, including AC or DC city power system or standalone electric power supplying devices;

-- The periodic fluid direction-change operative control device (250): It is constituted by electromechanical components, solid state electronic components, or microprocessors with related software and control interfaces to operatively control the two bi-directional fluid pumps (140) inside the bi-directional fluid pumping device (123) for periodically

changing the flowing direction of the two fluids in different flowing directions passing through the heat exchange device (1000), thereby operatively controlling the temperature distribution status between the fluids and the heat exchanger (100) of the heat exchange device (1000);

The timing of periodic fluid direction-change could be **1)** open-loop operation with pre-set periodic fluid direction changing timing; or **2)** randomly manual switching; or **3)** installing at least one temperature detecting device (11) at position capable of directly or indirectly detecting the temperature variation of pumping fluid, wherein the detected signal is used as the reference to determine the periodic switching timing of fluid flowing direction change operation.

FIG. 3 is the second structural block schematic view of the embodiment showing the double flow-circuit heat exchange device for periodic positive and reverse directional pumping of the present invention being applied in the heat exchanger.

As shown in FIG. 3, the fluid port (a), fluid port (b), fluid port (c), and fluid port (d) of bi-directional fluid in the heat exchange device (1000) are respectively installed with bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure to constitute the bi-directional fluid pumping device (123), wherein the bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure in the bi-directional fluid pumping device (123) driven by electric power source (300) to periodically change the flowing direction of the pumping fluid and constantly maintain the two fluid circuits which through the heat exchanger (100) flowing in different directions; wherein:

The heat exchange device (1000) and the bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure could be integrated in one or separately installed to constitute the function of bi-directional fluid pumping device (123), wherein the four bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure are separately installed at fluid port (a), fluid port (b), fluid port (c) and fluid port (d) for generating the pumping to change fluids in different flowing directions, and wherein the aforementioned bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure are controlled by the periodic fluid direction-change operative control device (250). The fluid pumps (111) and (113) installed at fluid port (a) and fluid port (c) form one set, which could be driven by individually installed electric

motors, or jointly driven by single electric motor, while the fluid pumps (112) and (114) form another set, which could be driven by individually installed electric motors, or jointly driven by single electric motor. Under the control of periodic fluid direction-change operative control device (250) to provide one or multiple following operating functions, including: **1)** partial of the bi-directional fluid pumps alternately pump in negative pressure periodically to allow the two fluid circuits in different flowing directions periodically changing flowing directions; or **2)** partial of the bi-directional fluid pumps alternately pump in positive pressure periodically to allow the two fluid circuits in different flowing directions periodically changing flowing directions; **3)** partial or all of the bi-directional fluid pumps being formed auxiliary pumping by the positive pressure pumping and negative pressure pumping generated by different fluid pumps in the same fluid circuits, thereby allowing two fluid circuits in different flowing directions periodically changing flowing direction; in aforementioned two functions **1)**, **2)**, **3)**, the flowing direction of the fluid inside the two channels at both sides of the heat exchanger (100) in the heat exchange device (1000) maintains opposite flowing directions;

-- The at least one temperature detecting device (11) is installed at position capable of directly or indirectly detecting the temperature variation of pumping fluid, wherein the detected signal is used as the reference to determine the periodic switch timing of fluid flowing direction change operation;

-- Bi-directional fluid pumping device (123): Bi-directional fluid port (a), fluid port (b), fluid port (c), fluid port (d) are individually installed with bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure to constitute the bi-directional fluid pumping device (123), wherein with the periodic fluid direction-change operative control device (250) to operatively control the bi-directional fluid pumping device (123) driven by electric power source (300) for periodic fluid direction changing operation, and constantly maintain the two fluid circuits which through the heat exchanger (100) flowing in different directions;

-- The power source (300): The device which provides the operating power source, including AC or DC city power system or standalone electric power supplying devices;

-- The periodic fluid direction-change operative control device (250): It is constituted by electromechanical components, solid state electronic components, or microprocessors with related software and control interfaces to operatively control individual bi-directional fluid pumps (111), (112), (113), (114) that constitute the bi-directional

fluid pumping device (123), for the periodic fluid direction changing operation of the two different direction fluid through the heat exchange device to control the temperature distribution status between the fluid and the heat exchanger (100) of the heat exchange device;

-- The heat exchanger (100): It is the heat exchanger having two internal flow channels with heat absorbing/releasing capability, wherein the two flow channels are individually set with two fluid ports at both sides for separately fluid pumping and is constituted by conventional heat exchange structure for the function of heat exchanging between two fluids;

The timing of periodic fluid direction-change could be **1)** open-loop operation with pre-set periodic fluid direction changing timing; or **2)** randomly manual switching; or **3)** installing at least one temperature detecting device (11) at position capable of directly or indirectly detecting the temperature variation of pumping fluid, wherein the detected signal is used as the reference to determine the periodic switching timing of fluid flowing direction change operation.

FIG. 4 is the third structural block schematic view of the embodiment showing the double flow-circuit heat exchange device for periodic positive and reverse directional pumping of the present invention being applied in the heat exchanger;

As shown in FIG. 4, the fluid port (a), fluid port (b), fluid port (c), fluid port (d) of the two flow channels of the two bi-directional fluid of heat exchanging device (1000) of the present invention to separately install the unidirectional fluid pump (120a), (120b), (120c), (120d) for unidirectional pumping to constitute the bi-directional fluid pumping device (123), wherein the electrical power from the electrical power source (300) through the periodic fluid direction-change operative control device (250) to control the unidirectional pumps (120a), (120b), (120c), (120d) of the bi-directional fluid pumping device (123) to periodical change the flowing direction of pumping fluid, and to constantly maintain the fluid flowing directions of both circuits passing through the heat exchanger (100) in different direction, wherein:

The heat exchanging device (1000) and unidirectional fluid pumps (120a), (120b), (120c), (120d) could be integrated in one or separately installed to constitute the function of bi-directional fluid pumping device (123), wherein the four unidirectional fluid pumps (120a), (120b), (120c), (120d) are separately installed at fluid port (a), fluid port (b), fluid port (c) and fluid port (d) for fluid pumping, and wherein the aforementioned

unidirectional fluid pumps (120a), (120b), (120c), (120d) are controlled by the periodic fluid direction-change operative control device (250). The unidirectional fluid pumps (120a) and (120c) installed at fluid port (a) and fluid port (c) form one set, which could be driven by individually installed electric motors, or jointly driven by single electric motor, while the unidirectional fluid pumps (120b) and (120c) form another set, which could be driven by individually installed electric motors, or jointly driven by single electric motor. Under the control of periodic fluid direction-change operative control device (250) to compose the structure and operating methods for providing one or multiple following functions, including: **1)** The arrangement of unidirectional pumps for negative pressure pumping on fluids, wherein the unidirectional fluid pump (120a) and unidirectional fluid pump (120c) form one set, and the unidirectional fluid pump (120b) and unidirectional fluid pump (120d) form the other set, and that the two sets provide periodic negative pressure pumping alternatively to make the fluids with different flowing direction in two channels changing their flowing direction periodically; or **2)** The arrangement of unidirectional pumps for positive pressure pumping on fluids, wherein the unidirectional fluid pump (120a) and unidirectional fluid pump (120c) form one set, and the unidirectional fluid pump (120b) and unidirectional fluid pump (120d) form the other set, and that the two sets provide periodic positive pressure pumping alternatively to make the fluids with different flowing direction in two channels changing their flowing direction periodically;

In aforementioned two functions **1)** and **2)**, the flowing direction of the fluid inside the two channels at both sides of the heat exchanger (100) in the heat exchange device (1000) maintains opposite flowing directions;

-- The at least one temperature detecting device (11) is installed at position capable of directly or indirectly detecting the temperature variation of pumping fluid, wherein the detected signal is used as the reference to determine the periodic switch timing of fluid flowing direction change operation;

-- Bi-directional fluid pumping device (123): Bi-directional fluid port (a), fluid port (b), fluid port (c), fluid port (d) are individually installed with unidirectional fluid pumps (120a), (120b), (120c), (120d) capable of unidirectional pumping to constitute the bi-directional fluid pumping device (123), wherein with the periodic fluid direction-change operative control device (250) to operatively control the bi-directional fluid pumping device (123) driven by electric power source (300) for periodic fluid direction changing operation, and constantly maintain the two fluid circuits which

through the heat exchanger (100) flowing in different directions;

-- The power source (300): The device which provides the operating power source, including AC or DC city power system or standalone electric power supplying devices;

-- The periodic fluid direction-change operative control device (250): It is constituted by electromechanical components, solid state electronic components, or microprocessors with related software and control interfaces to operatively control individual unidirectional fluid pumps (120a), (120b), (120c), (120d) that constitute the bi-directional fluid pumping device (123), for the periodic fluid direction changing operation of the two different direction fluid through the two channels of the heat exchanger (100), thereby operatively controlling the temperature distribution status between the fluid and the heat exchanger (100) of the heat exchange device (1000);

-- The heat exchanger (100): It is the heat exchanger having two internal flow channels with heat absorbing/releasing capability, wherein the two flow channels are individually set with two fluid ports at both sides for separately fluid pumping and is constituted by conventional heat exchange structure for the function of heat exchanging between two fluids;

The timing of periodic fluid direction-change could be **1)** open-loop operation with pre-set periodic fluid direction changing timing; or **2)** randomly manual switching; or **3)** installing at least one temperature detecting device (11) at position capable of directly or indirectly detecting the temperature variation of pumping fluid, wherein the detected signal is used as the reference to determine the periodic switching timing of fluid flowing direction change operation.

FIG. 5 is the first structural block schematic view of the embodiment showing the double flow-circuit heat exchange device for periodic positive and reverse directional pumping of the present invention being applied in the total heat exchanger.

As shown in FIG. 5, for the double flow-circuit heat exchange device for periodic positive and reverse directional pumping, the conventional bi-directional heat exchange device (1000) is further installed with the bi-directional fluid pumping device (123) capable of positive and reverse directional pumping constituted by two bi-directional fluid pumps (140), and installed with the periodic fluid direction-change operative control device (250) for operatively controlling the bi-directional fluid pumping device (123) so as to allow the two different direction fluids periodically changing the flowing directions that is operated with the two bi-directional fluid pumps (140) of the

bi-directional fluid pumping device (123) driven by power source (300), and constantly maintain the tow fluid circuits in two different flowing directions to pass through the total heat exchanger (200) inside the heat exchange device (1000), wherein:

-- Both or either one of the at least one temperature detecting device (11) and the at least one humidity detecting device (21) are installed at positions capable of directly or indirectly detecting the temperature variation and humidity variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation;

Aforementioned temperature detecting device (11) and humidity detecting device (21) can be in an integral structure or in separated structures;

-- The bi-directional fluid pumping device (123): It is constituted by:

1) Two bi-directional pumps (140) capable of producing positive pressure to push fluid or negative pressure to attract fluid are pumped in opposite directions to constitute the bi-directional fluid pumping device (123) for pumping gaseous or liquid state fluids, wherein the two fluid pumps in opposite directions can be separately equipped with an electric motor or share a common electric motor, thereby being subject to the operative control of the periodic fluid direction-change operative control device (250) to rotate positively or reversely to change the flowing direction of the pumping fluid;

2) It is constituted by fluid pumps capable of simultaneously pumping in opposite directions individually as well as periodically changing the pumping directions;

The above pumping methods include **1)** producing negative pressure to push the fluid; or **2)** producing positive pressure to attract the fluid;

Said bi-directional fluid pumping device (123) and said heat exchange device (1000) are in an integral structure or are in separated structures;

-- Power source (300): The device which provides the operating power source, including AC or DC city power system or standalone electric power supplying devices;

-- The periodic fluid direction-change operative control device (250): It is constituted by electromechanical components, solid state electronic components, or microprocessors with related software and control interfaces to operatively control the two bi-directional fluid pumps (140) inside the bi-directional fluid pumping device (123) for periodically changing the flowing direction of the two fluids in different flowing directions passing through the heat exchange device (1000), thereby operatively controlling **1)** the temperature distribution status; or **2)** the humidity distribution status; or **3)** both of the

temperature and humidity distribution between the fluid and the total heat exchanger (200) of the heat exchange device (1000);

-- Total heat exchanger (200): It is the total heat exchanger having two internal flow channels with heat absorbing/releasing and humidity absorbing/releasing capability, wherein the two flow channels are individually set with two fluid ports at both sides for separately fluid pumping and is constituted by conventional total heat exchange structure for the function of heat exchanging between two fluids and function of de-humid capability;

The timing of periodic direction change of flowing fluid could be: **1)** open-loop operation with pre-set periodic fluid direction changing timing; or **2)** randomly manual switching; or **3)** installing both or either one of the at least one temperature detecting device (11) and the at least one humidity detecting device (21) at positions capable of directly or indirectly detecting the temperature variation and humidity variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation.

FIG. 6 is the second structural block schematic view of the embodiment showing the double flow-circuit heat exchange device for periodic positive and reverse directional pumping of the present invention being applied in the full heat exchanger.

As shown in FIG. 6, the fluid port (a), fluid port (b), fluid port (c), and fluid port (d) of bi-directional fluid in the heat exchange device (1000) are respectively installed with bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure to constitute the bi-directional fluid pumping device (123), wherein the bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure in the bi-directional fluid pumping device (123) driven by electric power source (300) is through the periodic fluid direction-change operative control device (250) to periodically change the flowing direction of the pumping fluid and constantly maintain the two fluid circuits flowing in different directions; wherein:

The heat exchange device (1000) and the bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure could be integrated in one or separately installed to constitute the function of bi-directional fluid pumping device (123), wherein the four bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure are separately installed

at fluid port (a), fluid port (b), fluid port (c) and fluid port (d) for generating the pumping to change fluids in different flowing directions, and wherein the aforementioned bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure are controlled by the periodic fluid direction-change operative control device (250), and the fluid pumps (111) and (113) installed at fluid port (a) and fluid port (c) form one set, which could be driven by individually installed electric motors, or jointly driven by single electric motor, while the fluid pumps (112) and (114) form another set, which could be driven by individually installed electric motors, or jointly driven by single electric motor, thereby under the control of periodic fluid direction-change operative control device (250) to provide one or multiple following operating functions, including: **1)** partial of the bi-directional fluid pumps alternately pump in negative pressure periodically to allow the two fluid circuits in different flowing directions periodically changing flowing directions; or **2)** partial of the bi-directional fluid pumps alternately pump in positive pressure periodically to allow the two fluid circuits in different flowing directions periodically changing flowing directions; **3)** partial or all of the bi-directional fluid pumps being formed auxiliary pumping by the positive pressure pumping and negative pressure pumping generated by different fluid pumps in the same fluid circuits, thereby allowing two fluid circuits in different flowing directions periodically changing flowing direction; in aforementioned two functions **1)**, **2)**, **3)**, the flowing direction of the fluid inside the two channels at both sides of the total heat exchanger (200) in the heat exchange device (1000) maintains opposite flowing directions;

-- Both or either one of the at least one temperature detecting device (11) and the at least one humidity detecting device (21) are installed at positions capable of directly or indirectly detecting the temperature variation and humidity variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation;

Aforementioned temperature detecting device (11) and humidity detecting device (21) can be in an integral structure or in separated structures;

-- Bi-directional fluid pumping device (123): Bi-directional fluid port (a), fluid port (b), fluid port (c), fluid port (d) are individually installed with bi-directional fluid pumps (111), (112), (113), (114) capable of producing positive pressures or negative pressure, thereby to constitute the bi-directional fluid pumping device (123), wherein with the periodic fluid direction-change operative control device (250) to operatively control the

bi-directional fluid pumping device (123) driven by electric power source (300) for periodic fluid direction changing operation, and constantly maintain the two fluid circuits which through the total heat exchanger (200) flowing in different direction;

-- The power source (300): The device which provides the operating power source, including AC or DC city power system or standalone electric power supplying devices;

-- The periodic fluid direction-change operative control device (250): It is constituted by electromechanical components, solid state electronic components, or microprocessors with related software and control interfaces to operatively control the bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure to constitute the bi-directional fluid pumping device (123), for the periodic fluid direction changing operation of the two different direction fluid through the two channels of the heat exchanging device to control **1)** the temperature distribution status; or **2)** the humidity distribution status; or **3)** both of the temperature and humidity distribution between the fluid and the total heat exchanger (200) of the heat exchange device;

-- Total heat exchanger (200): It is the total heat exchanger having two internal flow channels with heat absorbing/releasing and humidity absorbing/releasing capability, wherein the two flow channels are individually set with two fluid ports at both sides for separately fluid pumping and is constituted by conventional total heat exchange structure for the function of heat exchanging between two fluids and function of de-humid capability;

-- The timing of periodic direction change of flowing fluid could be: **1)** open-loop operation with pre-set periodic fluid direction changing timing; or **2)** randomly manual switching; or **3)** installing both or either one of the at least one temperature detecting device (11) and the at least one humidity detecting device (21) at positions capable of directly or indirectly detecting the temperature variation and humidity variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation.

FIG. 7 is the third structural block schematic view of the embodiment showing the double flow-circuit heat exchange device for periodic positive and reverse directional pumping of the present invention being applied in the full heat exchanger.

As shown in FIG. 7, the fluid port (a), fluid port (b), fluid port (c), fluid port (d) of the two flow channels of the two bi-directional fluid of heat exchanging device (1000) of the present invention to separately install the unidirectional fluid pump (120a), (120b),

(120c), (120d) for unidirectional pumping to constitute the bi-directional fluid pumping device (123), wherein the electrical power from the electrical power source (300) through the periodic fluid direction-change operative control device (250) to control the unidirectional pumps (120a), (120b), (120c), (120d) of the bi-directional fluid pumping device (123) to periodical change the flowing direction of pumping fluid, and to constantly maintain the fluid flowing directions of both circuits in different direction; wherein:

The heat exchanging device (1000) and unidirectional fluid pumps (120a), (120b), (120c), (120d) could be integrated in one or separately installed to constitute the function of bi-directional fluid pumping device (123), wherein the four unidirectional fluid pumps (120a), (120b), (120c), (120d) are separately installed at fluid port (a), fluid port (b), fluid port (c) and fluid port (d) for fluid pumping, and wherein the aforementioned unidirectional fluid pumps (120a), (120b), (120c), (120d) are controlled by the periodic fluid direction-change operative control device (250). The unidirectional fluid pumps (120a) and (120c) installed at fluid port (a) and fluid port (c) form one set, which could be driven by individually installed electric motors, or jointly driven by single electric motor, while the unidirectional fluid pumps (120b) and (120c) form another set, which could be driven by individually installed electric motors, or jointly driven by single electric motor. Under the control of periodic fluid direction-change operative control device (250) to compose the structure and operating methods for providing one or multiple following functions, including:

1) The arrangement of unidirectional pumps for negative pressure pumping on fluids, wherein the unidirectional fluid pump (120a) and unidirectional fluid pump (120c) form one set, and the unidirectional fluid pump (120b) and unidirectional fluid pump (120d) form the other set, and that the two sets provide periodic negative pressure pumping alternatively to make the fluids with different flowing direction in two channels changing their flowing direction periodically; or

2) The arrangement of unidirectional pumps for positive pressure pumping on fluids, wherein the unidirectional fluid pump (120a) and unidirectional fluid pump (120c) form one set, and the unidirectional fluid pump (120b) and unidirectional fluid pump (120d) form the other set, and that the two sets provide periodic positive pressure pumping alternatively to make the fluids with different flowing direction in two channels changing their flowing direction periodically;

In aforementioned two functions **1)** and **2)**, the flowing direction of the fluid inside

the two channels at both sides of total heat exchanger (200) in the heat exchange device (1000) maintains opposite flowing directions;

-- Both or either one of the at least one temperature detecting device (11) and the at least one humidity detecting device (21) are installed at positions capable of directly or indirectly detecting the temperature variation and humidity variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation;

Aforementioned temperature detecting device (11) and humidity detecting device (21) can be in an integral structure or in separated structures;

-- Bi-directional fluid pumping device (123): Bi-directional fluid port (a), fluid port (b), fluid port (c), fluid port (d) are individually installed with unidirectional fluid pumps (120a), (120b), (120c), (120d) capable of unidirectional pumping to constitute the bi-directional fluid pumping device (123), wherein with the periodic fluid direction-change operative control device (250) to operatively control the bi-directional fluid pumping device (123) driven by electric power source (300) for periodic fluid direction changing operation, and constantly maintain the two fluid circuits which through the total heat exchanger (200) flowing in different directions;

-- The power source (300): The device which provides the operating power source, including AC or DC city power system or standalone electric power supplying devices;

-- The periodic fluid direction-change operative control device (250): It is constituted by electromechanical components, solid state electronic components, or microprocessors with related software and control interfaces to operatively control individual unidirectional fluid pumps (120a), (120b), (120c), (120d) that constitute the bi-directional fluid pumping device (123), for the periodic fluid direction changing operation of the two different direction fluid through the two channels of the heat exchange device to control **1)** the temperature distribution status; or **2)** the humidity distribution status; or **3)** both of the temperature and humidity distribution between the fluid and the total heat exchanger (200) of the heat exchange device;

-- Total heat exchanger (200): It is the total heat exchanger having two internal flow channels with heat absorbing/releasing and humidity absorbing/releasing capability, wherein the two flow channels are individually set with two fluid ports at both sides for separately fluid pumping and is constituted by conventional total heat exchange structure for the function of heat exchanging between two fluids and function of de-humid capability;

The timing of periodic direction change of flowing fluid could be: **1)** open-loop operation with pre-set periodic fluid direction changing timing; or **2)** randomly manual switching; or **3)** installing both or either one of the at least one temperature detecting device (11) and the at least one humidity detecting device (21) at positions capable of directly or indirectly detecting the temperature variation and humidity variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation;

The heat exchanger or total heat exchanger of the double flow-circuit heat exchange device for periodic positive and reverse directional pumping of the present invention is embodied to have the following structural configurations: **1)** it is of the tubular structure in linear or other geometric shapes; or **2)** it is constituted by the multi-layer structure having fluid path for passing gaseous or liquid state fluids; or **3)** it is constituted by one or more than one flow circuit in series connection, parallel connection or series and parallel connection.

The comparison of traditional heat exchange device and present invention, the double flow-circuit heat exchange device for periodic positive and reverse directional pumping, is showed in following FIG. 8, FIG. 9, FIG. 10 and FIG. 11;

FIG. 8 is the schematic view showing operating principles of the conventional heat exchange device having pumping fluids in different flowing directions during simultaneous operation.

FIG. 9 is the schematic view showing the operation principles of the present invention.

FIG. 10 is the temperature distribution diagram of the heat exchange layer of the conventional heat exchange device having pumping fluids in different flowing directions during simultaneous operation.

FIG. 11 is the temperature distribution variation diagram of the heat exchange layer of the present invention during simultaneous operation.

FIG. 12 and FIG. 13 illustrate the comparison of conventional heat exchange device and the heat exchanger of the double flow-circuit heat exchange device for periodic positive and reverse directional pumping of the present invention applied in total heat exchange device.

FIG. 12 is the humidity distribution diagram of the total heat exchanger layer of the conventional heat exchange device having pumping fluids in different flowing directions

during simultaneous operation being operated as the total heat exchange device having dehumidification function.

FIG. 13 is the humidity distribution diagram of the operating total heat exchange layer of the total heat exchange device having dehumidification function of the present invention.

From the difference of the temperature difference distribution and humidity distribution in aforementioned FIG. 10, FIG. 11, FIG. 12, FIG. 13 shows the advantage of present invention on promoting the heat exchanging effectiveness as well as the total heat exchanging performance.

For the double flow-circuit heat exchange device for periodic positive and reverse directional pumping of the present invention further can be installed with all or at least one or more than one detecting device of temperature detecting device (11), humidity detecting device (21), and gaseous or liquid fluid composition detecting device (31) on the heat exchange device (1000), heat exchanger (100) or total heat exchanger (200) at positions near both or one of the fluid port (a) and fluid port (b), or at positions near both or one of the fluid port (c) and fluid port (d), or at other positions capable of detecting exchanging fluids, wherein the number of aforementioned detecting devices can be one or more than one to provide the detected signal as the reference for the operation of one or more than one functions as follows, including: **1)** as the reference for operatively controlling the periodic switch timing of fluid flowing direction pumped by the bi-directional fluid pumping devices (123); or **2)** as the reference for operatively controlling the bi-directional fluid pumping devices (123) to control the speed or the flow rate of the pumping fluid; or **3)** as the reference for operatively controlling the open volume of the fluid valve to control the speed or the flow rate of the pumping fluid;

For the aforementioned temperature detecting device (11), humidity detecting device (21), and the gaseous or liquid fluid composition detecting device (31), all detecting devices can be in an integral structure, or some detecting devices are in an integral structure, or each detecting device is in separated structure.

As shown in FIG. 14 is the structural principal schematic view of FIG. 2 being additionally installed with the gaseous or liquid fluid composition detecting device;

As shown in FIG. 14, for the double flow-circuit heat exchange device for periodic positive and reverse directional pumping, the conventional bi-directional heat exchange device (1000) is further installed with the bi-directional fluid pumping device (123)

capable of positive and reverse directional pumping constituted by two bi-directional fluid pumps (140), and installed with the periodic fluid direction-change operative control device (250) for operatively controlling the bi-directional fluid pumping device (123) so as to change the flowing directions of pumping fluid by periodic change that is operated with the two bi-directional fluid pumps of the bi-directional fluid pumping device (123) driven by power source (300), and constantly maintain the fluids in two different flowing directions to pass through the heat exchanger (100) inside the heat exchange device (1000), wherein:

-- The two bi-directional fluid pumps capable of producing positive pressure to push fluids or negative pressure to attract fluids are installed, thereby to constitute bi-directional fluid pumping device (123) for the application of pumping gaseous or liquid state fluids, and four fluid ports are installed at the heat exchange device (1000) to drive the bi-directional fluid pump (140) at the two sides of the heat exchanger (100) inside the heat exchange device (1000) by the electric power from power source (300) through the control of the periodic fluid directional-change operative control device (250); furthermore, flowing direction said two fluid circuits are respectively fed or discharged from the fluid ports at different sides, and discharged or fed via the fluid port at the other side, including the fluid is pumped into the heat exchanger (100) of the heat exchange device (1000) through the fluid port (a), passes through the fluid circuit at one side of the heat exchanger (100) and is discharged to outdoors via the fluid port (b) as well as the fluid is pumped into the heat exchanger (100) of the heat exchange device (1000) through the fluid port (c), passes through the fluid circuit at the other side of the heat exchanger (100) and is discharged to outdoors via the fluid port (d), and that the fluid port (a) and the fluid port (b) are disposed for connecting to the same space or object while the fluid port (c) and the fluid port (b) are disposed for connecting to the other space or objects with temperature difference, thereby to periodically change the flowing directions of the two fluid circuits;

-- The heat exchanger (100): It is the heat exchanger having two internal flow channels with heat absorbing/releasing capability, wherein the two flow channels are individually set with two fluid ports for separately pumping the fluid and is constituted by conventional heat exchange structure for the function of heat exchanging between two fluids;

-- Both or either one of the at least one temperature detecting device (11) and the at least one gaseous or liquid fluid composition detecting device (31) are installed at positions

capable of directly or indirectly detecting the temperature variation, or gaseous and liquid fluid composition variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switching timing of fluid flowing direction change operation;

Aforementioned temperature detecting device (11) and the gaseous or liquid fluid composition detecting device (31) can be in an integral structure or in separated structures;

-- The bi-directional fluid pumping device (123): It is constituted by:

1) Two bi-directional pumps (140) capable of producing positive pressure to push fluid or negative pressure to attract fluid are pumped in opposite directions to constitute the bi-directional fluid pumping device (123) for pumping gaseous or liquid state fluids, wherein the two fluid pumps in opposite directions can be respectively equipped with an electric motor or share a common electric motor, thereby being subject to the operative control of the periodic fluid direction-change operative control device (250) to rotate positively or reversely to change the flowing direction of the pumping fluid;

2) It is constituted by fluid pumps capable of simultaneously pumping in opposite directions individually as well as periodically changing the pumping directions;

The above pumping methods include **1)** producing negative pressure to push the fluid; or **2)** producing positive pressure to attract the fluid;

Said bi-directional fluid pumping device (123) and said heat exchange device (1000) are in an integral structure or are in separated structures.

-- Power source (300): The device which provides the operating power source, including AC or DC city power system or standalone electric power supplying devices;

-- The periodic fluid direction-change operative control device (250): It is constituted by electromechanical components, solid state electronic components, or microprocessors with related software and control interfaces to operatively control the two bi-directional fluid pumps (140) inside the bi-directional fluid pumping device (123) for periodically changing the flowing direction of the two fluids in different flowing directions passing through the heat exchange device (1000), thereby operatively controlling the temperature distribution status between the fluids and the heat exchanger (100) of the heat exchange device (1000);

The timing of periodic fluid direction-change could be **1)** open-loop operation with pre-set periodic fluid direction changing timing; or **2)** randomly manual switching; or **3)**

installing both or either one of the at least one temperature detecting device (11) and the at least one gaseous or liquid fluid composition detecting device (31) at positions capable of directly or indirectly detecting the temperature variation, or gaseous and liquid fluid composition variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switching timing of fluid flowing direction change operation.

As shown in FIG. 15 is the structural principal schematic view of FIG. 3 being additionally installed with the gaseous or liquid fluid composition detecting device;

As shown in FIG. 15, the fluid port (a), fluid port (b), fluid port (c), and fluid port (d) of bi-directional fluid in the heat exchange device (1000) are respectively installed with bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure to constitute the bi-directional fluid pumping device (123), wherein the bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure in the bi-directional fluid pumping device (123) driven by electric power source (300) to periodically change the flowing direction of the pumping fluid and constantly maintain the two fluid circuits which through the heat exchanger (100) flowing in different directions; wherein:

The heat exchange device (1000) and the bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure could be integrated in one or separately installed to constitute the function of bi-directional fluid pumping device (123), wherein the four bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure are separately installed at fluid port (a), fluid port (b), fluid port (c) and fluid port (d) for generating the pumping to change fluids in different flowing directions, and wherein the aforementioned bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure are controlled by the periodic fluid direction-change operative control device (250). The fluid pumps (111) and (113) installed at fluid port (a) and fluid port (c) form one set, which could be driven by individually installed electric motors, or jointly driven by single electric motor, while the fluid pumps (112) and (114) form another set, which could be driven by individually installed electric motors, or jointly driven by single electric motor. Under the control of periodic fluid direction-change operative control device (250) to provide one or multiple following operating functions, including: **1)** partial of the bi-directional fluid pumps alternately

pump in negative pressure periodically to allow the two fluid circuits in different flowing directions periodically changing flowing directions; or **2)** partial of the bi-directional fluid pumps alternately pump in positive pressure periodically to allow the two fluid circuits in different flowing directions periodically changing flowing directions; **3)** partial or all of the bi-directional fluid pumps being formed auxiliary pumping by the positive pressure pumping and negative pressure pumping generated by different fluid pumps in the same fluid circuits, thereby allowing two fluid circuits in different flowing directions periodically changing flowing direction; in aforementioned two functions **1)**, **2)**, **3)**, the flowing direction of the fluid inside the two channels at both sides of the heat exchanger (100) in the heat exchange device (1000) maintains opposite flowing directions;

-- Both or either one of the at least one temperature detecting device (11) and the at least one gaseous or liquid fluid composition detecting device (31) are installed at positions capable of directly or indirectly detecting the temperature variation, or gaseous or liquid fluid composition variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation;

Aforementioned temperature detecting device (11) and gaseous or liquid fluid composition detecting device (31) can be in an integral structure or in separated structures;

-- Bi-directional fluid pumping device (123): Bi-directional fluid port (a), fluid port (b), fluid port (c), fluid port (d) are individually installed with bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure to constitute the bi-directional fluid pumping device (123), wherein with the periodic fluid direction-change operative control device (250) to operatively control the bi-directional fluid pumping device (123) driven by electric power source (300) for periodic fluid direction changing operation, and constantly maintain the two fluid circuits which through the heat exchanger (100) flowing in different directions;

-- The power source (300): The device which provides the operating power source, including AC or DC city power system or standalone electric power supplying devices;

-- The periodic fluid direction-change operative control device (250): It is constituted by electromechanical components, solid state electronic components, or microprocessors with related software and control interfaces to operatively control individual bi-directional fluid pumps (111), (112), (113), (114) that constitute the bi-directional

fluid pumping device (123), for the periodic fluid direction changing operation of the two different direction fluid through the heat exchange device to control the temperature distribution status between the fluid and the heat exchanger (100) of the heat exchange device;

-- The heat exchanger (100): It is the heat exchanger having two internal flow channels with heat absorbing/releasing capability, wherein the two flow channels are individually set with two fluid ports at both sides for separately fluid pumping and is constituted by conventional heat exchange structure for the function of heat exchanging between two fluids;

The timing of periodic fluid direction-change could be **1)** open-loop operation with pre-set periodic fluid direction changing timing; or **2)** randomly manual switching; or **3)** installing both or either one of the at least one temperature detecting device (11) and the at least one gaseous or liquid fluid composition detecting device (31) at positions capable of directly or indirectly detecting the temperature variation, or gaseous or liquid fluid composition variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation.

As shown in FIG. 16 is the structural principal schematic view of FIG. 4 being additionally installed with the gaseous or liquid fluid composition detecting device;

As shown in FIG. 16, the fluid port (a), fluid port (b), fluid port (c), fluid port (d) of the two flow channels of the two bi-directional fluid of heat exchanging device (1000) of the present invention to separately install the unidirectional fluid pump (120a), (120b), (120c), (120d) for unidirectional pumping to constitute the bi-directional fluid pumping device (123), wherein the electrical power from the electrical power source (300) through the periodic fluid direction-change operative control device (250) to control the unidirectional pumps (120a), (120b), (120c), (120d) of the bi-directional fluid pumping device (123) to periodical change the flowing direction of pumping fluid, and to constantly maintain the fluid flowing directions of both circuits passing through the heat exchanger (100) in different direction, wherein:

The heat exchanging device (1000) and unidirectional fluid pumps (120a), (120b), (120c), (120d) could be integrated in one or separately installed to constitute the function of bi-directional fluid pumping device (123), wherein the four unidirectional fluid pumps (120a), (120b), (120c), (120d) are separately installed at fluid port (a), fluid port (b),

fluid port (c) and fluid port (d) for fluid pumping, and wherein the aforementioned unidirectional fluid pumps (120a), (120b), (120c), (120d) are controlled by the periodic fluid direction-change operative control device (250). The unidirectional fluid pumps (120a) and (120c) installed at fluid port (a) and fluid port (c) form one set, which could be driven by individually installed electric motors, or jointly driven by single electric motor, while the unidirectional fluid pumps (120b) and (120c) form another set, which could be driven by individually installed electric motors, or jointly driven by single electric motor. Under the control of periodic fluid direction-change operative control device (250) to compose the structure and operating methods for providing one or multiple following functions, including: **1)** The arrangement of unidirectional pumps for negative pressure pumping on fluids, wherein the unidirectional fluid pump (120a) and unidirectional fluid pump (120c) form one set, and the unidirectional fluid pump (120b) and unidirectional fluid pump (120d) form the other set, and that the two sets provide periodic negative pressure pumping alternatively to make the fluids with different flowing direction in two channels changing their flowing direction periodically; or **2)** The arrangement of unidirectional pumps for positive pressure pumping on fluids, wherein the unidirectional fluid pump (120a) and unidirectional fluid pump (120c) form one set, and the unidirectional fluid pump (120b) and unidirectional fluid pump (120d) form the other set, and that the two sets provide periodic positive pressure pumping alternatively to make the fluids with different flowing direction in two channels changing their flowing direction periodically;

In aforementioned two functions **1)** and **2)**, the flowing direction of the fluid inside the two channels at both sides of the heat exchanger (100) in the heat exchange device (1000) maintains opposite flowing directions;

-- Both or either one of the at least one temperature detecting device (11) and the at least one gaseous or liquid fluid composition detecting device (31) are installed at positions capable of directly or indirectly detecting the temperature variation, or gaseous or liquid fluid composition variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation;

Aforementioned temperature detecting device (11) and gaseous or liquid fluid composition detecting device (31) can be in an integral structure or in separated structures;

-- Bi-directional fluid pumping device (123): Bi-directional fluid port (a), fluid port (b),

fluid port (c), fluid port (d) are individually installed with unidirectional fluid pumps (120a), (120b), (120c), (120d) capable of unidirectional pumping to constitute the bi-directional fluid pumping device (123), wherein with the periodic fluid direction-change operative control device (250) to operatively control the bi-directional fluid pumping device (123) driven by electric power source (300) for periodic fluid direction changing operation, and constantly maintain the two fluid circuits which through the heat exchanger (100) flowing in different directions;

-- The power source (300): The device which provides the operating power source, including AC or DC city power system or standalone electric power supplying devices;

-- The periodic fluid direction-change operative control device (250): It is constituted by electromechanical components, solid state electronic components, or microprocessors with related software and control interfaces to operatively control individual unidirectional fluid pumps (120a), (120b), (120c), (120d) that constitute the bi-directional fluid pumping device (123), for the periodic fluid direction changing operation of the two different direction fluid through the two channels of the heat exchanger (100), thereby operatively controlling the temperature distribution status between the fluid and the heat exchanger (100) of the heat exchange device (1000);

-- The heat exchanger (100): It is the heat exchanger having two internal flow channels with heat absorbing/releasing capability, wherein the two flow channels are individually set with two fluid ports at both sides for separately fluid pumping and is constituted by conventional heat exchange structure for the function of heat exchanging between two fluids;

The timing of periodic fluid direction-change could be **1)** open-loop operation with pre-set periodic fluid direction changing timing; or **2)** randomly manual switching; or **3)** installing both or either one of the at least one temperature detecting device (11) and the at least one gaseous or liquid fluid composition detecting device (31) at positions capable of directly or indirectly detecting the temperature variation, or gaseous or liquid fluid composition variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation.

As shown in FIG. 17 is the structural principal schematic view of FIG. 5 being additionally installed with the gaseous or liquid fluid composition detecting device;

As shown in FIG. 17, for the double flow-circuit heat exchange device for periodic

positive and reverse directional pumping, the conventional bi-directional heat exchange device (1000) is further installed with the bi-directional fluid pumping device (123) capable of positive and reverse directional pumping constituted by two bi-directional fluid pumps (140), and installed with the periodic fluid direction-change operative control device (250) for operatively controlling the bi-directional fluid pumping device (123) so as to allow the two different direction fluids periodically changing the flowing directions that is operated with the two bi-directional fluid pumps (140) of the bi-directional fluid pumping device (123) driven by power source (300), and constantly maintain the tow fluid circuits in two different flowing directions to pass through the total heat exchanger (200) inside the heat exchange device (1000), wherein:

-- All or at least one of the at least one temperature detecting device (11), the at least one humidity detecting device (21) and the at least one gaseous or liquid fluid composition detecting device (31) are installed at positions capable of directly or indirectly detecting the temperature variation, humidity variation, or gaseous or liquid fluid composition variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation;

For the aforementioned temperature detecting device (11), humidity detecting device (21), and the gaseous or liquid fluid composition detecting device (31), all detecting devices can be in an integral structure, or some detecting devices are in an integral structure, or each detecting device is in separated structure;

-- The bi-directional fluid pumping device (123): It is constituted by:

1) Two bi-directional pumps (140) capable of producing positive pressure to push fluid or negative pressure to attract fluid are pumped in opposite directions to constitute the bi-directional fluid pumping device (123) for pumping gaseous or liquid state fluids, wherein the two fluid pumps in opposite directions can be separately equipped with an electric motor or share a common electric motor, thereby being subject to the operative control of the periodic fluid direction-change operative control device (250) to rotate positively or reversely to change the flowing direction of the pumping fluid;

2) It is constituted by fluid pumps capable of simultaneously pumping in opposite directions individually as well as periodically changing the pumping directions;

The above pumping methods include **1)** producing negative pressure to push the fluid; or **2)** producing positive pressure to attract the fluid;

Said bi-directional fluid pumping device (123) and said heat exchange device (1000)

are in an integral structure or are in separated structures;

-- Power source (300): The device which provides the operating power source, including AC or DC city power system or standalone electric power supplying devices;

-- The periodic fluid direction-change operative control device (250): It is constituted by electromechanical components, solid state electronic components, or microprocessors with related software and control interfaces to operatively control the two bi-directional fluid pumps (140) inside the bi-directional fluid pumping device (123) for periodically changing the flowing direction of the two fluids in different flowing directions passing through the heat exchange device (1000), thereby operatively controlling **1)** the temperature distribution status; or **2)** the humidity distribution status; or **3)** both of the temperature and humidity distribution between the fluid and the total heat exchanger (200) of the heat exchange device (1000);

-- Total heat exchanger (200): It is the total heat exchanger having two internal flow channels with heat absorbing/releasing and humidity absorbing/releasing capability, wherein the two flow channels are individually set with two fluid ports at both sides for separately fluid pumping and is constituted by conventional total heat exchange structure for the function of heat exchanging between two fluids and function of de-humid capability;

The timing of periodic direction change of flowing fluid could be: **1)** open-loop operation with pre-set periodic fluid direction changing timing; or **2)** randomly manual switching; or **3)** installing all or at least one of the at least one temperature detecting device (11), the at least one humidity detecting device (21) and the at least one gaseous or liquid fluid composition detecting device (31) at positions capable of directly or indirectly detecting the temperature variation, humidity variation, or gaseous or liquid fluid composition variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation.

As shown in FIG. 18 is the structural principal schematic view of FIG. 6 being additionally installed with the gaseous or liquid fluid composition detecting device;

As shown in FIG. 18, the fluid port (a), fluid port (b), fluid port (c), and fluid port (d) of bi-directional fluid in the heat exchange device (1000) are respectively installed with bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure to constitute the bi-directional fluid pumping device (123),

wherein the bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure in the bi-directional fluid pumping device (123) driven by electric power source (300) is through the periodic fluid direction-change operative control device (250) to periodically change the flowing direction of the pumping fluid and constantly maintain the two fluid circuits flowing in different directions; wherein:

The heat exchange device (1000) and the bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure could be integrated in one or separately installed to constitute the function of bi-directional fluid pumping device (123), wherein the four bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure are separately installed at fluid port (a), fluid port (b), fluid port (c) and fluid port (d) for generating the pumping to change fluids in different flowing directions, and wherein the aforementioned bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure are controlled by the periodic fluid direction-change operative control device (250), and the fluid pumps (111) and (113) installed at fluid port (a) and fluid port (c) form one set, which could be driven by individually installed electric motors, or jointly driven by single electric motor, while the fluid pumps (112) and (114) form another set, which could be driven by individually installed electric motors, or jointly driven by single electric motor, thereby under the control of periodic fluid direction-change operative control device (250) to provide one or multiple following operating functions, including: **1)** partial of the bi-directional fluid pumps alternately pump in negative pressure periodically to allow the two fluid circuits in different flowing directions periodically changing flowing directions; or **2)** partial of the bi-directional fluid pumps alternately pump in positive pressure periodically to allow the two fluid circuits in different flowing directions periodically changing flowing directions; **3)** partial or all of the bi-directional fluid pumps being formed auxiliary pumping by the positive pressure pumping and negative pressure pumping generated by different fluid pumps in the same fluid circuits, thereby allowing two fluid circuits in different flowing directions periodically changing flowing direction; in aforementioned two functions **1)**, **2)**, **3)**, the flowing direction of the fluid inside the two channels at both sides of the total heat exchanger (200) in the heat exchange device (1000) maintains opposite flowing directions;

-- All or at least one of the at least one temperature detecting device (11), the at least one

humidity detecting device (21) and the at least one gaseous or liquid fluid composition detecting device (31) are installed at positions capable of directly or indirectly detecting the temperature variation, humidity variation, or gaseous or liquid fluid composition variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation;

For the aforementioned temperature detecting device (11), humidity detecting device (21), and the gaseous or liquid fluid composition detecting device (31), all detecting devices can be in an integral structure, or some detecting devices are in an integral structure, or each detecting device is in separated structure;

-- Bi-directional fluid pumping device (123): Bi-directional fluid port (a), fluid port (b), fluid port (c), fluid port (d) are individually installed with bi-directional fluid pumps (111), (112), (113), (114) capable of producing positive pressures or negative pressure, thereby to constitute the bi-directional fluid pumping device (123), wherein with the periodic fluid direction-change operative control device (250) to operatively control the bi-directional fluid pumping device (123) driven by electric power source (300) for periodic fluid direction changing operation, and constantly maintain the two fluid circuits which through the total heat exchanger (200) flowing in different direction;

-- The power source (300): The device which provides the operating power source, including AC or DC city power system or standalone electric power supplying devices;

-- The periodic fluid direction-change operative control device (250): It is constituted by electromechanical components, solid state electronic components, or microprocessors with related software and control interfaces to operatively control the bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure to constitute the bi-directional fluid pumping device (123), for the periodic fluid direction changing operation of the two different direction fluid through the two channels of the heat exchanging device to control **1)** the temperature distribution status; or **2)** the humidity distribution status; or **3)** both of the temperature and humidity distribution between the fluid and the total heat exchanger (200) of the heat exchange device;

-- Total heat exchanger (200): It is the total heat exchanger having two internal flow channels with heat absorbing/releasing and humidity absorbing/releasing capability, wherein the two flow channels are individually set with two fluid ports at both sides for separately fluid pumping and is constituted by conventional total heat exchange structure for the function of heat exchanging between two fluids and function of de-humid capability;

The timing of periodic direction change of flowing fluid could be: **1)** open-loop operation with pre-set periodic fluid direction changing timing; or **2)** randomly manual switching; or **3)** installing all or at least one of the at least one temperature detecting device (11), the at least one humidity detecting device (21) and the at least one gaseous or liquid fluid composition detecting device (31) at positions capable of directly or indirectly detecting the temperature variation, humidity variation, or gaseous or liquid fluid composition variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation.

As shown in FIG. 19 is the structural principal schematic view of FIG. 7 being additionally installed with the gaseous or liquid fluid composition detecting device;

As shown in FIG. 19, the fluid port (a), fluid port (b), fluid port (c), fluid port (d) of the two flow channels of the two bi-directional fluid of heat exchanging device (1000) of the present invention to separately install the unidirectional fluid pump (120a), (120b), (120c), (120d) for unidirectional pumping to constitute the bi-directional fluid pumping device (123), wherein the electrical power from the electrical power source (300) through the periodic fluid direction-change operative control device (250) to control the unidirectional pumps (120a), (120b), (120c), (120d) of the bi-directional fluid pumping device (123) to periodical change the flowing direction of pumping fluid, and to constantly maintain the fluid flowing directions of both circuits in different direction; wherein

The heat exchanging device (1000) and unidirectional fluid pumps (120a), (120b), (120c), (120d) could be integrated in one or separately installed to constitute the function of bi-directional fluid pumping device (123), wherein the four unidirectional fluid pumps (120a), (120b), (120c), (120d) are separately installed at fluid port (a), fluid port (b), fluid port (c) and fluid port (d) for fluid pumping, and wherein the aforementioned unidirectional fluid pumps (120a), (120b), (120c), (120d) are controlled by the periodic fluid direction-change operative control device (250). The unidirectional fluid pumps (120a) and (120c) installed at fluid port (a) and fluid port (c) form one set, which could be driven by individually installed electric motors, or jointly driven by single electric motor, while the unidirectional fluid pumps (120b) and (120c) form another set, which could be driven by individually installed electric motors, or jointly driven by single electric motor. Under the control of periodic fluid direction-change operative control

device (250) to compose the structure and operating methods for providing one or multiple following functions, including:

1) The arrangement of unidirectional pumps for negative pressure pumping on fluids, wherein the unidirectional fluid pump (120a) and unidirectional fluid pump (120c) form one set, and the unidirectional fluid pump (120b) and unidirectional fluid pump (120d) form the other set, and that the two sets provide periodic negative pressure pumping alternatively to make the fluids with different flowing direction in two channels changing their flowing direction periodically; or

2) The arrangement of unidirectional pumps for positive pressure pumping on fluids, wherein the unidirectional fluid pump (120a) and unidirectional fluid pump (120c) form one set, and the unidirectional fluid pump (120b) and unidirectional fluid pump (120d) form the other set, and that the two sets provide periodic positive pressure pumping alternatively to make the fluids with different flowing direction in two channels changing their flowing direction periodically;

In aforementioned two functions **1)** and **2)**, the flowing direction of the fluid inside the two channels at both sides of total heat exchanger (200) in the heat exchange device (1000) maintains opposite flowing directions;

-- All or at least one of the at least one temperature detecting device (11), the at least one humidity detecting device (21) and the at least one gaseous or liquid fluid composition detecting device (31) are installed at positions capable of directly or indirectly detecting the temperature variation, humidity variation, or gaseous or liquid fluid composition variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation;

For the aforementioned temperature detecting device (11), humidity detecting device (21), and the gaseous or liquid fluid composition detecting device (31), all detecting devices can be in an integral structure, or some detecting devices are in an integral structure, or each detecting device is in separated structure;

-- Bi-directional fluid pumping device (123): Bi-directional fluid port (a), fluid port (b), fluid port (c), fluid port (d) are individually installed with unidirectional fluid pumps (120a), (120b), (120c), (120d) capable of unidirectional pumping to constitute the bi-directional fluid pumping device (123), wherein with the periodic fluid direction-change operative control device (250) to operatively control the bi-directional fluid pumping device (123) driven by electric power source (300) for periodic fluid direction changing operation, and constantly maintain the two fluid circuits which

through the total heat exchanger (200) flowing in different directions;

-- The power source (300): The device which provides the operating power source, including AC or DC city power system or standalone electric power supplying devices;

-- The periodic fluid direction-change operative control device (250): It is constituted by electromechanical components, solid state electronic components, or microprocessors with related software and control interfaces to operatively control individual unidirectional fluid pumps (120a), (120b), (120c), (120d) that constitute the bi-directional fluid pumping device (123), for the periodic fluid direction changing operation of the two different direction fluid through the two channels of the heat exchange device to control **1)** the temperature distribution status; or **2)** the humidity distribution status; or **3)** both of the temperature and humidity distribution between the fluid and the total heat exchanger (200) of the heat exchange device;

-- Total heat exchanger (200): It is the total heat exchanger having two internal flow channels with heat absorbing/releasing and humidity absorbing/releasing capability, wherein the two flow channels are individually set with two fluid ports at both sides for separately fluid pumping and is constituted by conventional total heat exchange structure for the function of heat exchanging between two fluids and function of de-humid capability;

The timing of periodic direction change of flowing fluid could be: **1)** open-loop operation with pre-set periodic fluid direction changing timing; or **2)** randomly manual switching; or **3)** installing all or at least one of the at least one temperature detecting device (11), the at least one humidity detecting device (21) and the at least one gaseous or liquid fluid composition detecting device (31) at positions capable of directly or indirectly detecting the temperature variation, humidity variation, or gaseous or liquid fluid composition variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation.

According to above said definitions on operating functions, the selectable embodiments of the bi-directional fluid pumping devices (123) of the double flow-circuit heat exchange device for periodic positive and reverse directional pumping of the present invention include being constituted by following one or more than one structures, including:

1. It is by adopting at least two fluid pumps (140) capable of bi-directionally fluid pumping installed on the common fluid port of two different fluid channels to

operatively control the bi-directional fluid pump to periodic pump in positive or reverse directions, thereby periodically changing the fluid direction; as shown in Fig. 20 is the embodied schematic view of the present invention showing that at least two fluid pumps capable of bi-directionally fluid pumping are installed between the fluid source and both ends of common inlet/outlet port of the first fluid circuit and the second fluid circuit;

2. It is constituted by at least four bi-directional fluid pumps (111,112,113,114) capable of producing negative pressure or positive pressure, wherein two bi-directional fluid pumps (111,112) are installed at the fluid ports (a), (b) on the two ends of the first fluid circuit of the heat exchange device (1000), while the other two bi-directional fluid pumps (113,114) are installed at the fluid ports (c), (d) on the two ends of the second fluid circuit, whereby with the control of the periodic fluid direction-change operative control device (250) to form the structural arrangement and to provide one or multiple following functions, including: **1)** with the bi-directional fluid pumps (111,113) installed at one end of the first fluid circuit and the second fluid circuit to operate in negative pressure pumping, and periodically altered by bi-directional fluid pumps (112,114) installed at the other end of the first fluid circuit and second fluid circuit to operate in negative pressure pumping operation to provide the periodic flowing direction changing of the fluid; or **2)** with the bi-directional fluid pumps (111, 113) installed at one end of the first fluid circuit and the second fluid circuit to operate in positive pressure pumping, and periodically altered by bi-directional fluid pumps (112,114) installed at the other end of the first fluid circuit and second fluid circuit to operate in positive pressure pumping operation to provide the periodic flowing direction changing of the fluid; or **3)** with the positive fluid pump and negative fluid pump at the two ends of the same fluid channel of the two fluid channels to assist pump in the same direction and to periodic change the flowing direction alternately; as shown in FIG. 21 is the embodied schematic view of present invention showing that at least four bi-directional fluid pumps are installed, wherein two of the bi-directional fluid pumps are installed at the fluid ports (a), (b) of two ends of the first fluid circuit of the heat exchange device, while the other two of the bi-directional fluid pumps are installed at the fluid ports (c), (d) of two ends of the second fluid circuit;

3. It is constituted by at least four unidirectional fluid pumps (120a), (120b), (120c), (120d), wherein two unidirectional fluid pumps (120a), (120b) are separately

installed at fluid ports (a), (b) on the two ends of the first fluid circuit of the heat exchange device (1000), while the other two unidirectional fluid pumps (120c), (120d) are separately installed at fluid ports (c), (d) on the two ends of the second fluid circuit, whereby with the control of periodic fluid direction-change operative control device (250) to form the structural arrangement and to provide one or multiple following operating functions, including: **1)** the arrangement of unidirectional pumps for negative pressure pumping on fluids, wherein the unidirectional pump (120a) and unidirectional pump (120c) form one set, and the unidirectional pump (120b) and unidirectional pump (120d) form the other set, and that the two sets provide periodic negative pressure pumping alternatively to make the fluids with different flowing direction in two channels changing their flowing direction periodically; or **2)** the arrangement of unidirectional pumps for positive pressure pumping on fluids, wherein the unidirectional pump (120a) and unidirectional pump (120c) form one set, and the unidirectional pump (120b) and unidirectional pump (120d) form the other set, and that the two sets provide periodic positive pressure pumping alternatively to make the fluids with different flowing direction in two channels changing their flowing direction periodically; as shown in FIG. 22 is the embodied schematic view of the present invention showing that at least four unidirectional fluid pumps are installed, wherein two of the unidirectional fluid pumps are installed at the fluid ports (a), (b) of two ends of the first fluid circuit of the heat exchange device, while the other two of the bi-directional fluid pumps are installed at the fluid ports (c), (d) of two ends of the second fluid circuit;

4. It is constituted by at least two unidirectional fluid pumps (120), (120') in different pumping directions being series connected in different flowing direction to constitute the bi-directional fluid pumping set, wherein at least two aforementioned bi-directional fluid pumping sets are separately installed at the fluid ports (a), (c) of two different fluid channels to constitute the bi-directional fluid pumping device (123), wherein under the control of periodic fluid direction-change operative control device (250) to operate the unidirectional pump (120) and unidirectional pump (120') being installed in opposite pumping direction inside the two bi-directional fluid pumping sets in periodic alternate pumping to change the flowing direction of fluid insides two fluid channels periodically. If the structure of individual unidirectional fluid pumps (120), (120') is irreversible for flowing, then each unidirectional fluid pump (120), (120') could firstly individually parallel connect with reversible

conducting unidirectional valve (126) before being series connected; as shown in FIG. 23 is the embodied schematic view of the present invention showing that at least two unidirectional fluid pumps in different pumping directions are series connected to constitute the bi-directional fluid pumping set for being separately installed at one of the individual two fluid ports of two different fluid circuits;

5. It is constituted by at least two unidirectional pumps (120), (120') in different pumping directions being series connected in different flowing direction to constitute the bi-directional fluid pumping set, wherein at least two aforementioned bi-directional fluid pumping sets are separately installed at the fluid ports (a), (b) on two ends of the first fluid circuit, and at least two aforementioned bi-directional fluid pumping sets are separately installed at the fluid ports (c), (d) on two ends of the second fluid circuit, wherein under the control of periodic fluid direction-change operative control device (250) to operate the unidirectional pumps (120), (120') in different pumping direction being separately installed at the fluid ports (a), (b) on two ends of the first fluid circuit and the fluid ports (c), (d) on two ends of the second fluid circuit, thereby to provide one or multiple following operating functions, including: **1)** with the unidirectional pump (120') installed in the arrangement of negative pressure pumping direction inside the two bi-directional fluid pumping sets installed at the fluid ports on two ends of the first fluid circuit and second fluid circuit to operate in negative pressure pumping, and changing the fluid flowing direction periodically; or **2)** with the unidirectional pump (120) installed in the arrangement of positive pressure pumping direction inside the two bi-directional fluid pumping sets installed at fluid ports on two ends of the first fluid circuit and second fluid circuit to operate in positive pressure pumping, and changing the fluid flowing direction periodically; or **3)** with the unidirectional pump (120) and unidirectional pump (120') installed at both ends of both fluid channels to assist pumping in the same direction, and changing the pumping direction periodically. If the structure of individual unidirectional fluid pumps (120), (120') is irreversible for flowing, then each unidirectional fluid pump (120), (120') could firstly individually parallel connect with reversible conducting unidirectional valve (126) before being series connected; as shown in FIG. 24 is the embodied schematic view of the present invention showing that at least two unidirectional fluid pumps in different pumping directions are series connected to constitute the bi-directional fluid pumping set, wherein two bi-directional fluid pumping sets are installed at the

fluid ports on both ends of the first fluid circuit, while the other two bi-directional fluid pumping sets are installed at fluid ports on both ends of the second fluid circuit;

6. It is constituted by at least two unidirectional fluid pumps (120), (120') in different pumping directions being parallel connected to constitute the bi-directional fluid pumping set, wherein at least two aforementioned bi-directional fluid pumping sets are separately installed at the fluid ports (a), (c) of two different fluid channels to constitute the bi-directional fluid pumping device (123), wherein under the control of periodic fluid direction-change operative control device (250) to operate the unidirectional pump (120) and unidirectional pump (120') being installed in opposite pumping direction inside the two bi-directional fluid pumping sets in periodic alternate pumping to change the flowing direction of fluid insides two fluid channels periodically. If the structure of individual unidirectional fluid pumps (120), (120') does not have anti-reverse flow function, then each unidirectional fluid pump (120), (120') could firstly separately series connect with the unidirectional valve (126) in forward polarity before being parallel connected to avoid reverse flows; as shown in FIG. 25 is the embodied schematic view of the present invention showing that at least two unidirectional fluid pumps in different pumping directions are parallel connected to constitute the bi-directional fluid pumping set for being separately installed at one of the individual two fluid ports of two different fluid circuits;

7. It is constituted by at least two unidirectional pumps (120), (120') in different pumping directions being parallel connected to constitute the bi-directional fluid pumping set, wherein at least two aforementioned bi-directional fluid pumping sets are separately installed at the fluid ports (a), (b) on two ends of the first fluid circuit, and at least two aforementioned bi-directional fluid pumping sets are separately installed at the fluid ports (c), (d) on two ends of the second fluid circuit, wherein under the control of periodic fluid direction switching controller (250) to operate the unidirectional pumps (120), (120') in different pumping direction being separately installed at the fluid ports (a), (b) on two ends of the first fluid circuit and the fluid ports (c), (d) on two ends of the second fluid circuit, thereby to provide one or multiple following operating functions, including: **1)** with the unidirectional pump (120') installed in the arrangement of negative pressure pumping direction inside the two bi-directional fluid pumping sets installed at the fluid ports on two ends of the

first fluid circuit and second fluid circuit to operate in negative pressure pumping, and changing the fluid flowing direction periodically; or **2)** with the unidirectional pump (120) installed in the arrangement of positive pressure pumping direction inside the two bi-directional fluid pumping sets installed at fluid ports on two ends of the first fluid circuit and second fluid circuit to operate in positive pressure pumping, and changing the fluid flowing direction periodically; or **3)** with the unidirectional pump (120) and unidirectional pump (120') installed at both ends of both fluid channels to assist pumping in the same direction, and changing the pumping direction periodically. If the structure of individual unidirectional fluid pumps (120), (120') does not have anti-reverse flow function, then each unidirectional fluid pump (120), (120') could firstly separately series connect with the unidirectional valve (126) in forward polarity before being parallel connected; as shown in FIG. 26 is the embodied schematic view of the present invention showing that at least two unidirectional fluid pumps in different pumping directions are parallel connected to constitute the bi-directional fluid pumping set, wherein two bi-directional fluid pumping sets are installed at the fluid ports on both ends of the first fluid circuit, while the other two bi-directional fluid pumping sets are installed at fluid ports on both ends of the second fluid circuit;

8. It is by adopting at least one unidirectional fluid pump (120) and four controllable switch type fluid valves (129a), (129b), (129c), (129d) in bridge type combination to constitute the bridge type bi-directional fluid pumping set, wherein at least two aforementioned bi-directional fluid pumping sets are separately installed at one of the two fluid ports of each two different fluid circuits to constitute the bi-directional pumping device (123), and that under the control of periodic fluid direction-change operative control device (250), in the operation of the unidirectional pump of the two aforementioned bi-directional fluid pumping sets, by alternately setting the two fluid valves (129a), (129b) as open, the other two fluid valves (129c), (129d) as close, or setting two fluid valves (129a), (129b) as close, the other two fluid valves (129c), (129d) as open, to control the periodically direction change of fluid; as shown in FIG. 27 is the first embodied schematic view of the present invention showing that the bridge type bi-directional fluid pumping set is constituted by at least one unidirectional fluid pump and four controllable switch type fluid valves and at least two bi-directional fluid pumping sets are separately installed at one of the two fluid ports of each two fluid circuits in the heat exchange device;

9. It is by adopting at least one unidirectional fluid pump (120) and four controllable switch type fluid valves (129a), (129b), (129c), (129d) in bridge type combination to constitute the bridge type bi-directional fluid pumping set, wherein at least four aforementioned bridge type bi-directional fluid pumping sets are separately installed at the two fluid ports at two ends of each two different fluid circuits to constitute the bi-directional pumping device (123), and that under the control of periodic fluid direction-change operative control device (250), in the operation of the unidirectional pump of the two aforementioned bi-directional fluid pumping sets, by alternately setting the two fluid valves (129a), (129b) as open, the other two fluid valves (129c), (129d) as close, or setting two fluid valves (129a), (129b) as close, the other two fluid valves (129c), (129d) as open, to control the periodically direction change of fluid; as shown in FIG. 28 is the second embodied schematic view of the present invention showing that the bridge type bi-directional fluid pumping set is constituted by at least one unidirectional fluid pump and four controllable switch type fluid valves and at least four bridge type bi-directional fluid pumping sets are separately installed at the two fluid ports at two ends of each two fluid circuits in the heat exchange device;

10. It is by adopting at least one unidirectional fluid pump (120) being series connected to four controllable switch type fluid valves in bridge type combination to constitute the bridge type bi-directional fluid pumping set; wherein

In the fluid circuit pumped by the unidirectional fluid pump (120a) connected with the heat exchange device (1000):

-- On end of the fluid valve (129a) connects to the outlet of the fluid valve (129c) as well as the outlet of the unidirectional fluid pump (120a), and the inlet end of the unidirectional fluid pump (120a) connects to side A;

-- The other end of the fluid valve (129a) connects to both the fluid port (a) of the heat exchange device (1000) and one end of the fluid valve (129d);

-- The other end of the fluid valve (129d) connects to one end of the fluid valve (129b), therefore connects to side B;

-- The other end of the fluid valve (129b) connects to the fluid port (b) of the heat exchange device (1000) and the fluid valve (129c), while the other end of the fluid valve (129c) connects to the fluid valve (129a), therefore jointly connect to the outlet end of the fluid pump (120a);

In the fluid circuit pumped by the unidirectional fluid pump (120c) connected

with the heat exchange device (1000):

-- On end of the fluid valve (129a') connects to the outlet of the fluid valve (129c') as well as the outlet of the unidirectional fluid pump (120c), and the inlet end of the unidirectional fluid pump (120c) connects to side C;

-- The other end of the fluid valve (129a') connects to the fluid port (c) of the heat exchange device (1000) as well as one end of the fluid valve (129d');

-- The other end of the fluid valve (129d') connects to one end of the fluid valve (129b'), therefore connects to side D;

-- The other end of the fluid valve (129b') connects to the fluid port (d) of the heat exchange device (1000) and the fluid valve (129c'), while the other end of the fluid valve (129c') connects to the fluid valve (129a'), therefore jointly connect to the outlet end of the fluid pump (120c);

With the operative control of the periodic fluid direction-change operative control device (250), in the bridge type bi-directional fluid pumping set constituted by the unidirectional fluid pump (120a) and fluid valves (129a), (129b), (129c), (129d), by setting the fluid valve (129a) and the fluid valve (129b) as one set and the fluid valve (129c) and the fluid valve (129d) as one set to alternately control the two sets to open or close, as well as in the bridge type bi-directional fluid pumping set constituted by the unidirectional fluid pump (120c) and fluid valves (129a'), (129b'), (129c'), (129d'), by setting the fluid valve (129a') and the fluid valve (129b') as one set and the fluid valve (129c') and the fluid valve (129d') as one set to alternately control the two sets to open or close, thereby to form the function of periodically alternately change flowing direction on the two fluid circuits in the heat exchange device (1000); as shown in FIG. 29 is the third embodied schematic view of the present invention showing that the bridge type bi-directional fluid pumping set is constituted by at least one unidirectional fluid pump and four controllable switch type fluid valves and at least four bridge type bi-directional fluid pumping sets are separately installed at the two fluid ports at two ends of each two fluid circuits in the heat exchange device;

11. It is by adopting at least one unidirectional fluid pump (120) being series connected to four controllable switch type fluid valves in bridge type combination to constitute the bi-directional fluid pumping set; wherein

In the fluid circuit pumped by the unidirectional fluid pumps (120a), (120b) connected with the heat exchange device (1000):

-- On end of the fluid valve (129a) connects to the outlet of the fluid valve (129c) as well as the outlet of the unidirectional fluid pump (120a), and the inlet end of the unidirectional fluid pump (120a) connects to side A;

-- The other end of the fluid valve (129a) connects to both the fluid port (a) of the heat exchange device (1000) and one end of the fluid valve (129d);

-- The other end of the fluid valve (129d) connects to one end of the fluid valve (129b), and connects to the negative pressure fluids inlet side of the unidirectional fluid pump (120b), thereby via the fluid outlet side of the unidirectional fluid pump (120b) connecting to side B;

-- The other end of the fluid valve (129b) connects to the fluid port (b) of the heat exchange device (1000) and the fluid valve (129c), while the other end of the fluid valve (129c) connects to the fluid valve (129a), therefore jointly connect to the outlet end of the fluid pump (120a);

In the fluid circuit pumped by the unidirectional fluid pump (120c) connected with the heat exchange device (1000);

-- On end of the fluid valve (129a') connects to the outlet of the fluid valve (129c') as well as the outlet of the unidirectional fluid pump (120c), and the inlet end of the unidirectional fluid pump (120c) connects to side C;

-- The other end of the fluid valve (129a') connects to the fluid port (c) of the heat exchange device (1000) as well as one end of the fluid valve (129d');

-- The other end of the fluid valve (129d') connects to one end of the fluid valve (129b'), and connects to the negative pressure fluids inlet side of the unidirectional fluid pump (120d), thereby via the fluid outlet side of the unidirectional fluid pump (120d) connecting to side B;

-- The other end of the fluid valve (129b') connects to the fluid port (d) of the heat exchange device (1000) and the fluid valve (129c'), while the other end of the fluid valve (129c') connects to the fluid valve (129a'), therefore jointly connect to the outlet end of the fluid pump (120c);

With the operative control of the periodic fluid direction-change operative control device (250), in the bi-directional fluid pumping set constituted by the unidirectional fluid pump (120a) and fluid valves (129a), (129b), (129c), (129d), by setting the unidirectional fluid valve (129a) and the unidirectional fluid valve (129b) as one set and the unidirectional fluid valve (129c) and the unidirectional fluid valve (129d) as one set to alternately control the two sets to open or close, as well as in

the bi-directional fluid pumping set constituted by the unidirectional fluid pump (120c) and fluid valves (129a'), (129b'), (129c'), (129d'), by setting the unidirectional fluid valve (129a') and the unidirectional fluid valve (129b') as one set and the unidirectional fluid valve (129c') and the unidirectional fluid valve (129d') as one set to alternately control the two sets to open or close, thereby to form the function of periodically alternately change flowing direction on the two fluid circuits in the heat exchange device (1000); as shown in FIG. 30 is the fourth embodied schematic view of the present invention showing that the bridge type bi-directional fluid pumping set is constituted by at least one unidirectional fluid pump and four controllable switch type fluid valves and at least four bridge type bi-directional fluid pumping sets are separately installed at the two fluid ports at two ends of each two fluid circuits in the heat exchange device;

Aforementioned fluid pumping devices are provided for pumping gaseous or liquid fluids, wherein besides the fluid pumps can be driven by standalone electric motor or at least two fluid pumps can jointly be driven by a single electric motor, the fluid pumps can be driven by engine power, or the mechanical or electric power generated or converted from other wind energy, thermal energy, temperature difference energy or solar energy.

Said periodic fluid direction-change operative control device (250) of the double flow-circuit heat exchange device for periodic positive and reverse directional pumping of the present invention is equipped with electric motor, or controllable engine power, or mechanical or electric power generated or converted from other wind energy, thermal energy, temperature-difference energy, or solar energy for controlling various fluid pumps for driven, or controlling the operation timing of the fluid pumps or fluid valves, thereby changing the direction of the two circuits passing through the heat exchanger (100) and further to operatively control partial or all regulations of rotational speed, flow rate, fluid pressure of various fluid pumps thereof.

For the aforementioned double flow-circuit heat exchange device for periodic positive and reverse directional pumping of the present invention, in the operation of periodically positive and reverse directional pumping fluid, it further through the periodic fluid direction-change operative control device (250) to manipulate the flow rate of fluid pumped by the bi-directional pumping device (123), wherein the operational modes include one or more than one types as follows, including:

1) the flow rate of pumping fluid is adjusted or set manually;

2) the flow rate of fluid is operatively controlled by referring to the detected signal of the at least one temperature detecting device;

3) the flow rate of fluid is operatively controlled by referring to the detected signal of the at least one moisture detecting device;

4) the flow rate of fluid is operatively controlled by referring to the detected signal of the at least one gaseous or liquid fluid composition detecting device;

5) the flow rate of the fluid is jointly operatively controlled by two or more than two said **1)~4)** items.

The double flow-circuit heat exchange device for periodic positive and reverse directional pumping of the present invention when installed with the function of operatively controlling the flow rate, the flow rate range of the controlled fluid is between stop delivery to the maximum delivering volume, and the flow rate of fluid is manipulated in stepped or stepless according to the operational requirements, wherein it is further by following one or more than one devices to change the flow rate of fluid, including:

1) to operatively control the rotational speed in pumping operation of bi-directional pumping device (123) from idling to the maximum speed range, thereby to further operatively control the flow rate of fluid;

2) by adopting the bi-directional pumping device (123) with controllable fluid valve inlet/outlet to operatively control the open volume of the fluid valve inlet/outlet of the bi-directional pumping device (123), thereby to further operatively control the flow rate of fluid;

3) by adopting the unidirectional valve (126) with controllable fluid valve inlet/outlet to operatively control the open volume of the fluid valve inlet/outlet of the unidirectional valve (126), thereby to further operatively control the flow rate of fluid;

4) by adopting the fluid valve (129) and fluid valve (129') with controllable fluid valve inlet/outlet to operatively control the open volume of the fluid valve inlet/outlet of the fluid valve (129) and fluid valve (129'), thereby to further operatively control the flow rate of fluid;

5) by operatively controlling at least one of devices in item **1)~4)** to intermittingly pumping fluid, thereby to modulate the average flow rate by the time ratio of pumping and stop pumping.

For the aforementioned double flow-circuit heat exchange device for periodic

positive and reverse directional pumping of the present invention, the flow rate ratio of the two flow circuits passing through the heat exchange device (1000) during the operation can be one or more than one ratio modes as follows, including:

1) In the operation of periodically positive and reverse directional pumping fluid, the flow rate of one flow circuit is greater than that of the other flow circuit;

2) In the operation of periodically positive and reverse directional pumping fluid, the flow rate of the two flow circuits are the same;

3) In the operation of periodically positive and reverse directional pumping fluid, when operation in one direction, the flow rate of the two flow circuits are different, while operation in the other direction, the flow rate of the two flow circuits are the same.

For the aforementioned double flow-circuit heat exchange device for periodic positive and reverse directional pumping of the present invention, in the operation of periodically positive and reverse directional pumping fluid, the pumping periodic mode includes one or more than one type as follows, including:

1) In the operation of periodically positive and reverse directional pumping fluid, the operational time of positive direction and reverse direction are the same;

2) In the operation of periodically positive and reverse directional pumping fluid, the operational time of positive direction and reverse direction are different;

3) The mixed mode of both item **1)** and **2)**.

For the aforementioned double flow-circuit heat exchange device for periodic positive and reverse directional pumping of the present invention, except for the function of periodically positive and reverse directional pumping operation, it further simultaneously has one ore more than one special operational modes, including:

1) The fluid of two flow circuits pump in fluid in the same flowing direction;

2) The fluid of two flow circuits reversely pump out fluid in the same flowing direction;

3) The fluid of two flow circuits execute periodically positive and reverse directional pumping operation by pumping in fluid and reversely pumping out fluid in the same flowing direction.

The function of the same directional pumping of aforementioned two flow circuits can be applied for the requirement to emergently increase the flow rate of fluid pumping in or pumping out.

For the double flow-circuit heat exchange device for periodic positive and reverse directional pumping of present invention, in the operation of flow direction change, to mitigate the impact generated by the gaseous or liquid state fluid in the course of pump when the fluid being intercepted at sudden, including the liquid hammer effect generated when the pumping liquid state fluid being interrupted, one or more than one operational methods as follows can be further added to the operational modes of the flow direction change control:

1) In the operation of fluid flow direction change, it is through the operatively control of the fluid pump or fluid valve to slowly reduce the flow rate of fluid, then to be switched to slowly increase the flow rate of fluid to a maximum preset value in the other flow direction;

2) In the operation of fluid flow direction change, it is through the operatively control of the fluid pump or fluid valve to slowly reduce the flow rate of fluid, and to be switched to stop pumping for a preset time period, then further to be switched to slowly increase the flow rate of fluid to a maximum preset value in the other flow direction.

CLAIMS:

1. A double flow-circuit heat exchange device for periodic positive and reverse directional pumping which has the double flow circuit heat exchange operating function for controllable periodic positive and reverse directional pumping thereby timely improving the temperature difference distribution between the fluid and the heat exchanger, and when the heat exchanger inside the heat exchange device is further interposed or coated with the desiccant materials using by permeation or absorbability type, or the heat exchanger itself is the total heat exchanger having concurrent moisture absorbing function, then it is through the double flow-circuit periodic positive and reverse directional pumping fluid and the heat exchanger being interposed or coated with desiccant material, and/or the heat exchanger itself having concurrent moisture absorbing function to constituted the dehumidification effect of total heat exchange function, wherein the double flow-circuit heat exchange device for periodic positive and reverse directional pumping of the present invention has following one or more than one functions, including: **1)** to periodically change the fluid pumping direction of the two fluid circuits and further to change the temperature difference distribution status at the two ends of the internal heat exchanger when passing through different directional fluids, thereby to increase the temperature difference conditions beneficial for heat absorbing and release of the internal heat exchanger, thereby promoting the heat exchange efficiency; **2)** for the applications of the heat exchanger being interposed or coated with desiccant material using by permeation or absorbability type, or the heat exchanger itself having concurrent moisture absorbing function, or in the application of the total heat exchange device with fluid piping being series connected with the moisture absorbing device, the fluid flowing rate, or the flowing direction, or both being periodically manipulated to change is used furthermore to change the humidity saturation degrees at the two inlet and outlet ports and two sides of the heat exchanger for passing through fluids in different flowing directions inside the heat exchanger device thereby promoting the dehumidification effect; **3)** The composition of the exchanging fluid is detected by installing the gaseous or liquid fluid composition detecting device for controlling the exchanging fluid flowing rate or direction or both; **4)** The impurities or pollutants brought in by the fluid flow at previous flowing direction are discharged by the double flow circuit for periodic positive and reverse directional pumping fluids thereby reducing the

disadvantages of impurity accumulations at fixed flowing directions.

2. A double flow-circuit heat exchange device for periodic positive and reverse directional pumping according to claim 1, wherein the bi-directional heat exchange device (1000) is installed with the bi-directional fluid pumping device (123) capable of positive and reverse directional pumping constituted by two bi-directional fluid pumps (140), and installed with the periodic fluid direction-change operative control device (250) for operatively controlling the bi-directional fluid pumping device (123) so as to change the flowing directions of pumping fluid by periodic change that is operated with the two bi-directional fluid pumps of the bi-directional fluid pumping device (123) driven by power source (300), and constantly maintain the fluids in two different flowing directions to pass through the heat exchanger (100) inside the heat exchange device (1000), wherein:

-- The two bi-directional fluid pumps capable of producing positive pressure to push fluids or negative pressure to attract fluids are installed, thereby to constitute bi-directional fluid pumping device (123) for the application of pumping gaseous or liquid state fluids, and four fluid ports are installed at the heat exchange device (1000) to drive the bi-directional fluid pump (140) at the two sides of the heat exchanger (100) inside the heat exchange device (1000) by the electric power from power source (300) through the control of the periodic fluid directional-change operative control device (250); furthermore, flowing direction said two fluid circuits are respectively fed or discharged from the fluid ports at different sides, and discharged or fed via the fluid port at the other side, including the fluid is pumped into the heat exchanger (100) of the heat exchange device (1000) through the fluid port (a), passes through the fluid circuit at one side of the heat exchanger (100) and is discharged to outdoors via the fluid port (b) as well as the fluid is pumped into the heat exchanger (100) of the heat exchange device (1000) through the fluid port (c), passes through the fluid circuit at the other side of the heat exchanger (100) and is discharged to outdoors via the fluid port (d), and that the fluid port (a) and the fluid port (b) are disposed for connecting to the same space or object while the fluid port (c) and the fluid port (b) are disposed for connecting to the other space or objects with temperature difference, thereby to periodically change the flowing directions of the two fluid circuits;

-- The heat exchanger (100): It is the heat exchanger having two internal flow

channels with heat absorbing/releasing capability, wherein the two flow channels are individually set with two fluid ports for separately pumping the fluid and is constituted by conventional heat exchange structure for the function of heat exchanging between two fluids;

-- The at least one temperature detecting device (11) is installed at position capable of directly or indirectly detecting the temperature variation of pumping fluid, wherein the detected signal is used as the reference to determine the periodic switching timing of fluid flowing direction change operation;

-- The bi-directional fluid pumping device (123): It is constituted by:

1) Two bi-directional pumps (140) capable of producing positive pressure to push fluid or negative pressure to attract fluid are pumped in opposite directions to constitute the bi-directional fluid pumping device (123) for pumping gaseous or liquid state fluids, wherein the two fluid pumps in opposite directions can be respectively equipped with an electric motor or share a common electric motor, thereby being subject to the operative control of the periodic fluid direction-change operative control device (250) to rotate positively or reversely to change the flowing direction of the pumping fluid;

2) It is constituted by fluid pumps capable of simultaneously pumping in opposite directions individually as well as periodically changing the pumping directions;

The above pumping methods include **1)** producing negative pressure to push the fluid; or **2)** producing positive pressure to attract the fluid;

Said bi-directional fluid pumping device (123) and said heat exchange device (1000) are in an integral structure or are in separated structures;

-- Power source (300): The device which provides the operating power source, including AC or DC city power system or standalone electric power supplying devices;

-- The periodic fluid direction-change operative control device (250): It is constituted by electromechanical components, solid state electronic components, or microprocessors with related software and control interfaces to operatively control the two bi-directional fluid pumps (140) inside the bi-directional fluid pumping device (123) for periodically changing the flowing direction of the two fluids in different flowing directions passing through the heat exchange device (1000), thereby operatively controlling the temperature distribution status between the fluids and the heat exchanger (100) of the heat exchange device (1000);

The timing of periodic fluid direction-change could be **1)** open-loop operation with pre-set periodic fluid direction changing timing; or **2)** randomly manual switching; or **3)** installing at least one temperature detecting device (11) at position capable of directly or indirectly detecting the temperature variation of pumping fluid, wherein the detected signal is used as the reference to determine the periodic switching timing of fluid flowing direction change operation.

3. A double flow-circuit heat exchange device for periodic positive and reverse directional pumping according to claim 1, wherein the fluid port (a), fluid port (b), fluid port (c), and fluid port (d) of bi-directional fluid in the heat exchange device (1000) are respectively installed with bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure to constitute the bi-directional fluid pumping device (123), wherein the bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure in the bi-directional fluid pumping device (123) driven by electric power source (300) to periodically change the flowing direction of the pumping fluid and constantly maintain the two fluid circuits which through the heat exchanger (100) flowing in different directions; wherein:

The heat exchange device (1000) and the bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure could be integrated in one or separately installed to constitute the function of bi-directional fluid pumping device (123), wherein the four bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure are separately installed at fluid port (a), fluid port (b), fluid port (c) and fluid port (d) for generating the pumping to change fluids in different flowing directions, and wherein the aforementioned bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure are controlled by the periodic fluid direction-change operative control device (250); the fluid pumps (111) and (113) installed at fluid port (a) and fluid port (c) form one set, which could be driven by individually installed electric motors, or jointly driven by single electric motor, while the fluid pumps (112) and (114) form another set, which could be driven by individually installed electric motors, or jointly driven by single electric motor; under the control of periodic fluid direction-change operative control device (250) to provide one or multiple following operating functions, including: **1)**

partial of the bi-directional fluid pumps alternately pump in negative pressure periodically to allow the two fluid circuits in different flowing directions periodically changing flowing directions; or **2)** partial of the bi-directional fluid pumps alternately pump in positive pressure periodically to allow the two fluid circuits in different flowing directions periodically changing flowing directions; **3)** partial or all of the bi-directional fluid pumps being formed auxiliary pumping by the positive pressure pumping and negative pressure pumping generated by different fluid pumps in the same fluid circuits, thereby allowing two fluid circuits in different flowing directions periodically changing flowing direction; in aforementioned two functions **1)**, **2)**, **3)**, the flowing direction of the fluid inside the two channels at both sides of the heat exchanger (100) in the heat exchange device (1000) maintains opposite flowing directions;

-- The at least one temperature detecting device (11) is installed at position capable of directly or indirectly detecting the temperature variation of pumping fluid, wherein the detected signal is used as the reference to determine the periodic switch timing of fluid flowing direction change operation;

-- Bi-directional fluid pumping device (123): Bi-directional fluid port (a), fluid port (b), fluid port (c), fluid port (d) are individually installed with bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure to constitute the bi-directional fluid pumping device (123), wherein with the periodic fluid direction-change operative control device (250) to operatively control the bi-directional fluid pumping device (123) driven by electric power source (300) for periodic fluid direction changing operation, and constantly maintain the two fluid circuits which through the heat exchanger (100) flowing in different directions;

-- The power source (300): The device which provides the operating power source, including AC or DC city power system or standalone electric power supplying devices;

-- The periodic fluid direction-change operative control device (250): It is constituted by electromechanical components, solid state electronic components, or microprocessors with related software and control interfaces to operatively control individual bi-directional fluid pumps (111), (112), (113), (114) that constitute the bi-directional fluid pumping device (123), for the periodic fluid direction changing operation of the two different direction fluid through the heat exchange device to

control the temperature distribution status between the fluid and the heat exchanger (100) of the heat exchange device;

-- The heat exchanger (100): It is the heat exchanger having two internal flow channels with heat absorbing/releasing capability, wherein the two flow channels are individually set with two fluid ports at both sides for separately fluid pumping and is constituted by conventional heat exchange structure for the function of heat exchanging between two fluids;

The timing of periodic fluid direction-change could be **1)** open-loop operation with pre-set periodic fluid direction changing timing; or **2)** randomly manual switching; or **3)** installing at least one temperature detecting device (11) at position capable of directly or indirectly detecting the temperature variation of pumping fluid, wherein the detected signal is used as the reference to determine the periodic switching timing of fluid flowing direction change operation.

4. A double flow-circuit heat exchange device for periodic positive and reverse directional pumping according to claim 1, wherein the fluid port (a), fluid port (b), fluid port (c), fluid port (d) of the two flow channels of the two bi-directional fluid of heat exchanging device (1000) of the present invention to separately install the unidirectional fluid pump (120a), (120b), (120c), (120d) for unidirectional pumping to constitute the bi-directional fluid pumping device (123), wherein the electrical power from the electrical power source (300) through the periodic fluid direction-change operative control device (250) to control the unidirectional pumps (120a), (120b), (120c), (120d) of the bi-directional fluid pumping device (123) to periodical change the flowing direction of pumping fluid, and to constantly maintain the fluid flowing directions of both circuits passing through the heat exchanger (100) in different direction, wherein:

The heat exchanging device (1000) and unidirectional fluid pumps (120a), (120b), (120c), (120d) could be integrated in one or separately installed to constitute the function of bi-directional fluid pumping device (123), wherein the four unidirectional fluid pumps (120a), (120b), (120c), (120d) are separately installed at fluid port (a), fluid port (b), fluid port (c) and fluid port (d) for fluid pumping, and wherein the aforementioned unidirectional fluid pumps (120a), (120b), (120c), (120d) are controlled by the periodic fluid direction-change operative control device (250); the unidirectional fluid pumps (120a) and (120c) installed at fluid port (a)

and fluid port (c) form one set, which could be driven by individually installed electric motors, or jointly driven by single electric motor, while the unidirectional fluid pumps (120b) and (120c) form another set, which could be driven by individually installed electric motors, or jointly driven by single electric motor; under the control of periodic fluid direction-change operative control device (250) to compose the structure and operating methods for providing one or multiple following functions, including: **1)** The arrangement of unidirectional pumps for negative pressure pumping on fluids, wherein the unidirectional fluid pump (120a) and unidirectional fluid pump (120c) form one set, and the unidirectional fluid pump (120b) and unidirectional fluid pump (120d) form the other set, and that the two sets provide periodic negative pressure pumping alternatively to make the fluids with different flowing direction in two channels changing their flowing direction periodically; or **2)** The arrangement of unidirectional pumps for positive pressure pumping on fluids, wherein the unidirectional fluid pump (120a) and unidirectional fluid pump (120c) form one set, and the unidirectional fluid pump (120b) and unidirectional fluid pump (120d) form the other set, and that the two sets provide periodic positive pressure pumping alternatively to make the fluids with different flowing direction in two channels changing their flowing direction periodically;

In aforementioned two functions **1)** and **2)**, the flowing direction of the fluid inside the two channels at both sides of the heat exchanger (100) in the heat exchange device (1000) maintains opposite flowing directions;

-- The at least one temperature detecting device (11) is installed at position capable of directly or indirectly detecting the temperature variation of pumping fluid, wherein the detected signal is used as the reference to determine the periodic switch timing of fluid flowing direction change operation;

-- Bi-directional fluid pumping device (123): Bi-directional fluid port (a), fluid port (b), fluid port (c), fluid port (d) are individually installed with unidirectional fluid pumps (120a), (120b), (120c), (120d) capable of unidirectional pumping to constitute the bi-directional fluid pumping device (123), wherein with the periodic fluid direction-change operative control device (250) to operatively control the bi-directional fluid pumping device (123) driven by electric power source (300) for periodic fluid direction changing operation, and constantly maintain the two fluid circuits which through the heat exchanger (100) flowing in different directions;

-- The power source (300): The device which provides the operating power source,

including AC or DC city power system or standalone electric power supplying devices;

-- The periodic fluid direction-change operative control device (250): It is constituted by electromechanical components, solid state electronic components, or microprocessors with related software and control interfaces to operatively control individual unidirectional fluid pumps (120a), (120b), (120c), (120d) that constitute the bi-directional fluid pumping device (123), for the periodic fluid direction changing operation of the two different direction fluid through the two channels of the heat exchanger (100), thereby operatively controlling the temperature distribution status between the fluid and the heat exchanger (100) of the heat exchange device (1000);

-- The heat exchanger (100): It is the heat exchanger having two internal flow channels with heat absorbing/releasing capability, wherein the two flow channels are individually set with two fluid ports at both sides for separately fluid pumping and is constituted by conventional heat exchange structure for the function of heat exchanging between two fluids;

The timing of periodic fluid direction-change could be **1)** open-loop operation with pre-set periodic fluid direction changing timing; or **2)** randomly manual switching; or **3)** installing at least one temperature detecting device (11) at position capable of directly or indirectly detecting the temperature variation of pumping fluid, wherein the detected signal is used as the reference to determine the periodic switching timing of fluid flowing direction change operation.

5. A double flow-circuit heat exchange device for periodic positive and reverse directional pumping according to claim 1, wherein the bi-directional heat exchange device (1000) is further installed with the bi-directional fluid pumping device (123) capable of positive and reverse directional pumping constituted by two bi-directional fluid pumps (140), and installed with the periodic fluid direction-change operative control device (250) for operatively controlling the bi-directional fluid pumping device (123) so as to allow the two different direction fluids periodically changing the flowing directions that is operated with the two bi-directional fluid pumps (140) of the bi-directional fluid pumping device (123) driven by power source (300), and constantly maintain the tow fluid circuits in two different flowing directions to pass through the total heat exchanger (200) inside the

heat exchange device (1000), wherein:

-- Both or either one of the at least one temperature detecting device (11) and the at least one humidity detecting device (21) are installed at positions capable of directly or indirectly detecting the temperature variation and humidity variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation;

Aforementioned temperature detecting device (11) and humidity detecting device (21) can be in an integral structure or in separated structures;

-- The bi-directional fluid pumping device (123): It is constituted by:

1) Two bi-directional pumps (140) capable of producing positive pressure to push fluid or negative pressure to attract fluid are pumped in opposite directions to constitute the bi-directional fluid pumping device (123) for pumping gaseous or liquid state fluids, wherein the two fluid pumps in opposite directions can be separately equipped with an electric motor or share a common electric motor, thereby being subject to the operative control of the periodic fluid direction-change operative control device (250) to rotate positively or reversely to change the flowing direction of the pumping fluid;

2) It is constituted by fluid pumps capable of simultaneously pumping in opposite directions individually as well as periodically changing the pumping directions;

The above pumping methods include **1)** producing negative pressure to push the fluid; or **2)** producing positive pressure to attract the fluid;

Said bi-directional fluid pumping device (123) and said heat exchange device (1000) are in an integral structure or are in separated structures;

-- Power source (300): The device which provides the operating power source, including AC or DC city power system or standalone electric power supplying devices;

-- The periodic fluid direction-change operative control device (250): It is constituted by electromechanical components, solid state electronic components, or microprocessors with related software and control interfaces to operatively control the two bi-directional fluid pumps (140) inside the bi-directional fluid pumping device (123) for periodically changing the flowing direction of the two fluids in different flowing directions passing through the heat exchange device (1000), thereby operatively controlling **1)** the temperature distribution status; or **2)** the

humidity distribution status; or **3)** both of the temperature and humidity distribution between the fluid and the total heat exchanger (200) of the heat exchange device (1000);

-- Total heat exchanger (200): It is the total heat exchanger having two internal flow channels with heat absorbing/releasing and humidity absorbing/releasing capability, wherein the two flow channels are individually set with two fluid ports at both sides for separately fluid pumping and is constituted by conventional total heat exchange structure for the function of heat exchanging between two fluids and function of de-humid capability;

The timing of periodic direction change of flowing fluid could be: **1)** open-loop operation with pre-set periodic fluid direction changing timing; or **2)** randomly manual switching; or **3)** installing both or either one of the at least one temperature detecting device (11) and the at least one humidity detecting device (21) at positions capable of directly or indirectly detecting the temperature variation and humidity variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation.

6. A double flow-circuit heat exchange device for periodic positive and reverse directional pumping according to claim 1, wherein the fluid port (a), fluid port (b), fluid port (c), and fluid port (d) of bi-directional fluid in the heat exchange device (1000) are respectively installed with bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure to constitute the bi-directional fluid pumping device (123), wherein the bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure in the bi-directional fluid pumping device (123) driven by electric power source (300) is through the periodic fluid direction-change operative control device (250) to periodically change the flowing direction of the pumping fluid and constantly maintain the two fluid circuits flowing in different directions; wherein:

The heat exchange device (1000) and the bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure could be integrated in one or separately installed to constitute the function of bi-directional fluid pumping device (123), wherein the four bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive

pressure are separately installed at fluid port (a), fluid port (b), fluid port (c) and fluid port (d) for generating the pumping to change fluids in different flowing directions, and wherein the aforementioned bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure are controlled by the periodic fluid direction-change operative control device (250), and the fluid pumps (111) and (113) installed at fluid port (a) and fluid port (c) form one set, which could be driven by individually installed electric motors, or jointly driven by single electric motor, while the fluid pumps (112) and (114) form another set, which could be driven by individually installed electric motors, or jointly driven by single electric motor, thereby under the control of periodic fluid direction-change operative control device (250) to provide one or multiple following operating functions, including: **1)** partial of the bi-directional fluid pumps alternately pump in negative pressure periodically to allow the two fluid circuits in different flowing directions periodically changing flowing directions; or **2)** partial of the bi-directional fluid pumps alternately pump in positive pressure periodically to allow the two fluid circuits in different flowing directions periodically changing flowing directions; **3)** partial or all of the bi-directional fluid pumps being formed auxiliary pumping by the positive pressure pumping and negative pressure pumping generated by different fluid pumps in the same fluid circuits, thereby allowing two fluid circuits in different flowing directions periodically changing flowing direction; in aforementioned two functions **1)**, **2)**, **3)**, the flowing direction of the fluid inside the two channels at both sides of the total heat exchanger (200) in the heat exchange device (1000) maintains opposite flowing directions;

-- Both or either one of the at least one temperature detecting device (11) and the at least one humidity detecting device (21) are installed at positions capable of directly or indirectly detecting the temperature variation and humidity variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation;

Aforementioned temperature detecting device (11) and humidity detecting device (21) can be in an integral structure or in separated structures;

-- Bi-directional fluid pumping device (123): Bi-directional fluid port (a), fluid port (b), fluid port (c), fluid port (d) are individually installed with bi-directional fluid pumps (111), (112), (113), (114) capable of producing positive pressures or negative pressure, thereby to constitute the bi-directional fluid pumping device

(123), wherein with the periodic fluid direction-change operative control device (250) to operatively control the bi-directional fluid pumping device (123) driven by electric power source (300) for periodic fluid direction changing operation, and constantly maintain the two fluid circuits which through the total heat exchanger (200) flowing in different direction;

-- The power source (300): The device which provides the operating power source, including AC or DC city power system or standalone electric power supplying devices;

-- The periodic fluid direction-change operative control device (250): It is constituted by electromechanical components, solid state electronic components, or microprocessors with related software and control interfaces to operatively control the bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure to constitute the bi-directional fluid pumping device (123), for the periodic fluid direction changing operation of the two different direction fluid through the two channels of the heat exchanging device to control **1)** the temperature distribution status; or **2)** the humidity distribution status; or **3)** both of the temperature and humidity distribution between the fluid and the total heat exchanger (200) of the heat exchange device;

-- Total heat exchanger (200): It is the total heat exchanger having two internal flow channels with heat absorbing/releasing and humidity absorbing/releasing capability, wherein the two flow channels are individually set with two fluid ports at both sides for separately fluid pumping and is constituted by conventional total heat exchange structure for the function of heat exchanging between two fluids and function of de-humid capability;

The timing of periodic direction change of flowing fluid could be: **1)** open-loop operation with pre-set periodic fluid direction changing timing; or **2)** randomly manual switching; or **3)** installing both or either one of the at least one temperature detecting device (11) and the at least one humidity detecting device (21) at positions capable of directly or indirectly detecting the temperature variation and humidity variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation.

7. A double flow-circuit heat exchange device for periodic positive and reverse

directional pumping according to claim 1, wherein the fluid port (a), fluid port (b), fluid port (c), fluid port (d) of the two flow channels of the two bi-directional fluid of heat exchanging device (1000) of the present invention to separately install the unidirectional fluid pump (120a), (120b), (120c), (120d) for unidirectional pumping to constitute the bi-directional fluid pumping device (123), wherein the electrical power from the electrical power source (300) through the periodic fluid direction-change operative control device (250) to control the unidirectional pumps (120a), (120b), (120c), (120d) of the bi-directional fluid pumping device (123) to periodical change the flowing direction of pumping fluid, and to constantly maintain the fluid flowing directions of both circuits in different direction; wherein:

The heat exchanging device (1000) and unidirectional fluid pumps (120a), (120b), (120c), (120d) could be integrated in one or separately installed to constitute the function of bi-directional fluid pumping device (123), wherein the four unidirectional fluid pumps (120a), (120b), (120c), (120d) are separately installed at fluid port (a), fluid port (b), fluid port (c) and fluid port (d) for fluid pumping, and wherein the aforementioned unidirectional fluid pumps (120a), (120b), (120c), (120d) are controlled by the periodic fluid direction-change operative control device (250); the unidirectional fluid pumps (120a) and (120c) installed at fluid port (a) and fluid port (c) form one set, which could be driven by individually installed electric motors, or jointly driven by single electric motor, while the unidirectional fluid pumps (120b) and (120c) form another set, which could be driven by individually installed electric motors, or jointly driven by single electric motor; under the control of periodic fluid direction-change operative control device (250) to compose the structure and operating methods for providing one or multiple following functions, including: **1)** The arrangement of unidirectional pumps for negative pressure pumping on fluids, wherein the unidirectional fluid pump (120a) and unidirectional fluid pump (120c) form one set, and the unidirectional fluid pump (120b) and unidirectional fluid pump (120d) form the other set, and that the two sets provide periodic negative pressure pumping alternatively to make the fluids with different flowing direction in two channels changing their flowing direction periodically; or **2)** The arrangement of unidirectional pumps for positive pressure pumping on fluids, wherein the unidirectional fluid pump (120a) and unidirectional fluid pump (120c) form one set, and the unidirectional fluid pump (120b) and unidirectional fluid pump (120d) form the other set, and that the two sets provide

periodic positive pressure pumping alternatively to make the fluids with different flowing direction in two channels changing their flowing direction periodically; in aforementioned two functions **1)** and **2)**, the flowing direction of the fluid inside the two channels at both sides of total heat exchanger (200) in the heat exchange device (1000) maintains opposite flowing directions;

-- Both or either one of the at least one temperature detecting device (11) and the at least one humidity detecting device (21) are installed at positions capable of directly or indirectly detecting the temperature variation and humidity variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation;

Aforementioned temperature detecting device (11) and humidity detecting device (21) can be in an integral structure or in separated structures;

-- Bi-directional fluid pumping device (123): Bi-directional fluid port (a), fluid port (b), fluid port (c), fluid port (d) are individually installed with unidirectional fluid pumps (120a), (120b), (120c), (120d) capable of unidirectional pumping to constitute the bi-directional fluid pumping device (123), wherein with the periodic fluid direction-change operative control device (250) to operatively control the bi-directional fluid pumping device (123) driven by electric power source (300) for periodic fluid direction changing operation, and constantly maintain the two fluid circuits which through the total heat exchanger (200) flowing in different directions;

-- The power source (300): The device which provides the operating power source, including AC or DC city power system or standalone electric power supplying devices;

-- The periodic fluid direction-change operative control device (250): It is constituted by electromechanical components, solid state electronic components, or microprocessors with related software and control interfaces to operatively control individual unidirectional fluid pumps (120a), (120b), (120c), (120d) that constitute the bi-directional fluid pumping device (123), for the periodic fluid direction changing operation of the two different direction fluid through the two channels of the heat exchange device to control **1)** the temperature distribution status; or **2)** the humidity distribution status; or **3)** both of the temperature and humidity distribution between the fluid and the total heat exchanger (200) of the heat exchange device;

-- Total heat exchanger (200): It is the total heat exchanger having two internal flow channels with heat absorbing/releasing and humidity absorbing/releasing capability,

wherein the two flow channels are individually set with two fluid ports at both sides for separately fluid pumping and is constituted by conventional total heat exchange structure for the function of heat exchanging between two fluids and function of de-humid capability;

The timing of periodic direction change of flowing fluid could be: **1)** open-loop operation with pre-set periodic fluid direction changing timing; or **2)** randomly manual switching; or **3)** installing both or either one of the at least one temperature detecting device (11) and the at least one humidity detecting device (21) at positions capable of directly or indirectly detecting the temperature variation and humidity variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation.

8. A double flow-circuit heat exchange device for periodic positive and reverse directional pumping according to claim 1, wherein it is embodied to have the following structural configurations: **1)** it is of the tubular structure in linear or other geometric shapes; or **2)** it is constituted by the multi-layer structure having fluid path for passing gaseous or liquid state fluids; or **3)** it is constituted by one ore more than one flow circuit in series connection, parallel connection or series and parallel connection.

9. A double flow-circuit heat exchange device for periodic positive and reverse directional pumping according to claim 1, wherein it further can be installed with all or at least one or more than one detecting device of temperature detecting device (11), humidity detecting device (21), and gaseous or liquid fluid composition detecting device (31) on the heat exchange device (1000), heat exchanger (100) or total heat exchanger (200) at positions near both or one of the fluid port (a) and fluid port (b), or at positions near both or one of the fluid port (c) and fluid port (d), or at other positions capable of detecting exchanging fluids, wherein the number of aforementioned detecting devices can be one or more than one to provide the detected signal as the reference for the operation of one or more than one functions as follows, including: **1)** as the reference for operatively controlling the periodic switch timing of fluid flowing direction pumped by the bi-directional fluid pumping devices (123); or **2)** as the reference for operatively controlling the bi-directional

fluid pumping devices (123) to control the speed or the flow rate of the pumping fluid; or **3)** as the reference for operatively controlling the open volume of the fluid valve to control the speed or the flow rate of the pumping fluid;

For the aforementioned temperature detecting device (11), humidity detecting device (21), and the gaseous or liquid fluid composition detecting device (31), all detecting devices can be in an integral structure, or some detecting devices are in an integral structure, or each detecting device is in separated structure.

10. A double flow-circuit heat exchange device for periodic positive and reverse directional pumping according to claim 1, wherein the heat exchange device (1000) is further installed with the bi-directional fluid pumping device (123) capable of positive and reverse directional pumping constituted by two bi-directional fluid pumps (140), and installed with the periodic fluid direction-change operative control device (250) for operatively controlling the bi-directional fluid pumping device (123) so as to change the flowing directions of pumping fluid by periodic change that is operated with the two bi-directional fluid pumps of the bi-directional fluid pumping device (123) driven by power source (300), and constantly maintain the fluids in two different flowing directions to pass through the heat exchanger (100) inside the heat exchange device (1000), wherein:

-- The two bi-directional fluid pumps capable of producing positive pressure to push fluids or negative pressure to attract fluids are installed, thereby to constitute bi-directional fluid pumping device (123) for the application of pumping gaseous or liquid state fluids, and four fluid ports are installed at the heat exchange device (1000) to drive the bi-directional fluid pump (140) at the two sides of the heat exchanger (100) inside the heat exchange device (1000) by the electric power from power source (300) through the control of the periodic fluid directional-change operative control device (250); furthermore, flowing direction said two fluid circuits are respectively fed or discharged from the fluid ports at different sides, and discharged or fed via the fluid port at the other side, including the fluid is pumped into the heat exchanger (100) of the heat exchange device (1000) through the fluid port (a), passes through the fluid circuit at one side of the heat exchanger (100) and is discharged to outdoors via the fluid port (b) as well as the fluid is pumped into the heat exchanger (100) of the heat exchange device (1000) through the fluid port (c), passes through the fluid circuit at the other side of the heat exchanger (100) and is

discharged to outdoors via the fluid port (d), and that the fluid port (a) and the fluid port (b) are disposed for connecting to the same space or object while the fluid port (c) and the fluid port (b) are disposed for connecting to the other space or objects with temperature difference, thereby to periodically change the flowing directions of the two fluid circuits;

-- The heat exchanger (100): It is the heat exchanger having two internal flow channels with heat absorbing/releasing capability, wherein the two flow channels are individually set with two fluid ports for separately pumping the fluid and is constituted by conventional heat exchange structure for the function of heat exchanging between two fluids;

-- Both or either one of the at least one temperature detecting device (11) and the at least one gaseous or liquid fluid composition detecting device (31) are installed at positions capable of directly or indirectly detecting the temperature variation, or gaseous and liquid fluid composition variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switching timing of fluid flowing direction change operation;

Aforementioned temperature detecting device (11) and the gaseous or liquid fluid composition detecting device (31) can be in an integral structure or in separated structures;

-- The bi-directional fluid pumping device (123): It is constituted by:

1) Two bi-directional pumps (140) capable of producing positive pressure to push fluid or negative pressure to attract fluid are pumped in opposite directions to constitute the bi-directional fluid pumping device (123) for pumping gaseous or liquid state fluids, wherein the two fluid pumps in opposite directions can be respectively equipped with an electric motor or share a common electric motor, thereby being subject to the operative control of the periodic fluid direction-change operative control device (250) to rotate positively or reversely to change the flowing direction of the pumping fluid;

2) It is constituted by fluid pumps capable of simultaneously pumping in opposite directions individually as well as periodically changing the pumping directions;

The above pumping methods include **1)** producing negative pressure to push the fluid; or **2)** producing positive pressure to attract the fluid;

Said bi-directional fluid pumping device (123) and said heat exchange device (1000) are in an integral structure or are in separated structures;

-- Power source (300): The device which provides the operating power source, including AC or DC city power system or standalone electric power supplying devices;

-- The periodic fluid direction-change operative control device (250): It is constituted by electromechanical components, solid state electronic components, or microprocessors with related software and control interfaces to operatively control the two bi-directional fluid pumps (140) inside the bi-directional fluid pumping device (123) for periodically changing the flowing direction of the two fluids in different flowing directions passing through the heat exchange device (1000), thereby operatively controlling the temperature distribution status between the fluids and the heat exchanger (100) of the heat exchange device (1000);

The timing of periodic fluid direction-change could be **1)** open-loop operation with pre-set periodic fluid direction changing timing; or **2)** randomly manual switching; or **3)** installing both or either one of the at least one temperature detecting device (11) and the at least one gaseous or liquid fluid composition detecting device (31) at positions capable of directly or indirectly detecting the temperature variation, or gaseous and liquid fluid composition variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switching timing of fluid flowing direction change operation.

11. A double flow-circuit heat exchange device for periodic positive and reverse directional pumping according to claim 1, wherein the fluid port (a), fluid port (b), fluid port (c), and fluid port (d) of bi-directional fluid in the heat exchange device (1000) are respectively installed with bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure to constitute the bi-directional fluid pumping device (123), wherein the bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure in the bi-directional fluid pumping device (123) driven by electric power source (300) to periodically change the flowing direction of the pumping fluid and constantly maintain the two fluid circuits which through the heat exchanger (100) flowing in different directions; wherein:

The heat exchange device (1000) and the bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure could be integrated in one or separately installed to constitute the function of

bi-directional fluid pumping device (123), wherein the four bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure are separately installed at fluid port (a), fluid port (b), fluid port (c) and fluid port (d) for generating the pumping to change fluids in different flowing directions, and wherein the aforementioned bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure are controlled by the periodic fluid direction-change operative control device (250). The fluid pumps (111) and (113) installed at fluid port (a) and fluid port (c) form one set, which could be driven by individually installed electric motors, or jointly driven by single electric motor, while the fluid pumps (112) and (114) form another set, which could be driven by individually installed electric motors, or jointly driven by single electric motor. Under the control of periodic fluid direction-change operative control device (250) to provide one or multiple following operating functions, including: **1)** partial of the bi-directional fluid pumps alternately pump in negative pressure periodically to allow the two fluid circuits in different flowing directions periodically changing flowing directions; or **2)** partial of the bi-directional fluid pumps alternately pump in positive pressure periodically to allow the two fluid circuits in different flowing directions periodically changing flowing directions; **3)** partial or all of the bi-directional fluid pumps being formed auxiliary pumping by the positive pressure pumping and negative pressure pumping generated by different fluid pumps in the same fluid circuits, thereby allowing two fluid circuits in different flowing directions periodically changing flowing direction; in aforementioned two functions **1), 2), 3)**, the flowing direction of the fluid inside the two channels at both sides of the heat exchanger (100) in the heat exchange device (1000) maintains opposite flowing directions;

-- Both or either one of the at least one temperature detecting device (11) and the at least one gaseous or liquid fluid composition detecting device (31) are installed at positions capable of directly or indirectly detecting the temperature variation, or gaseous or liquid fluid composition variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation;

Aforementioned temperature detecting device (11) and gaseous or liquid fluid composition detecting device (31) can be in an integral structure or in separated structures;

-- Bi-directional fluid pumping device (123): Bi-directional fluid port (a), fluid port (b), fluid port (c), fluid port (d) are individually installed with bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure to constitute the bi-directional fluid pumping device (123), wherein with the periodic fluid direction-change operative control device (250) to operatively control the bi-directional fluid pumping device (123) driven by electric power source (300) for periodic fluid direction changing operation, and constantly maintain the two fluid circuits which through the heat exchanger (100) flowing in different directions;

-- The power source (300): The device which provides the operating power source, including AC or DC city power system or standalone electric power supplying devices;

-- The periodic fluid direction-change operative control device (250): It is constituted by electromechanical components, solid state electronic components, or microprocessors with related software and control interfaces to operatively control individual bi-directional fluid pumps (111), (112), (113), (114) that constitute the bi-directional fluid pumping device (123), for the periodic fluid direction changing operation of the two different direction fluid through the heat exchange device to control the temperature distribution status between the fluid and the heat exchanger (100) of the heat exchange device;

-- The heat exchanger (100): It is the heat exchanger having two internal flow channels with heat absorbing/releasing capability, wherein the two flow channels are individually set with two fluid ports at both sides for separately fluid pumping and is constituted by conventional heat exchange structure for the function of heat exchanging between two fluids;

The timing of periodic fluid direction-change could be **1)** open-loop operation with pre-set periodic fluid direction changing timing; or **2)** randomly manual switching; or **3)** installing both or either one of the at least one temperature detecting device (11) and the at least one gaseous or liquid fluid composition detecting device (31) at positions capable of directly or indirectly detecting the temperature variation, or gaseous or liquid fluid composition variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation.

12. A double flow-circuit heat exchange device for periodic positive and reverse directional pumping according to claim 1, wherein the fluid port (a), fluid port (b), fluid port (c), fluid port (d) of the two flow channels of the two bi-directional fluid of heat exchanging device (1000) to separately install the unidirectional fluid pump (120a), (120b), (120c), (120d) for unidirectional pumping to constitute the bi-directional fluid pumping device (123), wherein the electrical power from the electrical power source (300) through the periodic fluid direction-change operative control device (250) to control the unidirectional pumps (120a), (120b), (120c), (120d) of the bi-directional fluid pumping device (123) to periodical change the flowing direction of pumping fluid, and to constantly maintain the fluid flowing directions of both circuits passing through the heat exchanger (100) in different direction, wherein:

The heat exchanging device (1000) and unidirectional fluid pumps (120a), (120b), (120c), (120d) could be integrated in one or separately installed to constitute the function of bi-directional fluid pumping device (123), wherein the four unidirectional fluid pumps (120a), (120b), (120c), (120d) are separately installed at fluid port (a), fluid port (b), fluid port (c) and fluid port (d) for fluid pumping, and wherein the aforementioned unidirectional fluid pumps (120a), (120b), (120c), (120d) are controlled by the periodic fluid direction-change operative control device (250). The unidirectional fluid pumps (120a) and (120c) installed at fluid port (a) and fluid port (c) form one set, which could be driven by individually installed electric motors, or jointly driven by single electric motor, while the unidirectional fluid pumps (120b) and (120c) form another set, which could be driven by individually installed electric motors, or jointly driven by single electric motor. Under the control of periodic fluid direction-change operative control device (250) to compose the structure and operating methods for providing one or multiple following functions, including: **1)** The arrangement of unidirectional pumps for negative pressure pumping on fluids, wherein the unidirectional fluid pump (120a) and unidirectional fluid pump (120c) form one set, and the unidirectional fluid pump (120b) and unidirectional fluid pump (120d) form the other set, and that the two sets provide periodic negative pressure pumping alternatively to make the fluids with different flowing direction in two channels changing their flowing direction periodically; or **2)** The arrangement of unidirectional pumps for positive pressure pumping on fluids, wherein the unidirectional fluid pump (120a) and unidirectional

fluid pump (120c) form one set, and the unidirectional fluid pump (120b) and unidirectional fluid pump (120d) form the other set, and that the two sets provide periodic positive pressure pumping alternatively to make the fluids with different flowing direction in two channels changing their flowing direction periodically;

In aforementioned two functions **1)** and **2)**, the flowing direction of the fluid inside the two channels at both sides of the heat exchanger (100) in the heat exchange device (1000) maintains opposite flowing directions;

-- Both or either one of the at least one temperature detecting device (11) and the at least one gaseous or liquid fluid composition detecting device (31) are installed at positions capable of directly or indirectly detecting the temperature variation, or gaseous or liquid fluid composition variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation;

Aforementioned temperature detecting device (11) and gaseous or liquid fluid composition detecting device (31) can be in an integral structure or in separated structures;

-- Bi-directional fluid pumping device (123): Bi-directional fluid port (a), fluid port (b), fluid port (c), fluid port (d) are individually installed with unidirectional fluid pumps (120a), (120b), (120c), (120d) capable of unidirectional pumping to constitute the bi-directional fluid pumping device (123), wherein with the periodic fluid direction-change operative control device (250) to operatively control the bi-directional fluid pumping device (123) driven by electric power source (300) for periodic fluid direction changing operation, and constantly maintain the two fluid circuits which through the heat exchanger (100) flowing in different directions;

-- The power source (300): The device which provides the operating power source, including AC or DC city power system or standalone electric power supplying devices;

-- The periodic fluid direction-change operative control device (250): It is constituted by electromechanical components, solid state electronic components, or microprocessors with related software and control interfaces to operatively control individual unidirectional fluid pumps (120a), (120b), (120c), (120d) that constitute the bi-directional fluid pumping device (123), for the periodic fluid direction changing operation of the two different direction fluid through the two channels of the heat exchanger (100), thereby operatively controlling the temperature

distribution status between the fluid and the heat exchanger (100) of the heat exchange device (1000);

-- The heat exchanger (100): It is the heat exchanger having two internal flow channels with heat absorbing/releasing capability, wherein the two flow channels are individually set with two fluid ports at both sides for separately fluid pumping and is constituted by conventional heat exchange structure for the function of heat exchanging between two fluids;

The timing of periodic fluid direction-change could be **1)** open-loop operation with pre-set periodic fluid direction changing timing; or **2)** randomly manual switching; or **3)** installing both or either one of the at least one temperature detecting device (11) and the at least one gaseous or liquid fluid composition detecting device (31) at positions capable of directly or indirectly detecting the temperature variation, or gaseous or liquid fluid composition variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation.

13. A double flow-circuit heat exchange device for periodic positive and reverse directional pumping according to claim 1, wherein the heat exchange device (1000) is further installed with the bi-directional fluid pumping device (123) capable of positive and reverse directional pumping constituted by two bi-directional fluid pumps (140), and installed with the periodic fluid direction-change operative control device (250) for operatively controlling the bi-directional fluid pumping device (123) so as to allow the two different direction fluids periodically changing the flowing directions that is operated with the two bi-directional fluid pumps (140) of the bi-directional fluid pumping device (123) driven by power source (300), and constantly maintain the tow fluid circuits in two different flowing directions to pass through the total heat exchanger (200) inside the heat exchange device (1000), wherein:

-- All or at least one of the at least one temperature detecting device (11), the at least one humidity detecting device (21) and the at least one gaseous or liquid fluid composition detecting device (31) are installed at positions capable of directly or indirectly detecting the temperature variation, humidity variation, or gaseous or liquid fluid composition variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing

direction change operation;

For the aforementioned temperature detecting device (11), humidity detecting device (21), and the gaseous or liquid fluid composition detecting device (31), all detecting devices can be in an integral structure, or some detecting devices are in an integral structure, or each detecting device is in separated structure;

-- The bi-directional fluid pumping device (123): It is constituted by:

1) Two bi-directional pumps (140) capable of producing positive pressure to push fluid or negative pressure to attract fluid are pumped in opposite directions to constitute the bi-directional fluid pumping device (123) for pumping gaseous or liquid state fluids, wherein the two fluid pumps in opposite directions can be separately equipped with an electric motor or share a common electric motor, thereby being subject to the operative control of the periodic fluid direction-change operative control device (250) to rotate positively or reversely to change the flowing direction of the pumping fluid;

2) It is constituted by fluid pumps capable of simultaneously pumping in opposite directions individually as well as periodically changing the pumping directions;

The above pumping methods include **1)** producing negative pressure to push the fluid; or **2)** producing positive pressure to attract the fluid;

Said bi-directional fluid pumping device (123) and said heat exchange device (1000) are in an integral structure or are in separated structures;

-- Power source (300): The device which provides the operating power source, including AC or DC city power system or standalone electric power supplying devices;

-- The periodic fluid direction-change operative control device (250): It is constituted by electromechanical components, solid state electronic components, or microprocessors with related software and control interfaces to operatively control the two bi-directional fluid pumps (140) inside the bi-directional fluid pumping device (123) for periodically changing the flowing direction of the two fluids in different flowing directions passing through the heat exchange device (1000), thereby operatively controlling **1)** the temperature distribution status; or **2)** the humidity distribution status; or **3)** both of the temperature and humidity distribution between the fluid and the total heat exchanger (200) of the heat exchange device (1000);

-- Total heat exchanger (200): It is the total heat exchanger having two internal flow channels with heat absorbing/releasing and humidity absorbing/releasing capability, wherein the two flow channels are individually set with two fluid ports at both sides for separately fluid pumping and is constituted by conventional total heat exchange structure for the function of heat exchanging between two fluids and function of de-humid capability;

The timing of periodic direction change of flowing fluid could be: **1)** open-loop operation with pre-set periodic fluid direction changing timing; or **2)** randomly manual switching; or **3)** installing all or at least one of the at least one temperature detecting device (11), the at least one humidity detecting device (21) and the at least one gaseous or liquid fluid composition detecting device (31) at positions capable of directly or indirectly detecting the temperature variation, humidity variation, or gaseous or liquid fluid composition variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation.

14. A double flow-circuit heat exchange device for periodic positive and reverse directional pumping according to claim 1, wherein the fluid port (a), fluid port (b), fluid port (c), and fluid port (d) of bi-directional fluid in the heat exchange device (1000) are respectively installed with bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure to constitute the bi-directional fluid pumping device (123), wherein the bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure in the bi-directional fluid pumping device (123) driven by electric power source (300) is through the periodic fluid direction-change operative control device (250) to periodically change the flowing direction of the pumping fluid and constantly maintain the two fluid circuits flowing in different directions; wherein:

The heat exchange device (1000) and the bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure could be integrated in one or separately installed to constitute the function of bi-directional fluid pumping device (123), wherein the four bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure are separately installed at fluid port (a), fluid port (b), fluid port (c) and fluid port (d) for generating the pumping to change fluids in different flowing

directions, and wherein the aforementioned bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure are controlled by the periodic fluid direction-change operative control device (250), and the fluid pumps (111) and (113) installed at fluid port (a) and fluid port (c) form one set, which could be driven by individually installed electric motors, or jointly driven by single electric motor, while the fluid pumps (112) and (114) form another set, which could be driven by individually installed electric motors, or jointly driven by single electric motor, thereby under the control of periodic fluid direction-change operative control device (250) to provide one or multiple following operating functions, including: **1)** partial of the bi-directional fluid pumps alternately pump in negative pressure periodically to allow the two fluid circuits in different flowing directions periodically changing flowing directions; or **2)** partial of the bi-directional fluid pumps alternately pump in positive pressure periodically to allow the two fluid circuits in different flowing directions periodically changing flowing directions; **3)** partial or all of the bi-directional fluid pumps being formed auxiliary pumping by the positive pressure pumping and negative pressure pumping generated by different fluid pumps in the same fluid circuits, thereby allowing two fluid circuits in different flowing directions periodically changing flowing direction; in aforementioned two functions **1)**, **2)**, **3)**, the flowing direction of the fluid inside the two channels at both sides of the total heat exchanger (200) in the heat exchange device (1000) maintains opposite flowing directions;

-- All or at least one of the at least one temperature detecting device (11), the at least one humidity detecting device (21) and the at least one gaseous or liquid fluid composition detecting device (31) are installed at positions capable of directly or indirectly detecting the temperature variation, humidity variation, or gaseous or liquid fluid composition variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation;

For the aforementioned temperature detecting device (11), humidity detecting device (21), and the gaseous or liquid fluid composition detecting device (31), all detecting devices can be in an integral structure, or some detecting devices are in an integral structure, or each detecting device is in separated structure;

-- Bi-directional fluid pumping device (123): Bi-directional fluid port (a), fluid port (b), fluid port (c), fluid port (d) are individually installed with bi-directional fluid

pumps (111), (112), (113), (114) capable of producing positive pressures or negative pressure, thereby to constitute the bi-directional fluid pumping device (123), wherein with the periodic fluid direction-change operative control device (250) to operatively control the bi-directional fluid pumping device (123) driven by electric power source (300) for periodic fluid direction changing operation, and constantly maintain the two fluid circuits which through the total heat exchanger (200) flowing in different direction;

-- The power source (300): The device which provides the operating power source, including AC or DC city power system or standalone electric power supplying devices;

-- The periodic fluid direction-change operative control device (250): It is constituted by electromechanical components, solid state electronic components, or microprocessors with related software and control interfaces to operatively control the bi-directional fluid pumps (111), (112), (113), (114) capable of producing negative pressure or positive pressure to constitute the bi-directional fluid pumping device (123), for the periodic fluid direction changing operation of the two different direction fluid through the two channels of the heat exchanging device to control **1)** the temperature distribution status; or **2)** the humidity distribution status; or **3)** both of the temperature and humidity distribution between the fluid and the total heat exchanger (200) of the heat exchange device;

-- Total heat exchanger (200): It is the total heat exchanger having two internal flow channels with heat absorbing/releasing and humidity absorbing/releasing capability, wherein the two flow channels are individually set with two fluid ports at both sides for separately fluid pumping and is constituted by conventional total heat exchange structure for the function of heat exchanging between two fluids and function of de-humid capability;

-- The timing of periodic direction change of flowing fluid could be: **1)** open-loop operation with pre-set periodic fluid direction changing timing; or **2)** randomly manual switching; or **3)** installing all or at least one of the at least one temperature detecting device (11), the at least one humidity detecting device (21) and the at least one gaseous or liquid fluid composition detecting device (31) at positions capable of directly or indirectly detecting the temperature variation, humidity variation, or gaseous or liquid fluid composition variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid

flowing direction change operation.

15. A double flow-circuit heat exchange device for periodic positive and reverse directional pumping according to claim 1, wherein the fluid port (a), fluid port (b), fluid port (c), fluid port (d) of the two flow channels of the two bi-directional fluid of heat exchanging device (1000) to separately install the unidirectional fluid pump (120a), (120b), (120c), (120d) for unidirectional pumping to constitute the bi-directional fluid pumping device (123), wherein the electrical power from the electrical power source (300) through the periodic fluid direction-change operative control device (250) to control the unidirectional pumps (120a), (120b), (120c), (120d) of the bi-directional fluid pumping device (123) to periodical change the flowing direction of pumping fluid, and to constantly maintain the fluid flowing directions of both circuits in different direction; wherein

The heat exchanging device (1000) and unidirectional fluid pumps (120a), (120b), (120c), (120d) could be integrated in one or separately installed to constitute the function of bi-directional fluid pumping device (123), wherein the four unidirectional fluid pumps (120a), (120b), (120c), (120d) are separately installed at fluid port (a), fluid port (b), fluid port (c) and fluid port (d) for fluid pumping, and wherein the aforementioned unidirectional fluid pumps (120a), (120b), (120c), (120d) are controlled by the periodic fluid direction-change operative control device (250). The unidirectional fluid pumps (120a) and (120c) installed at fluid port (a) and fluid port (c) form one set, which could be driven by individually installed electric motors, or jointly driven by single electric motor, while the unidirectional fluid pumps (120b) and (120c) form another set, which could be driven by individually installed electric motors, or jointly driven by single electric motor. Under the control of periodic fluid direction-change operative control device (250) to compose the structure and operating methods for providing one or multiple following functions, including:

1) The arrangement of unidirectional pumps for negative pressure pumping on fluids, wherein the unidirectional fluid pump (120a) and unidirectional fluid pump (120c) form one set, and the unidirectional fluid pump (120b) and unidirectional fluid pump (120d) form the other set, and that the two sets provide periodic negative pressure pumping alternatively to make the fluids with different flowing direction in two channels changing their flowing

direction periodically; or

2) The arrangement of unidirectional pumps for positive pressure pumping on fluids, wherein the unidirectional fluid pump (120a) and unidirectional fluid pump (120c) form one set, and the unidirectional fluid pump (120b) and unidirectional fluid pump (120d) form the other set, and that the two sets provide periodic positive pressure pumping alternatively to make the fluids with different flowing direction in two channels changing their flowing direction periodically;

In aforementioned two functions **1)** and **2)**, the flowing direction of the fluid inside the two channels at both sides of total heat exchanger (200) in the heat exchange device (1000) maintains opposite flowing directions;

-- All or at least one of the at least one temperature detecting device (11), the at least one humidity detecting device (21) and the at least one gaseous or liquid fluid composition detecting device (31) are installed at positions capable of directly or indirectly detecting the temperature variation, humidity variation, or gaseous or liquid fluid composition variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation;

For the aforementioned temperature detecting device (11), humidity detecting device (21), and the gaseous or liquid fluid composition detecting device (31), all detecting devices can be in an integral structure, or some detecting devices are in an integral structure, or each detecting device is in separated structure;

-- Bi-directional fluid pumping device (123): Bi-directional fluid port (a), fluid port (b), fluid port (c), fluid port (d) are individually installed with unidirectional fluid pumps (120a), (120b), (120c), (120d) capable of unidirectional pumping to constitute the bi-directional fluid pumping device (123), wherein with the periodic fluid direction-change operative control device (250) to operatively control the bi-directional fluid pumping device (123) driven by electric power source (300) for periodic fluid direction changing operation, and constantly maintain the two fluid circuits which through the total heat exchanger (200) flowing in different directions;

-- The power source (300): The device which provides the operating power source, including AC or DC city power system or standalone electric power supplying devices;

-- The periodic fluid direction-change operative control device (250): It is

constituted by electromechanical components, solid state electronic components, or microprocessors with related software and control interfaces to operatively control individual unidirectional fluid pumps (120a), (120b), (120c), (120d) that constitute the bi-directional fluid pumping device (123), for the periodic fluid direction changing operation of the two different direction fluid through the two channels of the heat exchange device to control **1)** the temperature distribution status; or **2)** the humidity distribution status; or **3)** both of the temperature and humidity distribution between the fluid and the total heat exchanger (200) of the heat exchange device;

-- Total heat exchanger (200): It is the total heat exchanger having two internal flow channels with heat absorbing/releasing and humidity absorbing/releasing capability, wherein the two flow channels are individually set with two fluid ports at both sides for separately fluid pumping and is constituted by conventional total heat exchange structure for the function of heat exchanging between two fluids and function of de-humid capability;

The timing of periodic direction change of flowing fluid could be: **1)** open-loop operation with pre-set periodic fluid direction changing timing; or **2)** randomly manual switching; or **3)** installing all or at least one of the at least one temperature detecting device (11), the at least one humidity detecting device (21) and the at least one gaseous or liquid fluid composition detecting device (31) at positions capable of directly or indirectly detecting the temperature variation, humidity variation, or gaseous or liquid fluid composition variation of pumping fluid, wherein the detected signals are used as the reference to determine the periodic switch timing of fluid flowing direction change operation.

16. A double flow-circuit heat exchange device for periodic positive and reverse directional pumping as claimed in claim 1, wherein the bi-directional fluid pumping devices (123) is constituted by following one or more than one structures, including:

1) It is by adopting at least two fluid pumps (140) capable of bi-directionally fluid pumping installed on the common fluid port of two different fluid channels to operatively control the bi-directional fluid pump to periodic pump in positive or reverse directions, thereby periodically changing the fluid direction;

2) It is constituted by at least four bi-directional fluid pumps (111,112,113,114) capable of producing negative pressure or positive pressure, wherein two bi-directional fluid pumps (111,112) are installed at the fluid ports (a), (b) on the two ends of the first fluid circuit of the heat exchange device (1000), while

the other two bi-directional fluid pumps (113,114) are installed at the fluid ports (c), (d) on the two ends of the second fluid circuit, whereby with the control of the periodic fluid direction-change operative control device (250) to form the structural arrangement and to provide one or multiple following functions, including: **(i)** with the bi-directional fluid pumps (111,113) installed at one end of the first fluid circuit and the second fluid circuit to operate in negative pressure pumping, and periodically altered by bi-directional fluid pumps (112,114) installed at the other end of the first fluid circuit and second fluid circuit to operate in negative pressure pumping operation to provide the periodic flowing direction changing of the fluid; or **(ii)** with the bi-directional fluid pumps (111, 113) installed at one end of the first fluid circuit and the second fluid circuit to operate in positive pressure pumping, and periodically altered by bi-directional fluid pumps (112,114) installed at the other end of the first fluid circuit and second fluid circuit to operate in positive pressure pumping operation to provide the periodic flowing direction changing of the fluid; or **(iii)** with the positive fluid pump and negative fluid pump at the two ends of the same fluid channel of the two fluid channels to assist pump in the same direction and to periodic change the flowing direction alternately;

3) It is constituted by at least four unidirectional fluid pumps (120a), (120b), (120c), (120d), wherein two unidirectional fluid pumps (120a), (120b) are separately installed at fluid ports (a), (b) on the two ends of the first fluid circuit of the heat exchange device (1000), while the other two unidirectional fluid pumps (120c), (120d) are separately installed at fluid ports (c), (d) on the two ends of the second fluid circuit, whereby with the control of periodic fluid direction-change operative control device (250) to form the structural arrangement and to provide one or multiple following operating functions, including: **(i)** the arrangement of unidirectional pumps for negative pressure pumping on fluids, wherein the unidirectional pump (120a) and unidirectional pump (120c) form one set, and the unidirectional pump (120b) and unidirectional pump (120d) form the other set, and that the two sets provide periodic negative pressure pumping alternatively to make the fluids with different flowing direction in two channels changing their flowing direction periodically; or **(ii)** the arrangement of unidirectional pumps for positive pressure pumping on fluids, wherein the unidirectional pump (120a) and

unidirectional pump (120c) form one set, and the unidirectional pump (120b) and unidirectional pump (120d) form the other set, and that the two sets provide periodic positive pressure pumping alternatively to make the fluids with different flowing direction in two channels changing their flowing direction periodically;

4) It is constituted by at least two unidirectional fluid pumps (120), (120') in different pumping directions being series connected in different flowing direction to constitute the bi-directional fluid pumping set, wherein at least two aforementioned bi-directional fluid pumping sets are separately installed at the fluid ports (a), (c) of two different fluid channels to constitute the bi-directional fluid pumping device (123), wherein under the control of periodic fluid direction-change operative control device (250) to operate the unidirectional pump (120) and unidirectional pump (120') being installed in opposite pumping direction inside the two bi-directional fluid pumping sets in periodic alternate pumping to change the flowing direction of fluid insides two fluid channels periodically; if the structure of individual unidirectional fluid pumps (120), (120') is irreversible for flowing, then each unidirectional fluid pump (120), (120') could firstly individually parallel connect with reversible conducting unidirectional valve (126) before being series connected;

5) It is constituted by at least two unidirectional pumps (120), (120') in different pumping directions being series connected in different flowing direction to constitute the bi-directional fluid pumping set, wherein at least two aforementioned bi-directional fluid pumping sets are separately installed at the fluid ports (a), (b) on two ends of the first fluid circuit, and at least two aforementioned bi-directional fluid pumping sets are separately installed at the fluid ports (c), (d) on two ends of the second fluid circuit, wherein under the control of periodic fluid direction-change operative control device (250) to operate the unidirectional pumps (120), (120') in different pumping direction being separately installed at the fluid ports (a), (b) on two ends of the first fluid circuit and the fluid ports (c), (d) on two ends of the second fluid circuit, thereby to provide one or multiple following operating functions, including: **(i)** with the unidirectional pump (120') installed in the arrangement of negative pressure pumping direction inside the two bi-directional fluid pumping sets installed at the fluid ports on two ends of the first fluid circuit and second fluid

circuit to operate in negative pressure pumping, and changing the fluid flowing direction periodically; or **(ii)** with the unidirectional pump (120) installed in the arrangement of positive pressure pumping direction inside the two bi-directional fluid pumping sets installed at fluid ports on two ends of the first fluid circuit and second fluid circuit to operate in positive pressure pumping, and changing the fluid flowing direction periodically; or **(iii)** with the unidirectional pump (120) and unidirectional pump (120') installed at both ends of both fluid channels to assist pumping in the same direction, and changing the pumping direction periodically; if the structure of individual unidirectional fluid pumps (120), (120') is irreversible for flowing, then each unidirectional fluid pump (120), (120') could firstly individually parallel connect with reversible conducting unidirectional valve (126) before being series connected;

6) It is constituted by at least two unidirectional fluid pumps (120), (120') in different pumping directions being parallel connected to constitute the bi-directional fluid pumping set, wherein at least two aforementioned bi-directional fluid pumping sets are separately installed at the fluid ports (a), (c) of two different fluid channels to constitute the bi-directional fluid pumping device (123), wherein under the control of periodic fluid direction-change operative control device (250) to operate the unidirectional pump (120) and unidirectional pump (120') being installed in opposite pumping direction inside the two bi-directional fluid pumping sets in periodic alternate pumping to change the flowing direction of fluid insides two fluid channels periodically; if the structure of individual unidirectional fluid pumps (120), (120') does not have anti-reverse flow function, then each unidirectional fluid pump (120), (120') could firstly separately series connect with the unidirectional valve (126) in forward polarity before being parallel connected to avoid reverse flows;

7) It is constituted by at least two unidirectional pumps (120), (120') in different pumping directions being parallel connected to constitute the bi-directional fluid pumping set, wherein at least two aforementioned bi-directional fluid pumping sets are separately installed at the fluid ports (a), (b) on two ends of the first fluid circuit, and at least two aforementioned bi-directional fluid pumping sets are separately installed at the fluid ports (c), (d) on two ends of the second fluid circuit, wherein under the control of periodic fluid direction

switching controller (250) to operate the unidirectional pumps (120), (120') in different pumping direction being separately installed at the fluid ports (a), (b) on two ends of the first fluid circuit and the fluid ports (c), (d) on two ends of the second fluid circuit, thereby to provide one or multiple following operating functions, including: **(i)** with the unidirectional pump (120') installed in the arrangement of negative pressure pumping direction inside the two bi-directional fluid pumping sets installed at the fluid ports on two ends of the first fluid circuit and second fluid circuit to operate in negative pressure pumping, and changing the fluid flowing direction periodically; or **(ii)** with the unidirectional pump (120) installed in the arrangement of positive pressure pumping direction inside the two bi-directional fluid pumping sets installed at fluid ports on two ends of the first fluid circuit and second fluid circuit to operate in positive pressure pumping, and changing the fluid flowing direction periodically; or **(iii)** with the unidirectional pump (120) and unidirectional pump (120') installed at both ends of both fluid channels to assist pumping in the same direction, and changing the pumping direction periodically; if the structure of individual unidirectional fluid pumps (120), (120') does not have anti-reverse flow function, then each unidirectional fluid pump (120), (120') could firstly separately series connect with the unidirectional valve (126) in forward polarity before being parallel connected;

8) It is by adopting at least one unidirectional fluid pump (120) and four controllable switch type fluid valves (129a), (129b), (129c), (129d) in bridge type combination to constitute the bridge type bi-directional fluid pumping set, wherein at least two aforementioned bi-directional fluid pumping sets are separately installed at one of the two fluid ports of each two different fluid circuits to constitute the bi-directional pumping device (123), and that under the control of periodic fluid direction-change operative control device (250), in the operation of the unidirectional pump of the two aforementioned bi-directional fluid pumping sets, by alternately setting the two fluid valves (129a), (129b) as open, the other two fluid valves (129c), (129d) as close, or setting two fluid valves (129a), (129b) as close, the other two fluid valves (129c), (129d) as open, to control the periodically direction change of fluid;

9) It is by adopting at least one unidirectional fluid pump (120) and four controllable switch type fluid valves (129a), (129b), (129c), (129d) in bridge

type combination to constitute the bridge type bi-directional fluid pumping set, wherein at least four aforementioned bridge type bi-directional fluid pumping sets are separately installed at the two fluid ports at two ends of each two different fluid circuits to constitute the bi-directional pumping device (123), and that under the control of periodic fluid direction-change operative control device (250), in the operation of the unidirectional pump of the two aforementioned bi-directional fluid pumping sets, by alternately setting the two fluid valves (129a), (129b) as open, the other two fluid valves (129c), (129d) as close, or setting two fluid valves (129a), (129b) as close, the other two fluid valves (129c), (129d) as open, to control the periodically direction change of fluid;

10) It is by adopting at least one unidirectional fluid pump (120) being series connected to four controllable switch type fluid valves in bridge type combination to constitute the bridge type bi-directional fluid pumping set; wherein

In the fluid circuit pumped by the unidirectional fluid pump (120a) connected with the heat exchange device (1000):

-- On end of the fluid valve (129a) connects to the outlet of the fluid valve (129c) as well as the outlet of the unidirectional fluid pump (120a), and the inlet end of the unidirectional fluid pump (120a) connects to side A;

-- The other end of the fluid valve (129a) connects to both the fluid port (a) of the heat exchange device (1000) and one end of the fluid valve (129d);

-- The other end of the fluid valve (129d) connects to one end of the fluid valve (129b), therefore connects to side B;

-- The other end of the fluid valve (129b) connects to the fluid port (b) of the heat exchange device (1000) and the fluid valve (129c), while the other end of the fluid valve (129c) connects to the fluid valve (129a), therefore jointly connect to the outlet end of the fluid pump (120a);

In the fluid circuit pumped by the unidirectional fluid pump (120c) connected with the heat exchange device (1000):

-- On end of the fluid valve (129a') connects to the outlet of the fluid valve (129c') as well as the outlet of the unidirectional fluid pump (120c), and the inlet end of the unidirectional fluid pump (120c) connects to side C;

-- The other end of the fluid valve (129a') connects to the fluid port (c) of the

heat exchange device (1000) as well as one end of the fluid valve (129d');

-- The other end of the fluid valve (129d') connects to one end of the fluid valve (129b'), therefore connects to side D;

-- The other end of the fluid valve (129b') connects to the fluid port (d) of the heat exchange device (1000) and the fluid valve (129c'), while the other end of the fluid valve (129c') connects to the fluid valve (129a'), therefore jointly connect to the outlet end of the fluid pump (120c);

With the operative control of the periodic fluid direction-change operative control device (250), in the bridge type bi-directional fluid pumping set constituted by the unidirectional fluid pump (120a) and fluid valves (129a), (129b), (129c), (129d), by setting the fluid valve (129a) and the fluid valve (129b) as one set and the fluid valve (129c) and the fluid valve (129d) as one set to alternately control the two sets to open or close, as well as in the bridge type bi-directional fluid pumping set constituted by the unidirectional fluid pump (120c) and fluid valves (129a'), (129b'), (129c'), (129d'), by setting the fluid valve (129a') and the fluid valve (129b') as one set and the fluid valve (129c') and the fluid valve (129d') as one set to alternately control the two sets to open or close, thereby to form the function of periodically alternately change flowing direction on the two fluid circuits in the heat exchange device (1000);

11) It is by adopting at least one unidirectional fluid pump (120) being series connected to four controllable switch type fluid valves in bridge type combination to constitute the bi-directional fluid pumping set; wherein

In the fluid circuit pumped by the unidirectional fluid pumps (120a), (120b) connected with the heat exchange device (1000):

-- On end of the fluid valve (129a) connects to the outlet of the fluid valve (129c) as well as the outlet of the unidirectional fluid pump (120a), and the inlet end of the unidirectional fluid pump (120a) connects to side A;

-- The other end of the fluid valve (129a) connects to both the fluid port (a) of the heat exchange device (1000) and one end of the fluid valve (129d);

-- The other end of the fluid valve (129d) connects to one end of the fluid valve (129b), and connects to the negative pressure fluids inlet side of the unidirectional fluid pump (120b), thereby via the fluid outlet side of the unidirectional fluid pump (120b) connecting to side B;

-- The other end of the fluid valve (129b) connects to the fluid port (b) of the

heat exchange device (1000) and the fluid valve (129c), while the other end of the fluid valve (129c) connects to the fluid valve (129a), therefore jointly connect to the outlet end of the fluid pump (120a);

In the fluid circuit pumped by the unidirectional fluid pump (120c) connected with the heat exchange device (1000);

-- On end of the fluid valve (129a') connects to the outlet of the fluid valve (129c') as well as the outlet of the unidirectional fluid pump (120c), and the inlet end of the unidirectional fluid pump (120c) connects to side C;

-- The other end of the fluid valve (129a') connects to the fluid port (c) of the heat exchange device (1000) as well as one end of the fluid valve (129d');

-- The other end of the fluid valve (129d') connects to one end of the fluid valve (129b'), and connects to the negative pressure fluids inlet side of the unidirectional fluid pump (120d), thereby via the fluid outlet side of the unidirectional fluid pump (120d) connecting to side B;

-- The other end of the fluid valve (129b') connects to the fluid port (d) of the heat exchange device (1000) and the fluid valve (129c'), while the other end of the fluid valve (129c') connects to the fluid valve (129a'), therefore jointly connect to the outlet end of the fluid pump (120c);

With the operative control of the periodic fluid direction-change operative control device (250), in the bi-directional fluid pumping set constituted by the unidirectional fluid pump (120a) and fluid valves (129a), (129b), (129c), (129d), by setting the unidirectional fluid valve (129a) and the unidirectional fluid valve (129b) as one set and the unidirectional fluid valve (129c) and the unidirectional fluid valve (129d) as one set to alternately control the two sets to open or close, as well as in the bi-directional fluid pumping set constituted by the unidirectional fluid pump (120c) and fluid valves (129a'), (129b'), (129c'), (129d'), by setting the unidirectional fluid valve (129a') and the unidirectional fluid valve (129b') as one set and the unidirectional fluid valve (129c') and the unidirectional fluid valve (129d') as one set to alternately control the two sets to open or close, thereby to form the function of periodically alternately change flowing direction on the two fluid circuits in the heat exchange device (1000);

Aforementioned fluid pumping devices are provided for pumping gaseous or liquid fluids, wherein besides the fluid pumps can be driven by standalone electric motor or at least two fluid pumps can jointly be driven by a single electric motor,

the fluid pumps can be driven by engine power, or the mechanical or electric power generated or converted from other wind energy, thermal energy, temperature difference energy or solar energy.

17. A double flow-circuit heat exchange device for periodic positive and reverse directional pumping according to claim 1, wherein the periodic fluid direction-change operative control device (250) is equipped with electric motor, or controllable engine power, or mechanical or electric power generated or converted from other wind energy, thermal energy, temperature-difference energy, or solar energy for controlling various fluid pumps for driven, or controlling the operation timing of the fluid pumps or fluid valves, thereby changing the direction of the two circuits passing through the heat exchanger (100) and further to operatively control partial or all regulations of rotational speed, flow rate, fluid pressure of various fluid pumps thereof.

18. A double flow-circuit heat exchange device for periodic positive and reverse directional pumping according to claim 1, wherein in the operation of periodically positive and reverse directional pumping fluid, it further through the periodic fluid direction-change operative control device (250) to manipulate the flow rate of fluid pumped by the bi-directional pumping device (123), wherein the operational modes include one or more than one types as follows, including:

1) the flow rate of pumping fluid is adjusted or set manually;

2) the flow rate of fluid is operatively controlled by referring to the detected signal of the at least one temperature detecting device;

3) the flow rate of fluid is operatively controlled by referring to the detected signal of the at least one moisture detecting device;

4) the flow rate of fluid is operatively controlled by referring to the detected signal of the at least one gaseous or liquid fluid composition detecting device;

5) the flow rate of the fluid is jointly operatively controlled by two or more than two said **1)~4)** items.

19. A double flow-circuit heat exchange device for periodic positive and reverse directional pumping according to claim 1, wherein when installed with the function of operatively controlling the flow rate, the flow rate range of the controlled fluid is

between stop delivery to the maximum delivering volume, and the flow rate of fluid is manipulated in stepped or stepless according to the operational requirements, wherein it is further by following one or more than one devices to change the flow rate of fluid, including:

1) to operatively control the rotational speed in pumping operation of bi-directional pumping device (123) from idling to the maximum speed range, thereby to further operatively control the flow rate of fluid;

2) by adopting the bi-directional pumping device (123) with controllable fluid valve inlet/outlet to operatively control the open volume of the fluid valve inlet/outlet of the bi-directional pumping device (123), thereby to further operatively control the flow rate of fluid;

3) by adopting the unidirectional valve (126) with controllable fluid valve inlet/outlet to operatively control the open volume of the fluid valve inlet/outlet of the unidirectional valve (126), thereby to further operatively control the flow rate of fluid;

4) by adopting the fluid valve (129) and fluid valve (129') with controllable fluid valve inlet/outlet to operatively control the open volume of the fluid valve inlet/outlet of the fluid valve (129) and fluid valve (129'), thereby to further operatively control the flow rate of fluid;

5) by operatively controlling at least one of devices in item **1)~4)** to intermittingly pumping fluid, thereby to modulate the average flow rate by the time ratio of pumping and stop pumping.

20. A double flow-circuit heat exchange device for periodic positive and reverse directional pumping according to claim 1, wherein the flow rate ratio of the two flow circuits passing through the heat exchange device (1000) during the operation can be one or more than one ratio modes as follows, including:

1) In the operation of periodically positive and reverse directional pumping fluid, the flow rate of one flow circuit is greater than that of the other flow circuit;

2) In the operation of periodically positive and reverse directional pumping fluid, the flow rate of the two flow circuits are the same;

3) In the operation of periodically positive and reverse directional pumping fluid, when operation in one direction, the flow rate of the two flow circuits are different, while operation in the other direction, the flow rate of the two flow

circuits are the same.

21. A double flow-circuit heat exchange device for periodic positive and reverse directional pumping according to claim 1, wherein in the operation of periodically positive and reverse directional pumping fluid, the pumping periodic mode includes one or more than one type as follows, including:

1) In the operation of periodically positive and reverse directional pumping fluid, the operational time of positive direction and reverse direction are the same;

2) In the operation of periodically positive and reverse directional pumping fluid, the operational time of positive direction and reverse direction are different;

3) The mixed mode of both item **1)** and **2)**.

22. A double flow-circuit heat exchange device for periodic positive and reverse directional pumping according to claim 1, wherein except for the function of periodically positive and reverse directional pumping operation, it further simultaneously has one ore more than one special operational modes, including:

1) The fluid of two flow circuits pump in fluid in the same flowing direction;

2) The fluid of two flow circuits reversely pump out fluid in the same flowing direction;

3) The fluid of two flow circuits execute periodically positive and reverse directional pumping operation by pumping in fluid and reversely pumping out fluid in the same flowing direction.

23. A double flow-circuit heat exchange device for periodic positive and reverse directional pumping according to claim 1, wherein in the operation of flow direction change, to mitigate the impact generated by the gaseous or liquid state fluid in the course of pump when the fluid being intercepted at sudden, including the liquid hammer effect generated when the pumping liquid state fluid being interrupted, one or more than one operational methods as follows can be further added to the operational modes of the flow direction change control:

1) In the operation of fluid flow direction change, it is through the operatively control of the fluid pump or fluid valve to slowly reduce the flow rate of fluid, then to be switched to slowly increase the flow rate of fluid to a maximum preset value in the other flow direction;

2) In the operation of fluid flow direction change, it is through the operatively control of the fluid pump or fluid valve to slowly reduce the flow rate of fluid, and to be switched to stop pumping for a preset time period, then further to be switched to slowly increase the flow rate of fluid to a maximum preset value in the other flow direction.