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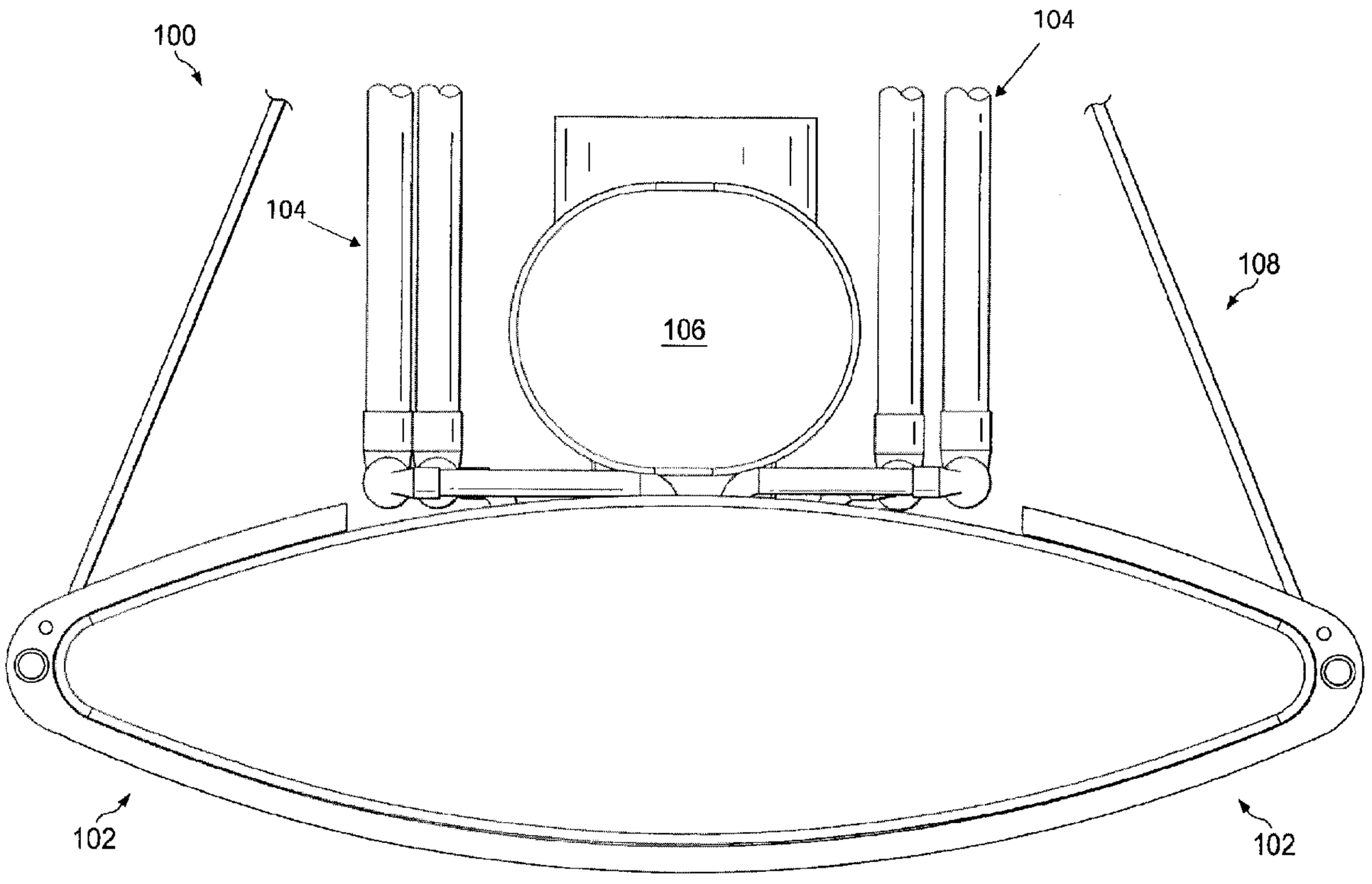
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(72) **Inventeurs/Inventors:**
HIRSCH, JOACHIM, US;
ZHANG, HONGHUI, US;
FREEMAN, ERNEST, US;
GLASCH, KEITH, US

(73) **Propriétaire/Owner:**
AIR DISTRIBUTION TECHNOLOGIES IP, LLC, US

(74) **Agent:** MOFFAT & CO.

(54) **Titre : COMMANDE D'ECLAIRAGE POUR POUTRE FROIDE**
(54) **Title: LIGHTING CONTROL FOR CHILLED BEAM**



(57) **Abrégé/Abstract:**
A device comprising a fin structure, a vent disposed in the fin structure, a cooling coil disposed in the vent, a light disposed in the fin structure and wherein the fin structure is configured to create a Coanda effect for air exiting the vent.

LIGHTING CONTROL FOR CHILLED BEAM

ABSTRACT

A device comprising a fin structure, a vent disposed in the fin structure, a cooling coil disposed in the vent, a light disposed in the fin structure and wherein the fin structure is configured to create a Coanda effect for air exiting the vent.

LIGHTING CONTROL FOR CHILLED BEAM

TECHNICAL FIELD

[0001] The present disclosure relates generally to heating, ventilation and air conditioning (HVAC) systems, and more specifically to a chilled beam light and temperature control.

BACKGROUND OF THE INVENTION

[0002] Chilled beams are typically used to provide cooled air, but can block light sources and, when exposed to low water temperatures or high humidity, generate condensation that drips on persons underneath the chilled beam.

SUMMARY OF THE INVENTION

[0003] A chilled beam is disclosed that uses a fin structure to create a Coanda effect, to modify the flow of air from the chilled beam from a vent disposed in the fin structure. A cooling coil disposed in the vent is used to chill the air from the vent, and a light is disposed in the fin structure.

[0004] Accordingly then, in one aspect, there is provided a method of controlling a chilled beam comprising: receiving a temperature reading; receiving a humidity reading; determining whether condensation will form on a heat exchanger as a function of the temperature reading and the humidity reading; and providing heat to a structure disposed underneath the heat exchanger to reduce condensation on the heat exchanger.

[0005] In accordance with a further aspect, there is provided a method of controlling a device having a fin structure, a vent disposed in the fin structure, a heat exchanger coil disposed in the vent, wherein the fin structure is configured to create a Coanda effect for air exiting the vent, a heat source connected to a plurality of pipes located underneath the heat exchanger coil, a first piping manifold coupled to the heat exchanger coil, a second piping manifold coupled to the heat source and the pipes, a humidity controller coupled to the heat source and configured to activate the heat source in response to a humidity measurement, a direct light source disposed on a top surface of the fin structure, an indirect light source disposed on a bottom surface of the fin structure, a first temperature controller coupled to the heat exchanger coil and configured to provide chilled water to the heat exchanger coil in response to a first temperature measurement, a second temperature controller coupled to the heat source and configured to activate the heat source in response to a second temperature measurement, and a duct disposed over the fin structure and coupled to the vent, the method comprising: receiving a temperature reading; receiving a humidity reading; determining whether condensation will form on the heat exchanger coil as a function of the temperature reading and the humidity reading; activating the heat source to reduce condensation on the heat exchanger coil; wherein receiving the temperature reading comprises receiving a chilled water temperature reading, wherein receiving the temperature reading comprises receiving an air inlet temperature reading, wherein receiving the humidity reading comprises receiving an air inlet humidity reading, wherein receiving the humidity reading comprises receiving a room air humidity reading,

wherein determining whether condensation will form on the heat exchanger coil as the function of the temperature reading and the humidity reading comprises using a look up table of dew point values, and wherein activation of the heat source comprises actuating a valve to allow hot water to flow through one or more of the pipes.

[0006] Other systems, methods, features, and advantages of the present disclosure will be or become apparent to one with skill in the art upon examination of the following drawings and detailed description. It is intended that all such additional systems, methods, features, and advantages be included within this description, be within the scope of the present disclosure, and be protected by the accompanying claims.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0007] Aspects of the disclosure can be better understood with reference to the following drawings. The components in the drawings are not necessarily to scale, emphasis instead being placed upon clearly illustrating the principles of the present disclosure. Moreover, in the drawings, like reference numerals designate corresponding parts throughout the several views, and in which:

[0008] FIGURE 1 is a diagram of a chilled beam in accordance with an exemplary embodiment of the present disclosure;

[0009] FIGURE 2 is a diagram of a chilled beam with direct and indirect lighting, in accordance with an exemplary embodiment of the present disclosure;

[0010] FIGURE 3 is a diagram of a chilled beam with an air duct interface, in accordance with an exemplary embodiment of the present disclosure;

[0011] FIGURE 4 is a diagram of a system for controlling a chilled beam, in accordance with an exemplary embodiment of the present disclosure; and

[0012] FIGURE 5 is a diagram of an algorithm for controlling a chilled beam, in accordance with an exemplary embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE INVENTION

[0013] In the description that follows, like parts are marked throughout the specification and drawings with the same reference numerals. The drawing figures might not be to scale and certain components can be shown in generalized or schematic form and identified by commercial designations in the interest of clarity and conciseness.

[0014] **FIGURE 1** is a diagram of chilled beam 100 in accordance with an exemplary embodiment of the present disclosure. Chilled beam 100 can be constructed from metallic materials such as stainless steel, copper and aluminum, can include additional decorative and functional components made from plastic, wood or other materials, and can include other suitable system components, such as lighting modules and valve controllers.

[0015] Chilled beam 100 includes a fin structure 102, which is used to create a Coanda effect to cause conditioned air to flow out of chilled beam 100 to the left and right of chilled beam 100, instead of in a downward direction from chilled beam 100. Fins comprising the fin structure 102 are arcuate and symmetrical about an X axis and a Y axis of chilled beam 100, and extend equidistant from a center line of chilled beam 100, but can also or alternatively be provided in other suitable configurations, such as with an

asymmetrical structure about the X axis, with an asymmetrical structure about the Y axis, with a design that does not create a Coanda effect on one or both sides or in other suitable configurations.

[0016] In addition, fin structure 102 includes lighting fixtures that are disposed in the top and bottom of each fin, to provide for both direct and indirect lighting. Piping manifolds 104 are used to supply heated or chilled water or other suitable heating and cooling media to chilled beam 100. Air duct 106 provides air to chilled beam 100 for heating or cooling, such as fresh air from outside of a building, recirculated air from inside of a building, a mix of fresh and recirculated air or air from other suitable sources. Supports 108 provide the structural support for chilled beam 100, and are attached to the ceiling, a beam, a girder, or other suitable support structures.

[0017] In operation, chilled beam 100 hangs from a ceiling or other suitable support structure and provides fresh air to a room in conjunction with heating or cooling the air, so as to allow the room climate to be controlled. In addition, chilled beam 100 includes direct and indirect lighting and humidity control, as discussed further herein.

[0018] **FIGURE 2** is a diagram of chilled beam 200 with direct and indirect lighting, in accordance with an exemplary embodiment of the present disclosure. Chilled beam 200 includes indirect lighting fixtures 202A and 202B and direct lighting fixtures 204A and 204B, which are coupled to a suitable controller (not explicitly shown) to allow a user to turn on either or both of indirect lighting fixtures 202A and 202B and either or both of direct lighting fixtures 204A and 204B. In this manner, a user who is working underneath chilled beam 200 can turn on direct lighting fixtures 204A

and 204B if additional direct lighting is required, whereas indirect lighting fixtures 202A and 202B can be used to provide ambient lighting to the room.

[0019] Chilled beam 200 further includes fluid inlets 210A and 212A and fluid outlets 210B and 212B. Fluid inlet 210A and fluid outlet 210B comprise a first piping manifold connected to the heat exchanger coils 206, and fluid inlet 212A and fluid outlet 212B comprise a second piping manifold connected to pipes 208, which can provide heated water on 212A and 212B or chilled water on 210A and 210B, steam or other suitable fluids to heat exchanger coils 206 and pipes 208. A valve structure 218 with one or more separate valves can be used to control the flow of heated or chilled water, and can be disposed at a suitable location, either within chilled beam 200 or at a location along the supply lines to fluid inlets 210A and 212A. In one exemplary embodiment, chilled water can be provided to heat exchanger coils 206, which remove heat from air provided by duct 106 to vent 214A, 214B. As previously discussed, the shape of fin structure 102 causes the air from vent 214A, 214B to travel in directions 216A and 216B, respectively, due to the Coanda effect, instead of blowing directly downward onto any persons who happen to be underneath chilled beam 200. In this manner, the temperature of the air within a room or other enclosed space can be controlled while avoiding exposure of persons within the room or enclosed space to drafts. In addition, heated water can be provided to pipes 208, which are disposed underneath heat exchanger coils 206, so as to raise the ambient temperature in the vicinity of the bottom of heat exchanger coils 206 so as to prevent the formation of condensation. In the absence of heated pipes 208, such condensation could accumulate and drip onto persons who

happen to be underneath chilled beam 200. A controller (not explicitly shown) can be used to measure the relative humidity of the air within the room or enclosed space, and heated water, steam or other suitable heating can be provided to pipes 208 when the humidity is above a level at which condensation forms. Pipes 208 can also be provided without any connection to a source of heating, such as in areas with low relative humidity, for decorative purposes only.

[0020] In addition, heated water, steam or other suitable heating fluids can be provided to pipes 208 for the purpose of heating the room or enclosed space by radiant heating, such as during the night when air is not being provided to the room through duct 106 and vent 214A, 214B. In this manner, chilled beam 200 can be used both for providing cooling during the day and heating during the night.

[0021] **FIGURE 3** is a diagram of chilled beam 300 with air duct interface 302, in accordance with an exemplary embodiment of the present disclosure. Air duct interface 302 is used to couple chilled beam 300 to an air duct (not explicitly shown), to allow fresh or combined fresh and recirculated air to be provided to chilled beam 300. In addition, fluid inlets 304A and 306A and fluid outlets 304B and 306B are used to convey chilled or heated water or other suitable fluids to chilled beam 300. Fluid inlets 304A and 306A and fluid outlets 304B and 306B extend downward from a ceiling or other suitable structures, parallel and adjacent to the duct that is used to provide fresh or combined fresh and recirculated air to chilled beam 300, and then turn 90 degrees and run parallel and adjacent to fins 308 and duct 310.

[0022] **FIGURE 4** is a diagram of a system 400 for controlling a chilled beam, in accordance with an exemplary

embodiment of the present disclosure. System 400 can be implemented in hardware or a suitable combination of hardware and software, and can be one or more software systems operating on one or more special purpose processors. In one exemplary embodiment, system 400 can be implemented on a touch screen user interface device and an associated processor that includes wireless connectivity to temperature sensors, humidity sensors, valve operators, lighting controllers, building energy management systems and other suitable systems and components.

[0023] As used herein, "hardware" can include a combination of discrete components, an integrated circuit, an application-specific integrated circuit, a field programmable gate array, or other suitable hardware. As used herein, "software" can include one or more objects, agents, threads, lines of code, subroutines, separate software applications, two or more lines of code or other suitable software structures operating in two or more software applications, on one or more processors (where a processor includes a microcomputer or other suitable controller, memory devices, input-output devices, displays, data input devices such as a keyboard or a mouse, peripherals such as printers and speakers, associated drivers, control cards, power sources, network devices, docking station devices, or other suitable devices operating under control of software systems in conjunction with the processor or other devices), or other suitable software structures. In one exemplary embodiment, software can include one or more lines of code or other suitable software structures operating in a general purpose software application, such as an operating system, and one or more lines of code or other suitable software structures operating in a specific purpose software application. As

used herein, the term "couple" and its cognate terms, such as "couples" and "coupled," can include a physical connection (such as a copper conductor), a virtual connection (such as through randomly assigned memory locations of a data memory device), a logical connection (such as through logical gates of a semiconducting device), other suitable connections, or a suitable combination of such connections.

[0024] Humidity control 404 receives temperature data from a room temperature sensor, temperature data from a chilled water source, humidity data from a room humidity sensor, humidity data from an air source humidity sensor and other suitable data, and determines whether local heating on a surface adjacent to a cooling coil is needed to prevent condensation on the cooling coil. In this exemplary embodiment, dew point tables or other suitable data can be used to determine whether chilled water that is being provided to a cooling coil of a heat exchanger will cause condensation to form on the coil. If it is determined that condensation will form, humidity control 404 can actuate a control valve to allow heated water to flow to pipes that are disposed underneath the cooling coil, so as to decrease the relative humidity of air in the immediate vicinity of the cooling coil, and prevent the formation of condensation. Likewise, if the humidity content of air within the room is different from the humidity content of fresh air that is being provided to the chilled beam, then additional processing can be used to determine whether the control valve for heated water should be activated, such as based on design factors of the chilled beam and the measured room and air source humidity levels, air flow rates or other data.

[0025] Direct light control 406 provides automatic or user control for direct lighting of a space underneath a lighted

chilled beam. In one exemplary embodiment, a motion sensor or other device can be used to determine whether a person is underneath the lighted chilled beam, and direct light control 406 can activate direct lighting of the lighted chilled beam if the motion sensor data or other suitable data indicates that a person is present. In addition or alternatively, a switch, touch screen interface or suitable user control can be used to allow a user to manually turn direct lighting on or off, as needed.

[0026] Indirect light control 408 provides automatic or user control of indirect lighting of a space in the vicinity of a lighted chilled beam. In one exemplary embodiment, a motion sensor, a timer or other suitable devices can be used to determine whether indirect lighting should be provided in a space, such as during normal working hours or when persons are present, and indirect light control 408 can activate indirect lighting of the lighted chilled beam if the motion sensor data, timer data or other suitable data indicates that indirect lighting should be activated. In addition or alternatively, a switch, touch screen interface or suitable user control can be used to allow a user to manually turn direct lighting on or off, as needed.

[0027] Temperature control 410 receives temperature data from a room temperature sensor, temperature data from a chilled water source, timer data from a clock and other suitable data, and determines whether chilled water should be provided to a cooling coil of a chilled beam, whether heated water or other suitable heat sources should be used to heat pipes or other suitable radiant heaters, or if other suitable temperature controls should be implemented. In this exemplary embodiment, room temperature measurement data and settings or other suitable data can be used to determine if

the room temperature should be reduced by providing chilled water to a cooling coil of a heat exchanger or if the room temperature should be increased by providing heated water to a radiant heater. If it is determined that chilled or heated water should be provided, temperature control 410 can actuate one or more control valves to allow the chilled or heated water to flow as needed. Likewise, a user-controllable thermostat, a touch screen interface or other suitable devices can be used to allow a user to control the temperature of the room.

[0028] **FIGURE 5** is a diagram of an algorithm 500 for controlling a chilled beam, in accordance with an exemplary embodiment of the present disclosure. Algorithm 500 can be implemented in hardware or a suitable combination of hardware and software, and can be one or more algorithms operating on a programmable controller or other suitable devices.

[0029] Algorithm 500 begins at 502, where the humidity content of room air, outside air provided by ductwork or other suitable air is measured. In one exemplary embodiment, the humidity can be measured based on the source that is the major contributor to condensation, such as when the humidity content of air within the controlled space is significantly greater or lesser than the humidity content of external air that is being provided to the controlled space. In addition, the air temperature within the controlled space, the air temperature of the external air, the temperature of the chilled water or other suitable temperature data that is needed to determine whether condensation will form can be obtained. The algorithm then proceeds to 504.

[0030] At 504, it is determined whether the measured humidity is greater than a predetermined level at which condensation will form, such as by comparing the measured

humidity to a table as a function of the air temperature, the water temperature of chilled water that is being provided to the chilled beam, or other suitable data. If the humidity does not exceed the predetermined level, the algorithm proceeds to 508, otherwise the algorithm proceeds to 506 where heat is provided to a grill that is adjacent to cooling coils where condensation would otherwise form. In one exemplary embodiment, the heat can be provided by heated water, steam, electrical heating or other suitable heating, the amount of heat can be varied as a function of the measured humidity, or other suitable processes can also or alternatively be used. The algorithm then proceeds to 508.

[0031] At 508, the room temperature is measured, such as for room temperature control or other suitable purposes. In one exemplary embodiment, a thermostat or other suitable device can be used to measure the temperature. The algorithm then proceeds to 510, where it is determined whether the temperature needs to be modified. In one exemplary embodiment, temperature set points as a function of time can be used to determine whether the temperature in a space needs to be increased or lowered, a user control can be provided to allow a user to increase or decrease the temperature as desired, or other suitable processes can also or alternatively be used. If it is determined that no modification is required, the algorithm proceeds to 514, otherwise the algorithm proceeds to 512, where a flow of heated or chilled water is adjusted as required in response to the temperature data and settings, such as by opening or closing one or more control valves. The algorithm then proceeds to 514.

[0032] At 514, light control data is read, such as by determining a state of a touch screen controller, a switch or

other suitable light controls. The algorithm then proceeds to 516, where it is determined whether an adjustment is required to a direct lighting control, such as in response to a user selection, motion sensor data or other suitable data. If it is determined that no adjustment is required, the algorithm proceeds to 520, otherwise the algorithm proceeds to 518, where the direct lighting is increased or decreased in response to the control data. The algorithm then proceeds to 520.

[0033] At 520, it is determined whether an adjustment is required to an indirect lighting control, such as in response to a user selection, time of day data or other suitable data. If it is determined that no adjustment is required, the algorithm returns to 502, otherwise the algorithm proceeds to 522, where the indirect lighting is increased or decreased in response to the control data. The algorithm then returns to 502.

[0034] Although algorithm 500 is shown as a flow chart, other suitable programming paradigms can also or alternatively be used to implement algorithm 500, such as a state diagram, two or more dedicated control algorithms of separate control devices, or other suitable configurations.

[0035] It should be emphasized that the above-described embodiments are merely examples of possible implementations. Many variations and modifications may be made to the above-described embodiments without departing from the principles of the present disclosure. All such modifications and variations are intended to be included herein within the scope of this disclosure and protected by the following claims.

What is claimed is:

1. A method of controlling a chilled beam comprising:

receiving a temperature reading;

receiving a humidity reading;

determining whether condensation will form on a heat exchanger as a function of the temperature reading and the humidity reading; and

providing heat to a structure disposed underneath the heat exchanger to reduce condensation on the heat exchanger.

2. The method of claim 1, wherein receiving the temperature reading comprises receiving a chilled water temperature reading.

3. The method of claim 1 or 2, wherein receiving the temperature reading comprises receiving an air inlet temperature reading.

4. The method of any one of claims 1 to 3, wherein receiving the humidity reading comprises receiving an air inlet humidity reading.

5. The method of any one of claims 1 to 3, wherein receiving the humidity reading comprises receiving a room air humidity reading.

6. The method of any one of claims 1 to 5, wherein determining whether condensation will form on the heat exchanger as the function of the temperature reading and the humidity reading comprises using a look up table of dew point values.

7. The method of any one of claims 1 to 6, wherein providing the heat to the structure disposed underneath the heat exchanger to reduce condensation on the heat exchanger comprises actuating a valve to allow hot water to flow through one or more pipes that are disposed underneath the heat exchanger.

8. A method of controlling a device having a fin structure, a vent disposed in the fin structure, a heat exchanger coil disposed in the vent, wherein the fin structure is configured to create a Coanda effect for air exiting the vent, a heat source connected to a plurality of pipes located underneath the heat exchanger coil, a first piping manifold coupled to the heat exchanger coil, a second piping manifold coupled to the heat source and the pipes, a humidity controller coupled to the heat source and configured to activate the heat source in response to a humidity measurement, a direct light source disposed on a top surface of the fin structure, an indirect light source disposed on a bottom surface of the fin structure, a first temperature controller coupled to the heat exchanger coil and configured to provide chilled water to the heat exchanger coil in response to a first temperature measurement, a second temperature controller coupled to the heat source and configured to activate the heat source in response to a second temperature measurement, and a duct disposed over the fin structure and coupled to the vent, the method comprising:

receiving a temperature reading;

receiving a humidity reading;

determining whether condensation will form on the heat exchanger coil as a function of the temperature reading and the humidity reading;

activating the heat source to reduce condensation on the heat exchanger coil;

wherein receiving the temperature reading comprises receiving a chilled water temperature reading, wherein receiving the temperature reading comprises receiving an air inlet temperature reading, wherein receiving the humidity reading comprises receiving an air inlet humidity reading, wherein receiving the humidity reading comprises receiving a room air humidity reading, wherein determining whether condensation will form on the heat exchanger coil as the function of the temperature reading and the humidity reading comprises using a look up table of dew point values, and wherein activation of the heat source comprises actuating a valve to allow hot water to flow through one or more of the pipes.

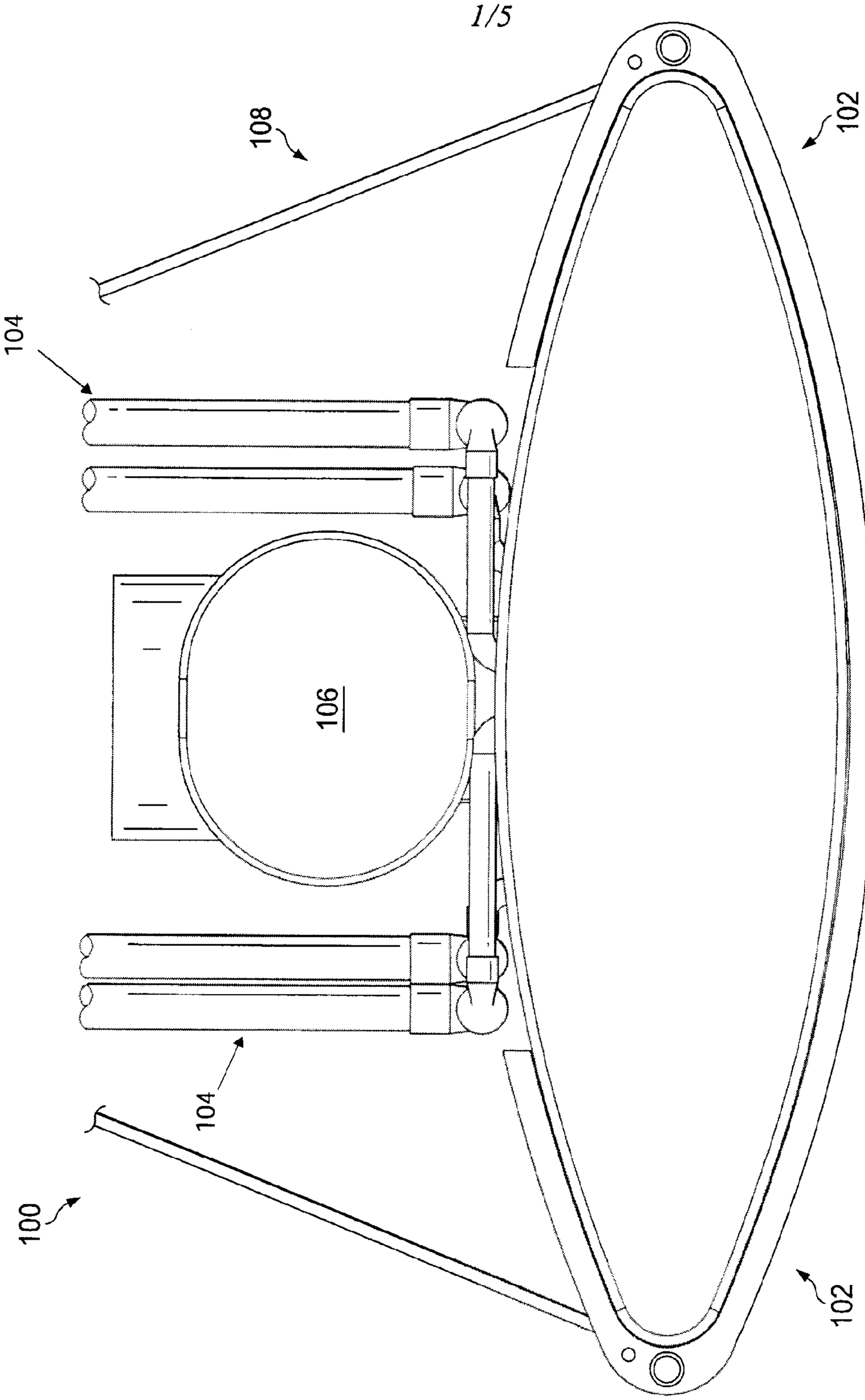


FIG. 1

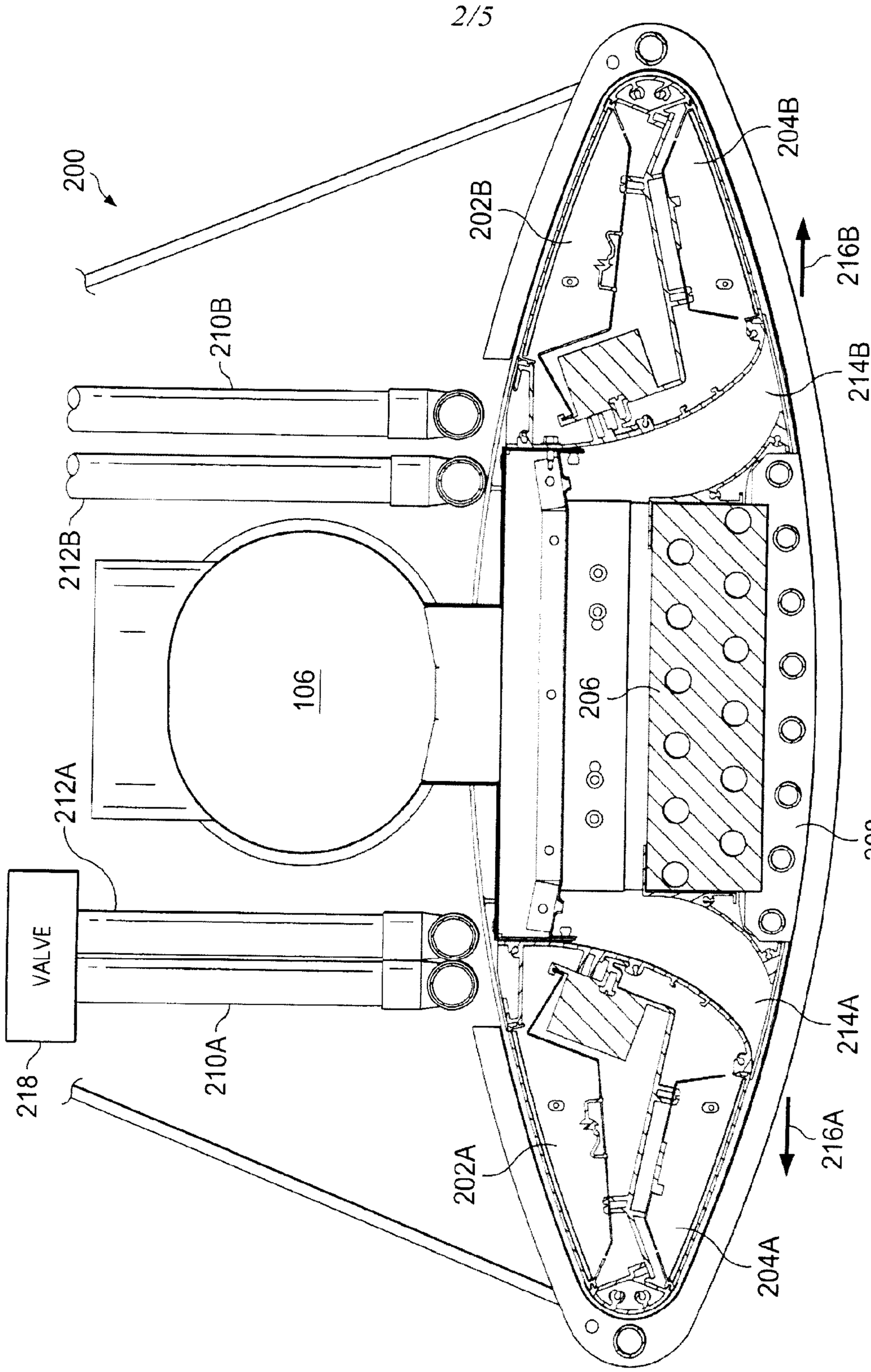

200
210B
212B
106
212A
VALVE
218
210A
202B
204B
216B
214B
206
208
214A
202A
204A
216A

FIG. 2

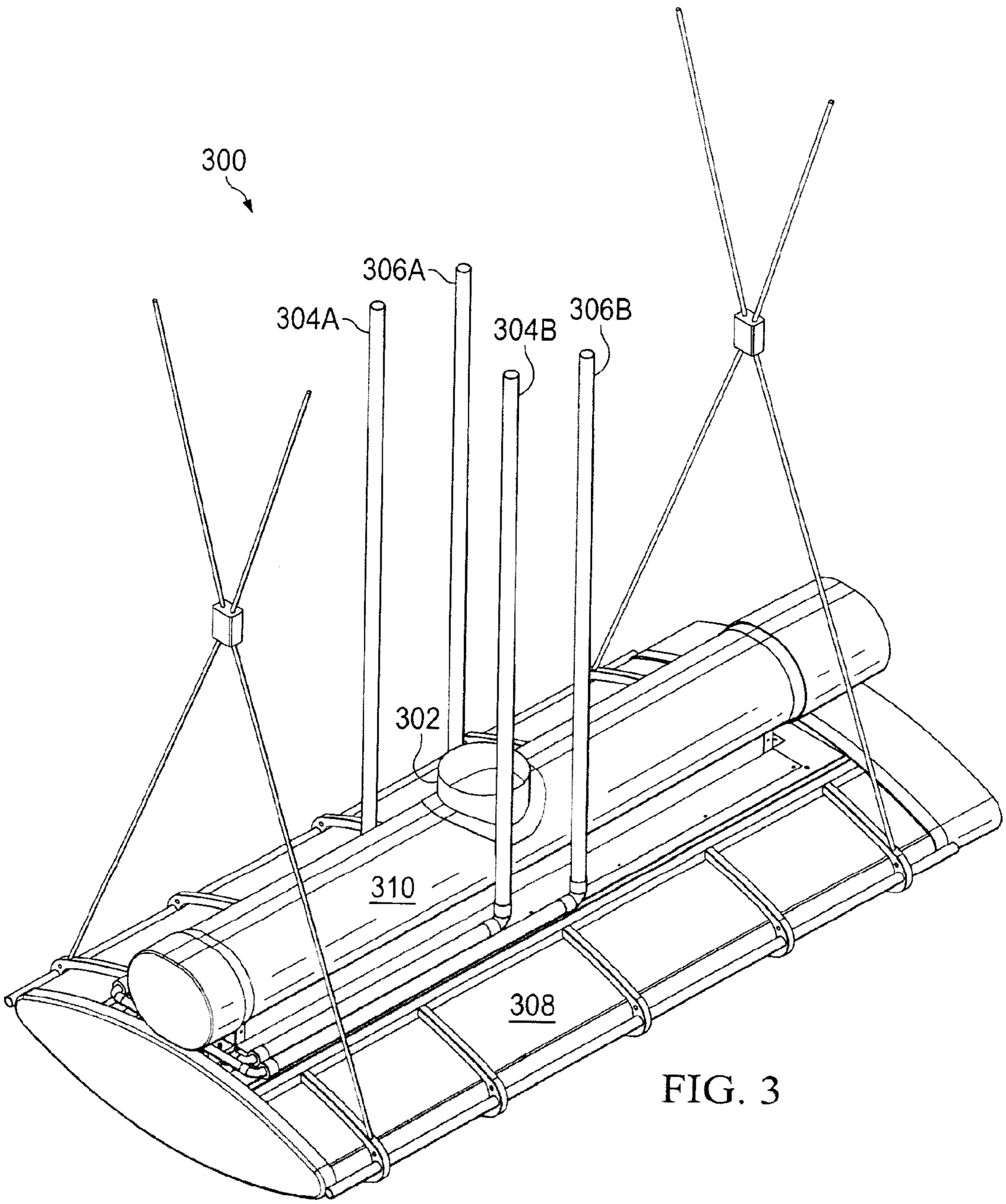


FIG. 3

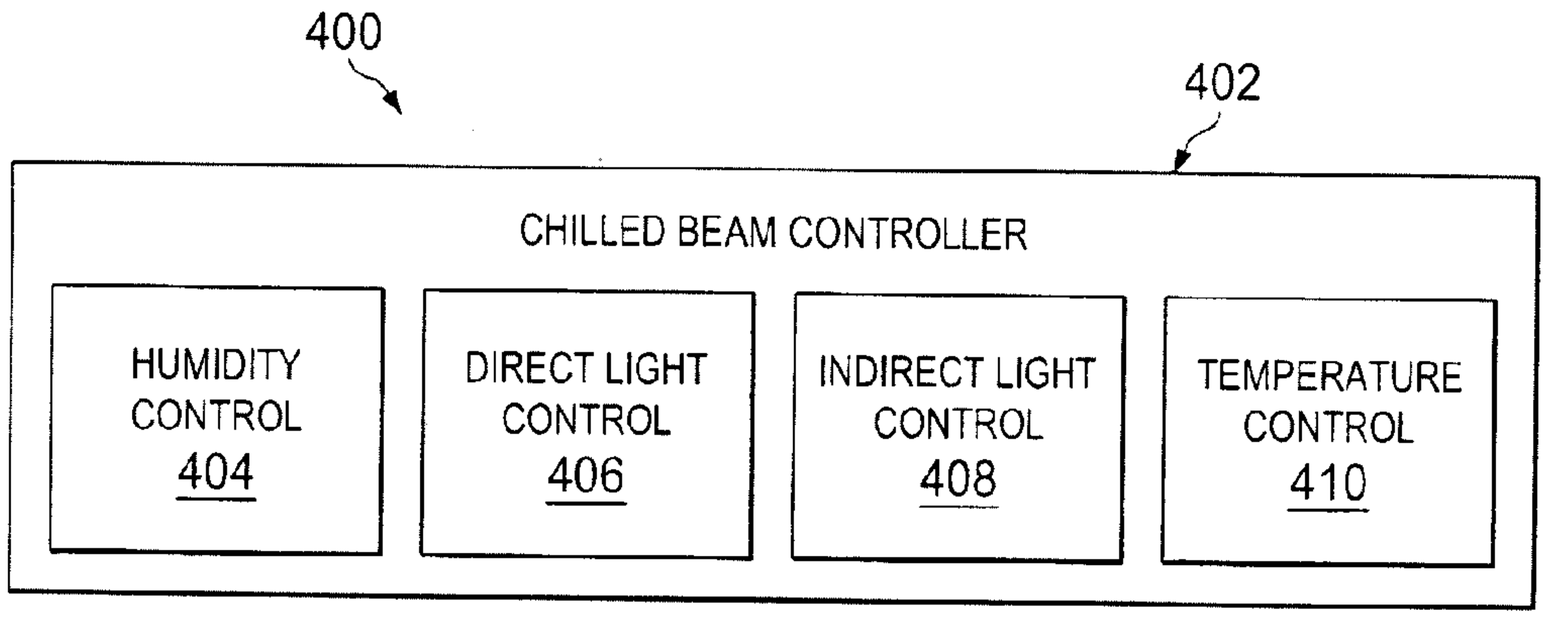

400
402
CHILLED BEAM CONTROLLER
HUMIDITY CONTROL 404
DIRECT LIGHT CONTROL 406
INDIRECT LIGHT CONTROL 408
TEMPERATURE CONTROL 410

FIG. 4

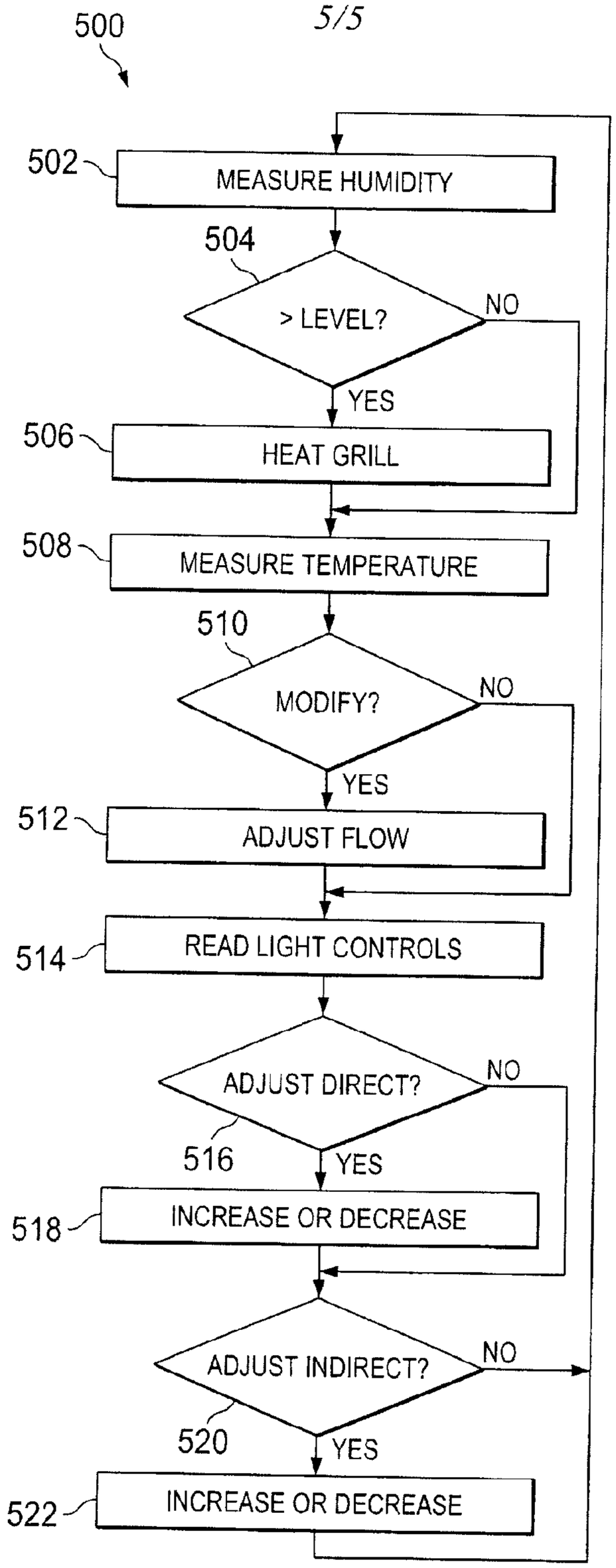
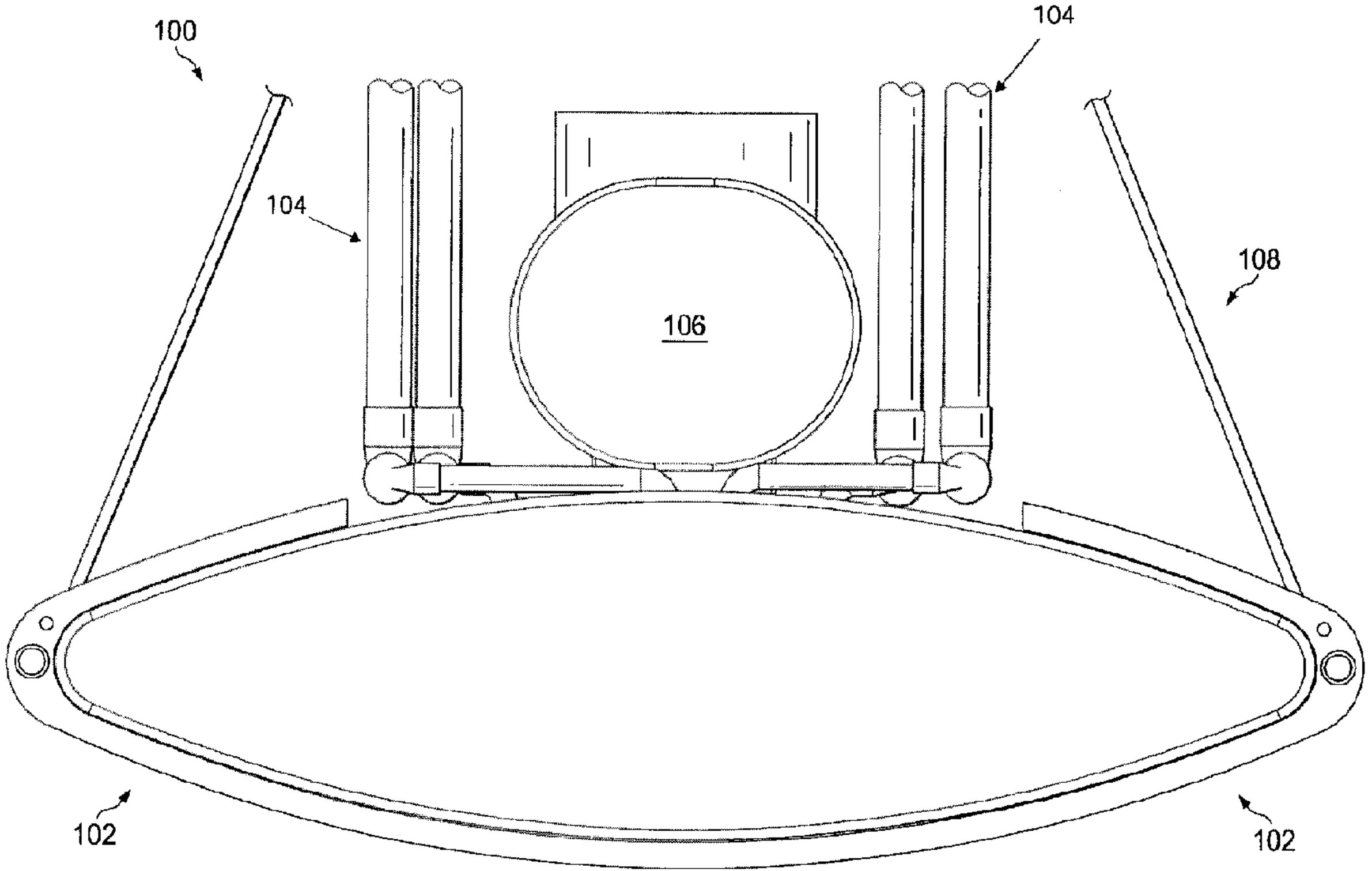

500
502
MEASURE HUMIDITY
504
> LEVEL?
NO
YES
506
HEAT GRILL
508
MEASURE TEMPERATURE
510
MODIFY?
NO
YES
512
ADJUST FLOW
514
READ LIGHT CONTROLS
ADJUST DIRECT?
NO
516
YES
518
INCREASE OR DECREASE
ADJUST INDIRECT?
NO
520
YES
522
INCREASE OR DECREASE

FIG. 5


100
104
104
106
108
102
102