CLAIMS

1. A fixed type heat exchange apparatus (1000) with double flow circuit structure each provided with a flow inlet and a flow outlet comprising:

a heat exchanger (100, 200);

a fluid pump (111, 112, 120a, 120b, 120c, 120d) arranged to pump fluid over the double flow circuit heat exchanger;

a detector arranged to detect the condition of the fluid of the heat exchanger, the detector comprising a gaseous or liquid state fluid composition detecting device (31), a temperature detector (11) and/or a humidity detector (21); and

a control device (250) arranged to receive a detection signal from the detector and to automatically modulate the fluid pump flow rate of the pumping exchange fluid depending on the conditions detected by the detector.

2. A fixed type heat exchange apparatus as claimed in claim 1, wherein two of the fluid pumps (111, 112, 120a, 120b, 120c, 120d) are respectively installed among fluid port (a), fluid port (b), fluid port (c), and fluid port (d) of the double flow circuit of the heat exchange apparatus (1000) capable of producing negative pressure or positive pressure to constitute a double flow circuit fluid pumping device (123) and two fluid streams are created to pass through the heat exchanger (100) in different flow directions, wherein the double flow circuit fluid pumping device (123) is driven by a power source (300) and operatively controlled by the operative control device (250), wherein:

bidirectional fluid pumps (111, 112) are respectively installed to the fluid port (b) and fluid port (d) for pumping the fluid in different pumping flow directions, wherein said bidirectional fluid pumps (111, 112) are driven by individual electric motors or driven by a common motor are operatively controlled by the operative control device (250) to have one or more than one functional mode operations of the following as needed: 1) the two bidirectional fluid pumps (111, 112) are pumped in negative pressure to allow the two fluid streams pass through the heat exchanger (100) in different pumping flow directions; 2) the two bidirectional fluid pumps (111, 112) are pumped in positive pressure to allow the two fluid streams pass through the heat exchanger (100) in different pumping flow directions;

the temperature detecting device (11) is installed at the position capable of directly or indirectly detecting the temperature variation of the exchange fluid, and at least one gaseous or liquid state fluid composition detecting device (31) is installed at the position capable of detecting the composition variation of the pumping gaseous or liquid state fluid, including the signals detected by both or at least one type of said detecting devices, wherein the detected signals are referred by the operative control device (250) to operatively control the double flow circuit fluid pumping device (123) for determining the flow rate operating timing of the pumping exchange fluid, that is, with automatic exchange flow rate modulation; and

said temperature detecting device (11) and gaseous or liquid state fluid composition detecting device (31) are integrally commonly combined or individually separately installed.

3. A fixed type heat exchange apparatus with automatic flow rate exchange modulation as claimed in claim 2, wherein the bidirectional fluid pump (111) and bidirectional fluid pump (112) are installed to the fluid ports (a, d) or fluid ports (b, c) or fluid ports (a, c), wherein one bidirectional fluid pump is pumped in positive pressure, while the other bidirectional fluid pump is pumped in negative pressure so as to allow the two fluid streams to pass through the heat exchanger (100) in different pumping flow directions.

4. A fixed type heat exchange apparatus as claimed in claim 1, wherein fluid port (a), fluid port (b), fluid port (c), and fluid port (d) of the double flow circuit of the heat exchange apparatus (1000) are respectively installed with unidirectional fluid pumps (120a, 120b, 120c, 120d) which are able to be pumped in unidirectional flow directions to constitute a double flow circuit fluid pumping device (123) and two fluid streams are created to pass through the heat exchanger (100) in different flow directions, wherein the double flow circuit fluid pumping device (123) is driven by a power source (300) and operatively controlled by the operative control device (250), wherein:

the heat exchange apparatus (1000) and unidirectional fluid pumps (120a, 120b, 120c, 120d) are integrally combined or separately installed to constitute the functions of the double flow circuit fluid pumping device (123); the four

unidirectional fluid pumps (120a, 120b, 120c, 120d) are respectively installed to the fluid port (a), fluid port (b), fluid port (c), and fluid port (d) for pumping the fluid, wherein the unidirectional fluid pumps (120a, 120c) being installed to the fluid port (a) and fluid port (c) are one group to be driven by individual electric motors or driven by a common motor, while the unidirectional fluid pumps (120b, 120d) being installed to the fluid port (b) and fluid port (d) are another group to be driven by individual electric motors or driven by a common motor, wherein they are operatively controlled by the operative control device (250) to have one or more than one functional modes of the structural types and operating methods of the following: 1) the unidirectional fluid pumps are structurally distributed to pump the fluid in negative pressure thereby allowing the two fluid streams to appear in different flow directions; or 2) the unidirectional fluid pumps are structurally distributed to pump the fluid in positive pressure thereby allowing the two fluid streams to appear in different flow directions; or 3) the different fluid pumps among part or all of the unidirectional fluid pumps (120a, 120b, 120c, 120d) are pumped in positive pressure and negative pressures to form auxiliary pumping in the same flow circuit and allow the two fluid streams to be pumped in different flow directions; in the functional mode operations of said items 1), 2) & 3), the flow directions of the two fluid streams passing through the two sides of the heat exchanger (100) inside the heat exchange apparatus (1000) are kept opposite to each other;

the temperature detecting device (11) is installed at the position capable of directly or indirectly detecting the temperature variation of the exchange fluid, and at least one gaseous or liquid state fluid composition detecting device (31) is installed at the position capable of detecting the composition variation of the pumping gaseous or liquid state fluid, including signals detected by both or at least one type of said detecting devices, wherein the detected signals are referred by the operative control device (250) to operatively control the double flow circuit fluid pumping device (123) for determining the flow rate operating timing of the pumping exchange fluid; and

said temperature detecting device (11) and gaseous or liquid state fluid composition detecting device (31) are integrally commonly combined or individually separately installed.

5. A fixed type heat exchange apparatus as claimed in claim 1, wherein the fluid port (b) and fluid port (d) among the fluid port (a), fluid port (b), fluid port (c), and fluid port (d) of the double flow circuit of the heat exchange apparatus (1000) are respectively installed with bidirectional fluid pumps (111, 112) capable of producing negative pressure or positive pressure to constitute the double flow circuit fluid pumping device (123), and two fluid streams are created to flow in different flow directions, wherein the double flow circuit fluid pumping device (123) is driven by a power source (300) and operatively controlled by the operative control device (250), wherein:

the heat exchange apparatus (1000) and the bidirectional fluid pumps (111, 112) capable of producing negative pressure or positive pressure are integrally combined or separately installed; the two bidirectional fluid pumps (111, 112) constituting the functions of double flow circuit fluid pumping device (123) are respectively installed to the fluid port (b) and fluid port (d) for pumping the fluid in different pumping flow directions, wherein said bidirectional fluid pumps (111, 112) are driven by individual electric motors or driven by a common motor are operatively controlled by the operative control device (250) to have one or more than one functional mode operations of the following as needed: 1) the two bidirectional fluid pumps (111, 112) are pumped in negative pressure to allow the two fluid streams passing through the heat exchanger (200) in different pumping flow directions; 2) the two bidirectional fluid pumps (111, 112) are pumped in positive pressure to allow the two fluid streams passing through the heat exchanger (200) in different pumping flow directions; in the functional mode operations of said items 1) & 2), the flow directions of the two fluid streams passing through the two sides of the heat exchanger (200) inside the heat exchange apparatus (1000) are kept opposite to each other;

the temperature detecting device (11), at least one humidity detecting device (21), and at least one gaseous or liquid state fluid composition detecting device (31) are installed at the positions capable of directly or indirectly detecting the temperature variation, or humidity variation, or gaseous or liquid state fluid composition variation, including installing all three or at least one type of said detecting devices, wherein the detected signals are referred by the operative control device (250) to operatively

control the double flow circuit fluid pumping device (123) for determining the flow rate operating timing of the pumping exchange fluid; and

said temperature detecting device (11) and humidity detecting device (21) as well as said gaseous or liquid state fluid composition detecting device (31) are integrally commonly combined or individually separately installed.

6. A fixed type heat exchange apparatus with automatic flow rate exchange modulation as claimed in claim 5, wherein the bidirectional fluid pump (111) and the bidirectional fluid pump (112) can also be installed to fluid ports (a, d), or fluid ports (b, c) or fluid ports (a, c), wherein one bidirectional fluid pump is pumped in positive pressure, while the other bidirectional fluid pump is pumped in negative pressure so as to allow the two fluid streams to pass through the heat exchanger (200) in different pumping flow directions.

7. A fixed type heat exchange apparatus with automatic flow rate exchange modulation as claimed in claim 1, wherein unidirectional fluid pumps (120a, 120b, 120c, 120d) able to be pumped in unidirectional flow directions are respectively installed to fluid port (a), fluid port (b), fluid port (c), and fluid port (d) of the double flow circuit of the heat exchange apparatus (1000) for passing through two double circuit fluids thereby to constitute a double flow circuit fluid pumping device (123); the double flow circuit fluid pumping device (123) is driven by a power source (300) and operatively controlled by the operative control device (250) in different flow directions, wherein:

unidirectional fluid pumps (120a, 120b, 120c, 120d) are integrally combined or separately installed to constitute the functions of the double flow circuit fluid pumping device (123); the four unidirectional fluid pumps (120a, 120b, 120c, 120d) are respectively installed to the fluid port (a), fluid port (b), fluid port (c), and fluid port (d) for pumping the fluid, wherein the unidirectional fluid pumps (120a, 120c) being installed to the fluid port (a) and fluid port (c) are one group to be driven by individual electric motors or driven by a common motor, while the unidirectional fluid pumps (120b, 120d) being installed to the fluid port (b) and fluid port (d) are another group to be driven by individual electric motors or driven by a common motor, wherein they are operatively controlled by the operative control device (250) to have

one or more than one functional modes of the structural types and operating methods of the following: 1) the unidirectional fluid pumps are structurally distributed to pump the fluid in negative pressure thereby allowing the two fluid streams to appear in different flow directions; or 2) the unidirectional fluid pumps are structurally distributed to pump the fluid in positive pressure thereby allowing the two fluid streams to appear in different flow directions; or 3) the different fluid pumps among part or all of the unidirectional fluid pumps (120a, 120b, 120c, 120d) are pumped in positive pressure and negative pressures to form auxiliary pumping in the same flow circuit and allow the two fluid streams to be pumped in different flow directions;

the temperature detecting device (11), at least one humidity detecting device (21), and at least one gaseous or liquid state fluid composition detecting device (31) are installed at the position capable of directly or indirectly detecting the temperature variation, or humidity variation, or gaseous or liquid state fluid composition variation, including signals detected by all three, or at least one of said detecting devices, wherein the detected signals are referred by the operative control device (250) to operatively control the double flow circuit fluid pumping device (123) for determining the flow rate operating timing of the pumping exchange fluid;

said temperature detecting device (11), humidity detecting device (21) and gaseous or liquid state fluid composition detecting device (31) are integrally commonly combined or individually separately installed; and

the heat exchanger (200) has two internal flow circuits and heat absorbing or dissipating function as well as the dehumidifying or humidifying functions, wherein the two flow circuits respectively individually have two fluid ports to respectively pump the fluid, to enable heat exchange and dehumidification functions between the two fluids.

8. A fixed type heat exchange apparatus with automatic flow rate exchange modulation as claimed in claim 7, wherein the structural types of the heat exchanger include one or more than one characteristic of the following: 1) the tubular structure in linear or other geometric shape; or 2) the multi-layer structure with fluid circuits for passing the gaseous or liquid state liquid fluid; or 3) one or more than one fluid circuit in series connection, parallel connection, or series and parallel connection.

9. A fixed type heat exchange apparatus with automatic flow rate exchange modulation as claimed in claim 1, wherein the detector installation positions include both or one of the positions near to a fluid port (a) and fluid port (b), or both or one of the positions near to a fluid port (c) and fluid port (d) of the heat exchanger (100), (200), or the heat exchange apparatus (1000), or the other positions capable of detecting the temperature, humidity or composition of the exchange fluid during heat exchange operation, and the number of them can be one or more than one to provide detected signals for reference to execute one or more than one functional operations as the following: 1) as the reference for operatively controlling a double flow circuit fluid pumping device (123) comprising two of the fluid pumps installed among the fluid ports (a, b, c, d) to modulate the flow speed or flow rate of the pumping fluid; or 2) as the reference for operatively controlling opening percentage of a fluid valve to modulate the flow speed or flow rate of the pumping fluid;

wherein said temperature detecting device (11), humidity detecting device (21), and gaseous or liquid state fluid composition detecting device (31), all of the detecting devices are integrally combined, or part of the detecting devices are integrally combined, or they are individually separately installed.

10. A fixed type heat exchange apparatus as claimed in claim 9, wherein the double flow circuit fluid pumping device (123) is configured for pumping gaseous or liquid state fluids, and the double flow circuit fluid pumping device (123) except for being driven by individual electric motors or at least two of the fluid pumps are driven by a common electric motor, it can be also driven by engine power, or mechanical or electric power converted from other wind power, thermal energy, temperature-difference energy, or solar energy.

CLAIMS

1. A heat exchange apparatus with automatic flow rate exchange modulation, comprising:

a heat exchange apparatus four fluid ports (a,b,c,d) through which the at least one heat exchange fluid is pumped into and out of the heat exchange apparatus, wherein first and fourth ones of the fluid ports (a,d) are on a first side of the heat exchange apparatus and second and third ones of the fluid ports (b,c) are on a second side of the heat exchange apparatus;

at least two fluid pumps (111,112 or 120a,120b,120c,120d) that form a double flow circuit fluid pumping device (123) for pumping at least one heat exchange fluid through the heat exchange apparatus in the first direction via a first fluid flow port from the first fluid port (a) on the first side of the heat exchange apparatus to the second fluid port (b) on the second side of the heat exchange apparatus and in the second direction via a second fluid flow path from the third fluid port (c) on the second side of the heat exchange apparatus to the fourth fluid port (d) on the first side of the heat exchange apparatus, said first fluid flow path being different from the second fluid flow path;

a power source (300) for supplying power to the at least two pumps; and

an operative control device (250) for operatively controlling said at least two fluid pumps to perform at least one of the following operations in order to operatively control a temperature distribution with the heat exchange apparatus: (a) switching a pumping direction; (b) operatively controlling a flow rate of the fluid; (c) operatively controlling both the pumping direction and the flow rate, wherein a timing of said operations is preset in an open loop operative control or manually controlled.

2. The heat exchange apparatus claimed in claim 1, wherein said at least two fluid pumps are bidirectional fluid pumps installed at two said fluid ports.

3. The heat exchange apparatus claimed in claim 2, wherein said bidirectional fluid pumps are installed at two said four ports (a,b,c,d), said two ports being selected according to whether both of said bidirectional pumps are operated to generate positive pressure or negative pressure, or whether one of said bidirectional pumps is operated to generate

positive pressure while the other of said two bidirectional pumps is operated to generate negative pressure.

4. The heat exchange apparatus claimed in claim 2, further comprising at least one temperature detecting device (11) installed at a position to directly or indirectly detect a temperature variation of a respective said heat exchange fluid, wherein the at least one temperature detecting device provides temperature detecting signals to said operative control device (250), and said operation of operatively controlling a temperature distribution status within the heat exchange apparatus including an operation of controlling a timing of said switching or said flow rate control to control said temperature distribution by using said temperature detecting signals as a reference.

5. The heat exchange apparatus claimed in claim 2, further comprising at least one temperature detecting device (11) or at least one humidity detecting device (21), said temperature detecting device (11) or humidity detecting device (21) installed at a position to directly or indirectly detect a temperature variation or a humidity variation within the heat exchange apparatus, wherein the at least one temperature detecting device (11) or humidity detecting device (21) respectively provide temperature or humidity detecting signals to said operative control device (250), said operation of operatively controlling a temperature distribution status within the heat exchange apparatus including an operation of controlling a timing of said switching or said flow rate control to control said temperature distribution by using said temperature detecting signals as a reference, and said humidity detecting device being arranged to provide humidity detecting signals to said operative control device (250) to operatively control a humidity distribution within said heat exchange apparatus by using said humidity detection signals as a reference to control said switching or flow rate timing.

6. The heat exchange apparatus claimed in claim 5, wherein said heat exchange apparatus includes both said at least one temperature detecting device (11) and said at least one humidity detecting device (12).

7. The heat exchange apparatus claimed in claim 2, further comprising at least one of the following: at least one temperature detecting device (11), at least one humidity detecting device (21), and at least one gaseous or liquid state fluid composition detecting device (31), said at least one temperature detecting device (11), humidity detecting device (21), or gaseous or liquid state fluid composition detecting device being installed at a position to directly or indirectly detect a temperature variation, a humidity variation, or a fluid composition variation within the heat exchange apparatus, wherein the at least one temperature detecting device (11), humidity detecting device (21), or gaseous or liquid state fluid composition detecting device (31) respectively provide temperature, humidity, or fluid composition detecting signals to said operative control device (250), said operation of operatively controlling a temperature distribution status within the heat exchange apparatus including an operation of controlling a timing of said switching or said flow rate control to control said temperature distribution by using said temperature detecting signals as a reference, said humidity detecting device being arranged to provide humidity detecting signals to said operative control device (250) to operatively control a humidity distribution within said heat exchange apparatus by using said humidity detection signals as a reference to control said switching or flow rate timing, and said gaseous or liquid state fluid composition detecting device being arranged to provide fluid composition detecting signals to said operative control device (250) as a reference to operatively control an inflow status of a respective said at least one heat exchange fluid.

8. The heat exchange apparatus claimed in claim 7, wherein said heat exchange apparatus includes two different ones of said at least one temperature detecting device (11), said at least one humidity detecting device (12), and said at least one temperature detecting device (31).

9. The heat exchange apparatus claimed in claim 7, wherein said operative control device (250) controls said switching or flow rate timing by operatively controlling said pumps.

10. The heat exchange apparatus claimed in claim 1, wherein said at least two fluid pumps include a first unidirectional pump (120a) installed at the first fluid port (a), a

second unidirectional pump (120b) installed at the second fluid port (b), a third unidirectional pump (120c) installed at the third fluid port (c), and a fourth unidirectional pump (120d) installed at the fourth fluid port (d), wherein said first and second unidirectional fluid pumps (120a,120b) operate to pump fluid in the first direction and the third and fourth unidirectional pumps (120c,120d) operate to pump said fluid in the second direction, and wherein switching between operation of the first and second unidirectional pumps (120a,120b) and operation of the third and fourth unidirectional pumps (120c,120d) switches a fluid flow direction within the heat exchange apparatus.

11. The heat exchange apparatus as claimed in claim 10, wherein at least one of said first and third unidirectional pumps (120a,120c) is operated to generate positive pressure and at least one of said second and fourth unidirectional pumps (120b,120d) is operated to generate negative pressure.

12. The heat exchange apparatus as claimed in claim 10, further comprising at least one temperature detecting device (11) installed at a position to directly or indirectly detect a temperature variation of a respective said heat exchange fluid, wherein the at least one temperature detecting device provides temperature detecting signals to said operative control device (250), and said operation of operatively controlling a temperature distribution status within the heat exchange apparatus including an operation of controlling a timing of said switching or said flow rate control to control said temperature distribution by using said temperature detecting signals as a reference.

13. The heat exchange apparatus as claimed in claim 10, further comprising at least one temperature detecting device (11) or at least one humidity detecting device (21), said temperature detecting device (11) or humidity detecting device (21) installed at a position to directly or indirectly detect a temperature variation or a humidity variation within the heat exchange apparatus, wherein the at least one temperature detecting device (11) or humidity detecting device (21) respectively provide temperature or humidity detecting signals to said operative control device (250), said operation of operatively controlling a temperature distribution status within the heat exchange apparatus including an operation of controlling a timing of said switching or said flow rate control to control said

temperature distribution by using said temperature detecting signals as a reference, and said humidity detecting device being arranged to provide humidity detecting signals to said operative control device (250) to operatively control a humidity distribution within said heat exchange apparatus by using said humidity detection signals as a reference to control said switching or flow rate timing.

14. The heat exchange apparatus as claimed in claim 13, wherein said heat exchange apparatus includes both said at least one temperature detecting device (11) and said at least one humidity detecting device (12).

15. The heat exchange apparatus as claimed in claim 10, further comprising at least one of the following: at least one temperature detecting device (11), at least one humidity detecting device (21), and at least one gaseous or liquid state fluid composition detecting device (31), said at least one temperature detecting device (11), humidity detecting device (21), or gaseous or liquid state fluid composition detecting device (31) being installed at a position to directly or indirectly detect a temperature variation, a humidity variation, or a gaseous or liquid state fluid composition variation within the heat exchange apparatus, wherein the at least one temperature detecting device (11), humidity detecting device (21), or gaseous or liquid state fluid composition detecting device (31) respectively provide temperature, humidity, or fluid composition detecting signals to said operative control device (250), said operation of operatively controlling a temperature distribution status within the heat exchange apparatus including an operation of controlling a timing of said switching or said flow rate control to control said temperature distribution by using said temperature detecting signals as a reference, said humidity detecting device being arranged to provide humidity detecting signals to said operative control device (250) to operatively control a humidity distribution within said heat exchange apparatus by using said humidity detection signals as a reference to control said switching or flow rate timing, and said gaseous or liquid state fluid composition detecting device being arranged to provide fluid composition detecting signals to said operative control device (250) as a reference to operatively control an inflow status of a respective said at least one heat exchange fluid.

16. The heat exchange apparatus as claimed in claim 15, wherein said heat exchange apparatus includes two different ones of said at least one temperature detecting device (11), said at least one humidity detecting device (12), and said at least one temperature detecting device (31).

17. The heat exchange apparatus as claimed in claim 15, wherein said operative control device (250) controls said switching or flow rate timing by operatively controlling said unidirectional pumps.

18. The heat exchange apparatus as claimed in claim 1, wherein the control device (250) is arranged to operatively control a timing of said at least two fluid pumps (111,112 or 120a,120b,120c,120d) that form a double flow circuit fluid pumping device (123) to change a direction of the fluid passing through the heat exchange apparatus and further to provide at least partial regulation of pump rotational speed, flow rate, and fluid pressure of individual said at least two fluid pumps (111,112 or 120a,120b,120c,120d) that form a double flow circuit fluid pumping device (123).

19. The heat exchange apparatus as claimed in claim 1, further comprising at least one of a temperature detecting device, a humidity detecting device, and a gaseous or liquid state fluid composition detecting device, wherein the at least two fluid pumps (111,112 or 120a,120b,120c,120d) that form a double flow circuit fluid pumping device (123) are operatively controlled by the operative control device (250) according to at least one of the following operative control modes:

(a) adjustment or setting of a pumping fluid flow rate is manually controlled;

(b) the flow rate is operatively controlled by referring to a signal detected by at least one temperature detecting device;

(c) the flow rate is operatively controlled by referring to a signal detected by at least one humidity detecting device;

(d) the flow rate is operatively controlled by referring to a signal detected by at least one gaseous or liquid state gaseous or liquid state fluid composition detecting device; and

(e) the flow rate is operatively controlled by two or more of said modes (a) to (d).

20. The heat exchange apparatus as claimed in claim 1, wherein operative control of flow rate of the at least one heat exchange fluid is achieved by:

(a) operatively controlling a rotational speed of said at least two fluid pumps (111,112 or 120a,120b,120c,120d) that form a double flow circuit fluid pumping device (123);

(b) operatively controlling said at least two fluid pumps (111,112 or 120a,120b,120c,120d) that form a double flow circuit fluid pumping device (123) to pump the fluid intermittently in order to modulate an average flow rate according to pumping on/off time ratio.

21. The heat exchange apparatus as claimed in claim 1, wherein a ratio of flow rates in said first and second fluid flow directions is one of the following:

(a) the flow rate in one said direction is greater than a flow rate in the other said direction;

(b) the flow rate in said directions is equal; and

(c) said pumps operating in different directions alternately pump the fluid streams in said first and second directions.

22. The heat exchange apparatus as claimed in claim 1, wherein said at least two fluid pumps (111,112 or 120a,120b,120c,120d) that form a double flow circuit fluid pumping device (123) are further arranged to pump said fluid into said heat exchange apparatus in same flow directions, to reversely pump said fluid out of said heat exchange apparatus, or to periodically pump said fluid into the heat exchange apparatus in same flow directions and out of said heat exchange apparatus in reverse flow directions.