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(54) **ICE MAKING SYSTEM WITH DISINFECTION FUNCTION**

(57) An ice making system (186) includes an ice maker (160) configured to form ice pieces therein with a top reservoir (188) upstream of the ice maker (160) and an ice bucket (164) in communication with the ice maker (160). The ice making system (186) also includes a recirculation tank (202) and a recirculation pump (204). An oxidizing agent generator (200) is configured to generate one or more oxidizing agents and provide the one or more oxidizing agents to form treated water within the ice making system (186).

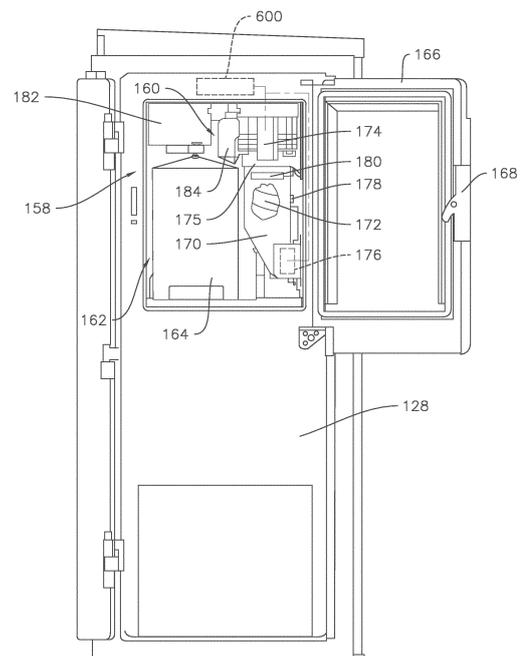


FIG. 3

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Description

FIELD OF THE INVENTION

[0001] The present subject matter relates generally to ice making systems and sanitizing features for such systems.

BACKGROUND OF THE INVENTION

[0002] Various appliances, such as refrigerator appliances or stand-alone ice maker appliances, include an ice making system. To produce ice, liquid water is directed to an ice maker of the ice making system and frozen. A variety of ice types can be produced depending upon the particular ice maker used. For example, certain ice makers include a mold body for receiving liquid water. An auger within the mold body can rotate and scrape ice off an inner surface of the mold body to form ice nuggets. Such ice makers are generally referred to as nugget style ice makers. Certain consumers prefer nugget style ice makers and their associated ice nuggets.

[0003] Ice nuggets are generally stored in an ice bucket at temperatures above the freezing temperature of liquid water to maintain a texture of the ice nuggets. When stored at temperatures above freezing, ice nuggets can melt and liquid water from melted ice nuggets can collect within the ice bucket. The liquid water is typically collected and recirculated through the system back to the ice maker for making additional ice. Recirculating the water, e.g., where the water remains within the ice making system for an extended period of time such as after melting and returning to the ice maker, may lead to biological contamination and biofilm formation over time.

[0004] Accordingly, an ice making system with features for removing or reducing microbes and other contaminants that may accumulate within the system, particularly in recirculated water within the system, would be useful.

BRIEF DESCRIPTION OF THE INVENTION

[0005] Aspects and advantages of the invention will be set forth in part in the following description, or may be apparent from the description, or may be learned through practice of the invention.

[0006] In one exemplary embodiment, an ice making system is provided. The ice making system includes an ice maker. The ice maker is configured to form ice pieces within the ice maker. The ice making system also includes a top reservoir upstream of the ice maker whereby the ice maker is configured to receive a flow of water from the top reservoir and to form the ice pieces from the received water from the top reservoir. The ice making system further includes an ice bucket defining a storage volume. The ice bucket is in communication with the ice maker whereby the ice bucket is configured to receive the ice pieces into the storage volume. The ice making

system also includes a recirculation tank in fluid communication with the ice bucket whereby the recirculation tank is configured to receive melt water from the storage volume of the ice bucket and a recirculation pump in fluid communication with the recirculation tank and the top reservoir. The recirculation pump is configured to pump the melt water from the recirculation tank to the top reservoir. The ice making system also includes an oxidizing agent generator configured to generate one or more oxidizing agents and provide the one or more oxidizing agents to form treated water within the ice making system.

[0007] In another exemplary embodiment, a refrigerator appliance is provided. The refrigerator appliance includes a housing defining a chilled chamber and an ice making system disposed within the housing. The ice making system includes an ice maker. The ice maker is configured to form ice pieces within the ice maker. The ice making system also includes a top reservoir upstream of the ice maker whereby the ice maker is configured to receive a flow of water from the top reservoir and to form the ice pieces from the received water from the top reservoir. The ice making system further includes an ice bucket defining a storage volume. The ice bucket is in communication with the ice maker whereby the ice bucket is configured to receive the ice pieces into the storage volume. The ice making system also includes a recirculation tank in fluid communication with the ice bucket whereby the recirculation tank is configured to receive melt water from the storage volume of the ice bucket and a recirculation pump in fluid communication with the recirculation tank and the top reservoir. The recirculation pump is configured to pump the melt water from the recirculation tank to the top reservoir. The ice making system also includes an oxidizing agent generator configured to generate one or more oxidizing agents and provide the one or more oxidizing agents to form treated water within the ice making system.

[0008] These and other features, aspects and advantages of the present invention will become better understood with reference to the following description and appended claims. The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] A full and enabling disclosure of the present invention, including the best mode thereof, directed to one of ordinary skill in the art, is set forth in the specification, which makes reference to the appended figures.

FIG. 1 provides a perspective view of a refrigerator appliance according to an exemplary embodiment of the present subject matter.

FIG. 2 provides a perspective view of a door of the

exemplary refrigerator appliance of FIG. 1.

FIG. 3 provides an elevation view of the door of the exemplary refrigerator appliance of FIG. 2 with an access door of the door shown in an open position. FIG. 4 provides a schematic diagram of an ice making system and water flow paths therethrough according to one or more exemplary embodiments of the present subject matter.

FIG. 5 provides a schematic diagram of an ice making system and water flow paths therethrough according to one or more additional exemplary embodiments of the present subject matter.

FIG. 6 provides a schematic diagram of an ice making system and water flow paths therethrough according to one or more additional exemplary embodiments of the present subject matter.

FIG. 7 provides a schematic diagram of an ice making system and water flow paths therethrough according to one or more additional exemplary embodiments of the present subject matter.

DETAILED DESCRIPTION

[0010] Reference now will be made in detail to embodiments of the invention, one or more examples of which are illustrated in the drawings. The detailed description uses numerical and letter designations to refer to features in the drawings. Like or similar designations in the drawings and description have been used to refer to like or similar parts of the disclosure. Each example is provided by way of explanation of the invention, not limitation of the invention. In fact, it will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope or spirit of the invention. For instance, features illustrated or described as part of one embodiment can be used with another embodiment to yield a still further embodiment. Thus, it is intended that the present invention covers such modifications and variations as come within the scope of the appended claims and their equivalents.

[0011] As used herein, the terms "first," "second," and "third" may be used interchangeably to distinguish one component from another and are not intended to signify location or importance of the individual components. The terms "includes" and "including" are intended to be inclusive in a manner similar to the term "comprising." Similarly, the term "or" is generally intended to be inclusive (i.e., "A or B" is intended to mean "A or B or both"). In addition, here and throughout the specification and claims, range limitations may be combined and/or interchanged. Such ranges are identified and include all the sub-ranges contained therein unless context or language indicates otherwise. For example, all ranges disclosed herein are inclusive of the endpoints, and the endpoints are independently combinable with each other. The singular forms "a," "an," and "the" include plural references unless the context clearly dictates otherwise.

[0012] Approximating language, as used herein throughout the specification and claims, may be applied to modify any quantitative representation that could permissibly vary without resulting in a change in the basic function to which it is related. Accordingly, a value modified by a term or terms, such as "generally," "about," "approximately," and "substantially," are not to be limited to the precise value specified. In at least some instances, the approximating language may correspond to the precision of an instrument for measuring the value, or the precision of the methods or machines for constructing or manufacturing the components and/or systems. For example, the approximating language may refer to being within a 10 percent margin, i.e., including values within ten percent greater or less than the stated value. In this regard, for example, when used in the context of an angle or direction, such terms include within ten degrees greater or less than the stated angle or direction, e.g., "generally vertical" includes forming an angle of up to ten degrees in any direction, e.g., clockwise or counterclockwise, with the vertical direction V.

[0013] The word "exemplary" is used herein to mean "serving as an example, instance, or illustration." In addition, references to "an embodiment" or "one embodiment" does not necessarily refer to the same embodiment, although it may. Any implementation described herein as "exemplary" or "an embodiment" is not necessarily to be construed as preferred or advantageous over other implementations.

[0014] The terms "upstream" and "downstream" refer to the relative flow direction with respect to fluid flow in a fluid pathway. For example, "upstream" refers to the flow direction from which the fluid flows, and "downstream" refers to the flow direction to which the fluid flows.

[0015] FIG. 1 provides a perspective view of a refrigerator appliance 100 according to an exemplary embodiment of the present subject matter. Refrigerator appliance 100 includes a cabinet or housing 120 that extends between a top 101 and a bottom 102 along a vertical direction V, between a left side 104 and a right side 106 along the lateral direction L, and between a front 108 and a rear 110 along the transverse direction T. Housing 120 defines chilled chambers for receipt of food items for storage. In particular, housing 120 defines fresh food chamber 122 positioned at or adjacent top 101 of housing 120 and a freezer chamber 124 arranged at or adjacent bottom 102 of housing 120. As such, refrigerator appliance 100 is generally referred to as a bottom mount refrigerator. It is recognized, however, that the benefits of the present disclosure apply to other types and styles of refrigerator appliances such as, e.g., a top mount refrigerator appliance, a side-by-side style refrigerator appliance or a standalone ice maker appliance. Consequently, the description set forth herein is for illustrative purposes only and is not intended to be limiting in any aspect to any particular refrigerator chamber configuration.

[0016] Refrigerator doors 128 are rotatably hinged to an edge of housing 120 for selectively accessing fresh

food chamber 122. In addition, a freezer door 130 is arranged below refrigerator doors 128 for selectively accessing freezer chamber 124. Freezer door 130 is coupled to a freezer drawer (not shown) slidably mounted within freezer chamber 124. Refrigerator doors 128 and freezer door 130 are shown in the closed configuration in FIG. 1.

[0017] Refrigerator appliance 100 also includes a dispensing assembly 140 for dispensing liquid water and/or ice. Dispensing assembly 140 includes a dispenser 142 positioned on or mounted to an exterior portion of refrigerator appliance 100, e.g., on one of doors 128. Dispenser 142 includes a discharging outlet 144 for accessing ice and liquid water. An actuating mechanism 146, shown as a paddle, is mounted below discharging outlet 144 for operating dispenser 142. In alternative exemplary embodiments, any suitable actuating mechanism may be used to operate dispenser 142. For example, dispenser 142 can include a sensor (such as an ultrasonic sensor) or a button rather than the paddle. A user interface panel 148 is provided for controlling the mode of operation. For example, user interface panel 148 includes a plurality of user inputs (not labeled), such as a water dispensing button and an ice-dispensing button, for selecting a desired mode of operation such as crushed or non-crushed ice.

[0018] Discharging outlet 144 and actuating mechanism 146 are an external part of dispenser 142 and are mounted in a dispenser recess 150. Dispenser recess 150 is positioned at a predetermined elevation convenient for a user to access ice or water and enabling the user to access ice without the need to bend-over and without the need to open doors 128. In the exemplary embodiment, dispenser recess 150 is positioned at a level that approximates the chest level of a user.

[0019] FIG. 2 provides a perspective view of a door of refrigerator doors 128. Refrigerator appliance 100 includes a sub-compartment 162 defined on refrigerator door 128. Sub-compartment 162 may be referred to as an "icebox." Sub-compartment 162 extends into fresh food chamber 122 when refrigerator door 128 is in the closed position. As discussed in greater detail below, an ice making assembly 158 including an ice maker 160 and an ice storage bin or ice bucket 164 (FIG. 3) may be positioned or disposed within sub-compartment 162. The ice maker 160 may be configured to form ice pieces, e.g., ice nuggets as described below, within the ice maker 160. The ice maker 160 may be in communication with the ice bucket 164 such that ice pieces, e.g., nuggets, formed in the ice maker 160 may be transferred to and stored in the ice bucket 164. Thus, ice is supplied to dispenser recess 150 (FIG. 1) from the ice bucket 164 in sub-compartment 162 on a back side of refrigerator door 128. Chilled air from a sealed system (not shown) of refrigerator appliance 100 may be directed into components within sub-compartment 162, e.g., ice maker 160 and/or ice bucket 164. In certain exemplary embodiments, a temperature of air within sub-compartment 162

may correspond to a temperature of air within fresh food chamber 122, such that ice within ice bucket 164 melts over time.

[0020] An access door 166 is hinged to refrigerator door 128. Access door 166 permits selective access to sub-compartment 162. Any manner of suitable latch 168 is configured with sub-compartment 162 to maintain access door 166 in a closed position. As an example, latch 168 may be actuated by a consumer in order to open access door 166 for providing access into sub-compartment 162. Access door 166 can also assist with insulating sub-compartment 162, e.g., by thermally isolating or insulating sub-compartment 162 from fresh food chamber 122.

[0021] FIG. 3 provides an elevation view of refrigerator door 128 with access door 166 shown in an open position. As may be seen in FIG. 3, ice making assembly 158 is positioned or disposed within sub-compartment 162. As mentioned above, ice maker 160 may be configured to form ice nuggets therein. Accordingly, in the illustrated example, ice maker 160 includes a casing 170. An auger 172 is rotatably mounted in a mold body within casing 170 (shown partially cutout to reveal auger 172). In particular, an ice maker motor 174 is mounted to casing 170 and is in mechanical communication with (e.g., coupled to) auger 172. Ice maker motor 174 is configured for selectively rotating auger 172 in the mold body within casing 170. During rotation of auger 172 within the mold body, auger 172 scrapes or removes ice off an inner surface of the mold body within casing 170 and directs such ice to an extruder 175. At extruder 175, ice nuggets are formed from ice within casing 170. The extruder 175 may be in communication with an ice chute 184 to direct ice nuggets formed in the extruder 175 from the extruder 175 to an ice bucket 164. The ice bucket 164 is positioned below ice chute 184 and receives the ice nuggets from extruder 175 via the ice chute 184.

[0022] From ice bucket 164, the ice nuggets can enter dispensing assembly 140 and be accessed by a user as discussed above. In such a manner, ice making assembly 158 can produce or generate ice nuggets and supply the same to the dispensing assembly 140. For example, an agitator (not shown) may be disposed within the ice bucket 164 for urging ice nuggets from the ice bucket 164 to the dispensing outlet 144. A dispenser motor 182 may be in mechanical communication with, e.g., operatively coupled to, the dispenser agitator such that the dispenser motor 182 can drive the dispenser agitator to promote movement of ice nuggets from the ice bucket 164 to the dispensing outlet 144.

[0023] Referring again to FIG. 3, ice making assembly 158 also includes a fan 176. Fan 176 is configured for directing a flow of chilled air towards casing 170. As an example, fan 176 can direct chilled air from an evaporator of a sealed system through a duct to casing 170. Thus, casing 170 can be cooled with chilled air from fan 176 such that ice maker 160 is air cooled in order to form ice therein. Ice maker 160 also includes a heater 180, such

as an electric resistance heating element, mounted to casing 170. Heater 180 is configured for selectively heating casing 170, e.g., when ice prevents or hinders rotation of auger 172 within casing 170.

[0024] Operation of ice making assembly 158 is controlled by a processing device or controller 600, e.g., that may be operatively coupled to control panel 148 for user manipulation to select features and operations of ice making assembly 158. Controller 600 can operate various components of ice making assembly 158 to execute selected system cycles and features. For example, controller 600 is in operative communication with the dispenser motor 182, ice maker motor 174, fan 176 and heater 180. Thus, controller 600 can selectively activate and operate dispenser motor 182, ice maker motor 174, fan 176 and heater 180.

[0025] Controller 600 may include a memory and microprocessor, such as a general or special purpose microprocessor operable to execute programming instructions or micro-control code associated with operation of ice making assembly 158. The memory may represent random access memory such as DRAM, or read only memory such as ROM or FLASH. In one embodiment, the processor executes programming instructions stored in memory. The memory may be a separate component from the processor or may be included onboard within the processor. Alternatively, controller 600 may be constructed without using a microprocessor, e.g., using a combination of discrete analog and/or digital logic circuitry (such as switches, amplifiers, integrators, comparators, flip-flops, AND gates, and the like) to perform control functionality instead of relying upon software. Motor 174, fan 176 and heater 180 may be in communication with controller 600 via one or more signal lines or shared communication busses.

[0026] Ice maker 160 also includes a temperature sensor 178. Temperature sensor 178 is configured for measuring a temperature of casing 170 and/or liquids, such as liquid water, within casing 170. Temperature sensor 178 can be any suitable device for measuring the temperature of casing 170 and/or liquids therein. For example, temperature sensor 178 may be a thermistor or a thermocouple. Controller 600 can receive a signal, such as a voltage or a current, from temperature sensor 178 that corresponds to the temperature of the temperature of casing 170 and/or liquids therein. In such a manner, the temperature of casing 170 and/or liquids therein can be monitored and/or recorded with controller 600.

[0027] As may be seen generally in FIGS. 4 through 7, in various embodiments, the ice making assembly 158 may be a component of an ice making system 186 which also includes water treatment and circulation components that will be described in more detail below. Such water circulation components, e.g., level sensors 208 and 210, and recirculation pump 204 may also be in operative communication with controller 600, as described above. The ice making system 186 may also include sanitizing features such as an oxidizing agent generator 200

which is operable to and configured to provide one or more oxidizing agents into water flowing therethrough and to thereby provide the oxidizing agent or agents to a water stream or water body in the ice making system.

5 The one or more oxidizing agents may be generated by the oxidizing agent generator using any suitable means, such as corona discharge, vacuum ultraviolet (VUV), cold plasma, surface plasma, electrolytic, chemical, or any other suitable oxidizing agent generation method or combination of methods. The one or more oxidizing agents may be provided to the treated water by an oxidizing agent injector 212 which is operable to and configured to inject the one or more oxidizing agents into the water. The oxidizing agent injector 212 may be any suitable injector, such as an active injector, e.g., may be or include an injector pump, or a passive injector, e.g., may be or include a venturi tube. Such pumps and venturi devices are well understood by those of ordinary skill in the art, and, as such, are not described or illustrated in further detail for the sake of brevity and clarity. For some generation methods, e.g., chemical and electrolytic, the one or more oxidizing agents may be generated directly in water and thereby provided to the water without the use of the oxidizing agent injector 212, such that in some 10 15 20 25

embodiments the ice making system 186 may include sanitizing features without including the oxidizing agent injector 212. The one or more oxidizing agents may include triatomic oxygen (O_3) and/or reactive oxygen species.

[0028] The ice making system 186 generally defines a water circulation path, at least a portion of which is a closed loop whereby at least a portion of water within the ice making system 186 recirculates through the system. The sanitizing system, e.g., oxidizing agent generator 200 and oxidizing agent injector 212, in embodiments which include the injector 212, treats the recirculated water in the closed loop portion of the ice making system 186. The sanitizing system treats the recirculated water by providing, e.g. generating and/or injecting, oxidizing agent to the recirculated water, thereby forming treated water. As shown in FIGS. 4 through 7 and described herein, the closed loop portion of the ice making system 186 includes tee 196, top reservoir 188, ice maker 160, ice bucket 164, filter 198, recirculation tank 202, recirculation pump 204, and one-way valve 206.

[0029] In various embodiments, examples of which will be described in more detail below, the treated water may flow through the entire recirculation loop (closed loop portion) of the ice making system 186 or the one or more oxidizing agents may be at least partially removed from a portion of the recirculation loop by a filter 214, e.g., the filter 214 may reduce the concentration of the oxidizing agent(s) in the recirculated water, such as to zero or to below a threshold which is greater than zero, such as about one part per million (1 ppm) or less, such as about 0.5 ppm or less, such as about 0.4 ppm or less, such as between about 0.4 ppm and about 0.1 ppm. The filter 214 may be, for example, a carbon filter, e.g., may include 45 50 55

a carbon filter media such as activated carbon, e.g., granular activated carbon or powdered activated carbon, etc.

[0030] Also, those of ordinary skill in the art will recognize that oxidizing agents discussed herein, e.g., reactive oxygen species, have a short residence time in water, whereby embodiments of the ice making system 186 that do not include the filter 214 provide water to the consumer, e.g., in the form of ice from ice maker 160, that includes acceptably low levels of the one or more oxidizing agents by treating the water with a small dose of oxidizing agents, whereby the oxidizing agents in the treated water will naturally decay to within or below the acceptable limits before reaching the consumer. The small dose of oxidizing agents may be about one milligram per liter (1 mg/L), e.g., one thousand micrograms per liter (1000 µg/L) or less, such as about 800 µgAL or less, such as about 600 µgAL or less, such as about 500 µgAL or less, such as about 400 µgAL or less. In particular, the small dose may be provided as part of a continuous treatment to prevent fouling or contamination within the ice making system 186, such as to prevent biofilm formation.

[0031] As mentioned above, the ice making system 186 generally defines a water flow path. As may be seen in FIGS. 4 through 7, the water flow path begins at an inlet where main water 1000, e.g., at the inlet, water from a water supply such as a plumbing system of a building flows in, where the ice making system 186 and/or refrigerator appliance 100 are connected to the plumbing system. The main water 1000 may flow through an inlet water filter 190. The inlet water filter 190 may include a filter medium such as a filter membrane or a carbon filter media, such as a carbon block. In some embodiments, e.g., where the ice making system 186 is incorporated into a refrigerator appliance 100 as illustrated, the ice making system 186 may include a diverter valve 192 downstream of the filter, whereby the water flows from the filter 190 to the diverter valve 192 and the diverter valve 192 then selectively directs the water to the dispenser 142 or into the recirculation loop described above via a tee fitting or tee junction 196. As mentioned above, embodiments of the present disclosure also include stand-alone ice making appliances, and such appliances generally do not include liquid water dispensers, e.g., in some embodiments, the ice making system 186 may not include the diverter valve 192 and may not include or may not be connected to a dispenser 142, such as when the ice making system is incorporated into a stand-alone ice making appliance or a refrigerator appliance which does not include a liquid water dispenser.

[0032] As mentioned, the recirculation loop flows through the tee 196. For example, as illustrated in FIGS. 4 through 7, the recirculated water in the closed loop portion of the ice making system 186 flows from the tee 196 to a top reservoir 188. The top reservoir 188 may include a level sensor 210, e.g., a float switch, therein. The top reservoir 188 may be coupled to the ice maker 160 to provide a flow of water from the top reservoir 188 to the ice maker 160. The ice maker 160 may then form

ice pieces, e.g., ice nuggets as described above, from the water that was received from the top reservoir 188. The recirculation loop then travels from the ice maker 160 to the ice bucket 164, such as via chute 184, as described above, e.g., the recirculated water traverses this segment of the closed loop portion of the ice making system 186 in solid form. As indicated by the leftmost arrow in FIGS. 4 through 7, some of the water may exit the closed portion of the ice making system 186 from the ice bucket 164 to the dispenser 142, e.g., some of the ice nuggets may be provided to the dispenser 142 from the ice bucket 164, such as in response to actuating mechanism 146, as described above. Ice that is not dispensed from the ice bucket 164 for a period of time may melt, thereby forming melt water which remains in the closed loop portion of the ice making system 186. The melt water from the ice bucket 164 flows to a recirculation tank 202. In some embodiments, the melt water flows to the recirculation tank 202 from the ice bucket 164 via a filter 198 such as an ion exchange filter, e.g., the filter 198 may be positioned between the ice bucket 164 and the recirculation tank 202, such as downstream of the ice bucket 164 and upstream of the recirculation tank 202 with respect to the flow of melt water, as illustrated. In other embodiments, the recirculation tank 202 may be upstream of the filter 198, e.g., directly and immediately downstream of the ice bucket 164 with respect to the flow of melt water, and the filter 198 may be downstream of the recirculation tank 202. A level sensor 208 may be positioned in the recirculation tank 202. When the melt water in the recirculation tank 202 reaches a certain level, e.g., when the recirculation tank 202 is full or nearly full, as detected by the level sensor 208, such as the level sensor 208 may be a float switch and may detect the certain level when the float switch reaches a predetermined height, a recirculation pump 204 may be activated. The recirculation pump 204 may recirculate the water back to the top reservoir 188 through the closed loop portion of the ice making system 186. For example, a one-way valve 206, e.g., a check valve, may be disposed downstream of the recirculation pump 204 and between the recirculation pump 204 and the tee 196. The recirculated water from the recirculation pump 204 may flow through the one-way valve 206 to the tee 196, and from tee 196 to top reservoir 188 as discussed above. The one-way valve 206 may limit or obstruct back flow to the recirculation pump 204, such as may prevent main water 1000 flowing into the tee 196 via the diverter valve 192 from flowing to the recirculation pump 204 instead of to the top reservoir 188.

[0033] Referring now specifically to FIG. 4, in some embodiments, the oxidizing agent generator 200 and injector 212 may be immediately upstream of the top reservoir 188. Alternatively, the oxidizing agent generator 200 may be coupled directly to and/or positioned in the top reservoir 188 and the injector 212 may be omitted. As mentioned, the top reservoir 188 holds water before the water enters the ice maker 160. Accordingly, in em-

bodiments where the one or more oxidizing agents are injected directly into or otherwise provided directly to (such as generated in) the top reservoir 188, the flow rate of the water through the top reservoir 188 may be sufficiently slow and/or the holding time of the water in the top reservoir 188 may be sufficiently long that the water is treated by the oxidizing agents before it enters the ice maker 160. Such embodiments may not include a filter 214, as discussed in more detail below, and therefore the oxidizing agent generator 200 may provide a low concentration of the one or more oxidizing agents to the water in the top reservoir 188. For example, the low concentration of the one or more oxidizing agents may be about 1 ppm or less, such as about 0.5 ppm or less, such as about 0.4 ppm or less, such as between about 0.4 ppm and about 0.1 ppm. Also, embodiments such as the exemplary embodiment illustrated in FIG. 4 may provide treated water throughout the entire system, e.g., may treat all of the recirculated water in the closed loop portion of the ice making system 186, in that at least a residual concentration of the one or more oxidizing agents remains in the water throughout the entire closed loop portion, e.g., up to and including the recirculation tank 202, recirculation pump 204, etc., including the return to the top reservoir 188 as described above. Biofilm formation may thereby be prevented in all locations throughout the closed loop portion of the ice making system 186 in such embodiments.

[0034] Referring now specifically to FIG. 5, in some embodiments, the oxidizing agent generator 200 and injector 212 may be immediately upstream of the recirculation tank 202. Alternatively, the oxidizing agent generator 200 may be coupled directly to and/or positioned in the recirculation tank 202 and the injector 212 may be omitted. Similar to the top reservoir 188 as described above with respect to the exemplary embodiment of FIG. 4, the recirculation tank 202 provides a slow flow rate and/or long residence time, whereby the recirculated water is treated before the recirculated water leaves the recirculation tank 202, thus, the filter 214 may be omitted and a low concentration of the one or more oxidizing agents may be provided to the water in the recirculation tank 202, similar to the exemplary embodiment of FIG. 4 as described above, including the same concentration ranges. Also as discussed above with respect to the exemplary embodiment of FIG. 4, embodiments where the oxidizing agents are provided to the recirculation tank 202, e.g., as illustrated in FIG. 5 and described herein, may provide treated water throughout the entire system, e.g., may treat all of the recirculated water in the closed loop portion of the ice making system 186 and thereby prevent biofilm formation in all locations throughout the closed loop portion of the ice making system 186.

[0035] Still with reference to FIG. 5 in particular, in some embodiments the oxidizing agent generator 200 may be downstream of the filter 198 (see also, e.g., FIG. 6). Particularly in embodiments where the filter 198 is an ion exchange filter, positioning the oxidizing agent gen-

erator 200 downstream of the filter 198 may advantageously avoid or minimize incompatibility of the ion exchange resin with the one or more oxidizing agents.

[0036] Embodiments which do not include the filter 214, such as the exemplary embodiments illustrated in FIG. 4 or FIG. 5, may also be operable to provide a higher dose, short-term, shock treatment to the system, e.g., to the closed loop portion of the ice making system 186, in addition to providing continuous treatment at the low concentration levels described above. As will be understood by those of ordinary skill in the art, a shock treatment comprises a surge or temporary increase in the concentration of the one or more oxidizing agents and may be performed periodically. In other embodiments, e.g., as illustrated in FIG. 6 or FIG. 7, an oxidizing agent reduction filter 214 may be included in the ice making system 186. The oxidizing agent reduction filter 214 may be configured to reduce the concentration of the one or more oxidizing agents in the recirculated water as the recirculated water flows through the oxidizing agent reduction filter 214, such as through a carbon filter media in the oxidizing agent reduction filter 214, as described above. Embodiments which include the oxidizing agent reduction filter 214 may also be operable to provide shock treatment. For example, the oxidizing agent reduction filter 214 may be removable, and the shock treatment may include removing the oxidizing agent reduction filter 214 in order to permit the higher concentration of the one or more oxidizing agents to circulate throughout the closed loop portion of the ice making system 186.

[0037] Referring specifically to FIG. 6, in some embodiments, the oxidizing agent generator 200 may be positioned immediately upstream of or within the recirculation tank 202, similar to the exemplary embodiments described above with respect to FIG. 5. In embodiments such as the exemplary embodiment illustrated in FIG. 6, the filter 214 may be positioned immediately upstream of the ice maker 160, such as between the top reservoir 188 and the ice maker 160, such as at the inlet to the ice maker 160. With this configuration, the recirculated water in the closed loop portion of the ice making system 186 may be treated with the one or more oxidizing agents throughout the bulk of the closed loop portion and may be removed or reduced prior to creating the ice pieces, e.g., ice nuggets, which may be provided to the consumer, in order to avoid exposing the consumer to excessive concentrations of the one or more oxidizing agents in those ice pieces which are dispensed, e.g., via dispenser 142. In such embodiments, the oxidizing agent generator 200 may therefore provide, e.g., inject in embodiments where the oxidizing agent injector 212 is included, a higher concentration of the one or more oxidizing agents to the recirculated water than in embodiments which do not include the filter 214. For example, the higher concentration may be about 0.4 ppm or more, such as about 0.5 ppm or more, such as about 1 ppm or more, such as about 2 ppm or more. Also, in such embodiments, while the ice that is dispensed has a reduced concentration of

the one or more oxidizing agents, the ice that melts may be treated with the one or more oxidizing agents, e.g., at or immediately upstream of the recirculation tank 202 as shown in FIG. 6 and described herein.

[0038] In additional embodiments, e.g., as illustrated in FIG. 7, the oxidizing agent reduction filter 214 may be provided in combination with the oxidizing agent generator 200 that is immediately upstream of the top reservoir 188. In such embodiments, a higher concentration of the one or more oxidizing agents may be provided, as described above with respect to FIG. 6. Such embodiments may thoroughly treat all of the water in the top reservoir 188, whereas reduced (e.g., post-filtration) levels of the one or more oxidizing agents are provided to the remainder of the ice making system 186. Also, in such embodiments, the filter 214 may be removable in order to treat the remainder of the system, such as during a maintenance cycle or shock treatment, as described above.

[0039] The sanitizing system according to the present disclosure provides several advantages which will be recognized by those of ordinary skill in the art. For example, the sanitizing system may provide both continuous treatment of water flowing, e.g., recirculating, through the ice making system and higher dose, shock, treatment of the ice making system with a single sanitizing system and a single treatment point or injection point. Additionally, the sanitizing system and/or ice making system having sanitizing features or components as disclosed herein may also advantageously reduce or remove additional contaminants or undesired constituents from the recirculated water, such as volatile organic compounds (VOCs), heavy metals, perfluorooctanoic acid (PFOA), and perfluorooctanesulfonic acid (PFOS). Accordingly, "sanitizing" is used herein to refer to removing any one or more of several possible contaminants from water, and is not necessarily limited to removing microbes or biofilms.

[0040] This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to practice the invention, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they include structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims.

Claims

1. An ice making system, comprising:

an ice maker configured to form ice pieces within the ice maker;
a top reservoir upstream of the ice maker where-

by the ice maker is configured to receive a flow of water from the top reservoir and to form the ice pieces from the received water from the top reservoir;

an ice bucket defining a storage volume, the ice bucket in communication with the ice maker whereby the ice bucket is configured to receive the ice pieces into the storage volume;

a recirculation tank in fluid communication with the ice bucket whereby the recirculation tank is configured to receive melt water from the storage volume of the ice bucket;

a recirculation pump in fluid communication with the recirculation tank and the top reservoir, the recirculation pump configured to pump the melt water from the recirculation tank to the top reservoir; and

an oxidizing agent generator configured to generate one or more oxidizing agents and provide the one or more oxidizing agents to form treated water within the ice making system.

2. The ice making system of claim 1, further comprising an oxidizing agent injector coupled to the oxidizing agent generator, wherein the oxidizing agent injector is configured to inject the one or more oxidizing agents into the treated water.

3. The ice making system of claim 1, wherein the oxidizing agent generator is immediately upstream of the top reservoir.

4. The ice making system of claim 1, wherein the oxidizing agent generator is immediately upstream of the recirculation tank.

5. The ice making system of claim 1, further comprising an oxidizing agent reduction filter configured to reduce a concentration of the one or more oxidizing agents in water flowing through the oxidizing agent reduction filter.

6. The ice making system of claim 5, wherein the oxidizing agent reduction filter is between the top reservoir and the ice maker, whereby the oxidizing agent reduction filter is configured to reduce the concentration of the one or more oxidizing agents in the flow of water from the top reservoir.

7. The ice making system of claim 5, wherein the oxidizing agent generator is immediately upstream of the recirculation tank.

8. The ice making system of claim 5, wherein the oxidizing agent generator is immediately upstream of the top reservoir.

9. The ice making system of claim 1, further comprising

an ion exchange filter, wherein the oxidizing agent generator is downstream of the ion exchange filter.

10. A refrigerator appliance comprising:

a housing defining a chilled chamber;
an ice making system disposed within the housing, the ice making system comprising:

an ice maker configured to form ice pieces within the ice maker;

a top reservoir upstream of the ice maker whereby the ice maker is configured to receive a flow of water from the top reservoir and to form the ice pieces from the received water from the top reservoir;

an ice bucket defining a storage volume, the ice bucket in communication with the ice maker to receive the ice pieces into the storage volume;

a recirculation tank in fluid communication with the ice bucket whereby the recirculation tank is configured to receive melt water from the storage volume of the ice bucket;

a recirculation pump in fluid communication with the recirculation tank and the top reservoir, the recirculation pump configured to pump the melt water from the recirculation tank to the top reservoir; and

an oxidizing agent generator configured to generate one or more oxidizing agents and provide the one or more oxidizing agents to form treated water within the ice making system.

11. The refrigerator appliance of claim 10, further comprising an oxidizing agent injector coupled to the oxidizing agent generator, wherein the oxidizing agent injector is configured to inject the one or more oxidizing agents into the treated water.

12. The refrigerator appliance of claim 10, wherein the oxidizing agent generator is immediately upstream of the top reservoir.

13. The refrigerator appliance of claim 10, wherein the oxidizing agent generator is immediately upstream of the recirculation tank.

14. The refrigerator appliance of claim 10, further comprising an oxidizing agent reduction filter configured to reduce a concentration of the one or more oxidizing agents in water flowing through the oxidizing agent reduction filter.

15. The refrigerator appliance of claim 14, wherein the oxidizing agent reduction filter is between the top reservoir and the ice maker, whereby the oxidizing

agent reduction filter is configured to reduce the concentration of the one or more oxidizing agents in the flow of water from the top reservoir.

16. The refrigerator appliance of claim 14, wherein the oxidizing agent generator is immediately upstream of the recirculation tank.

17. The refrigerator appliance of claim 14, wherein the oxidizing agent generator is immediately upstream of the top reservoir.

18. The refrigerator appliance of claim 10, further comprising an ion exchange filter, wherein the oxidizing agent generator is downstream of the ion exchange filter.

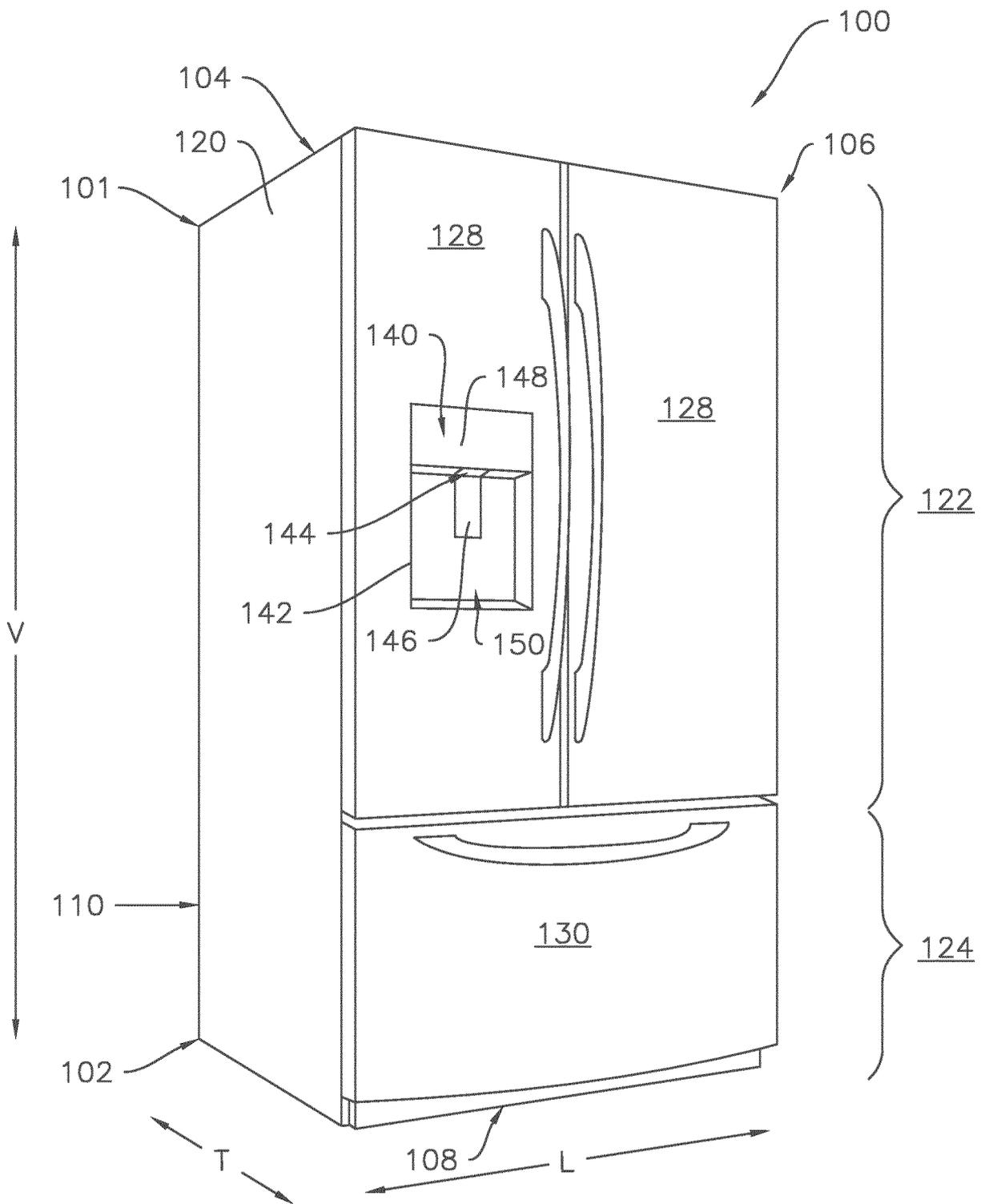


FIG. 1

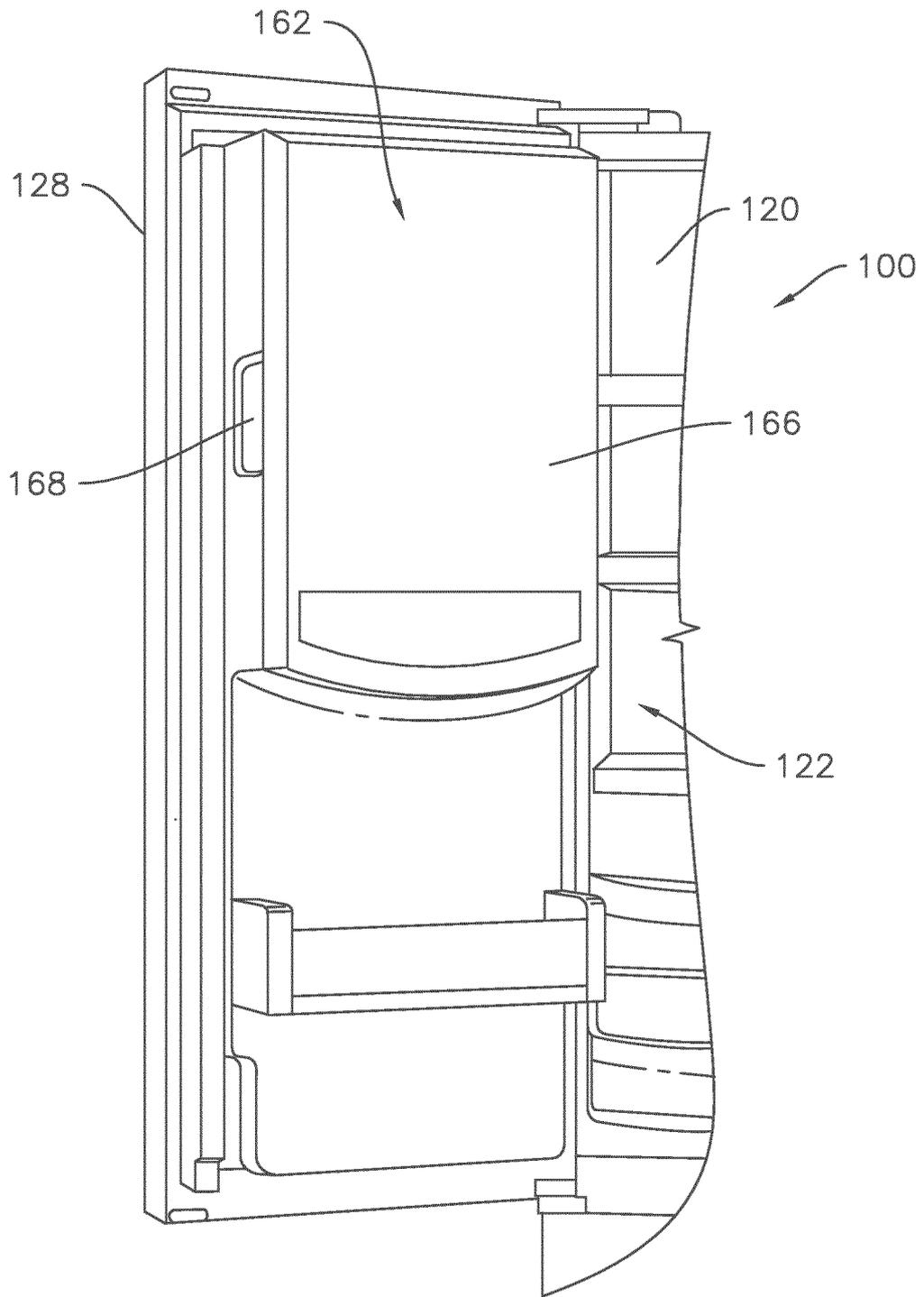


FIG. 2

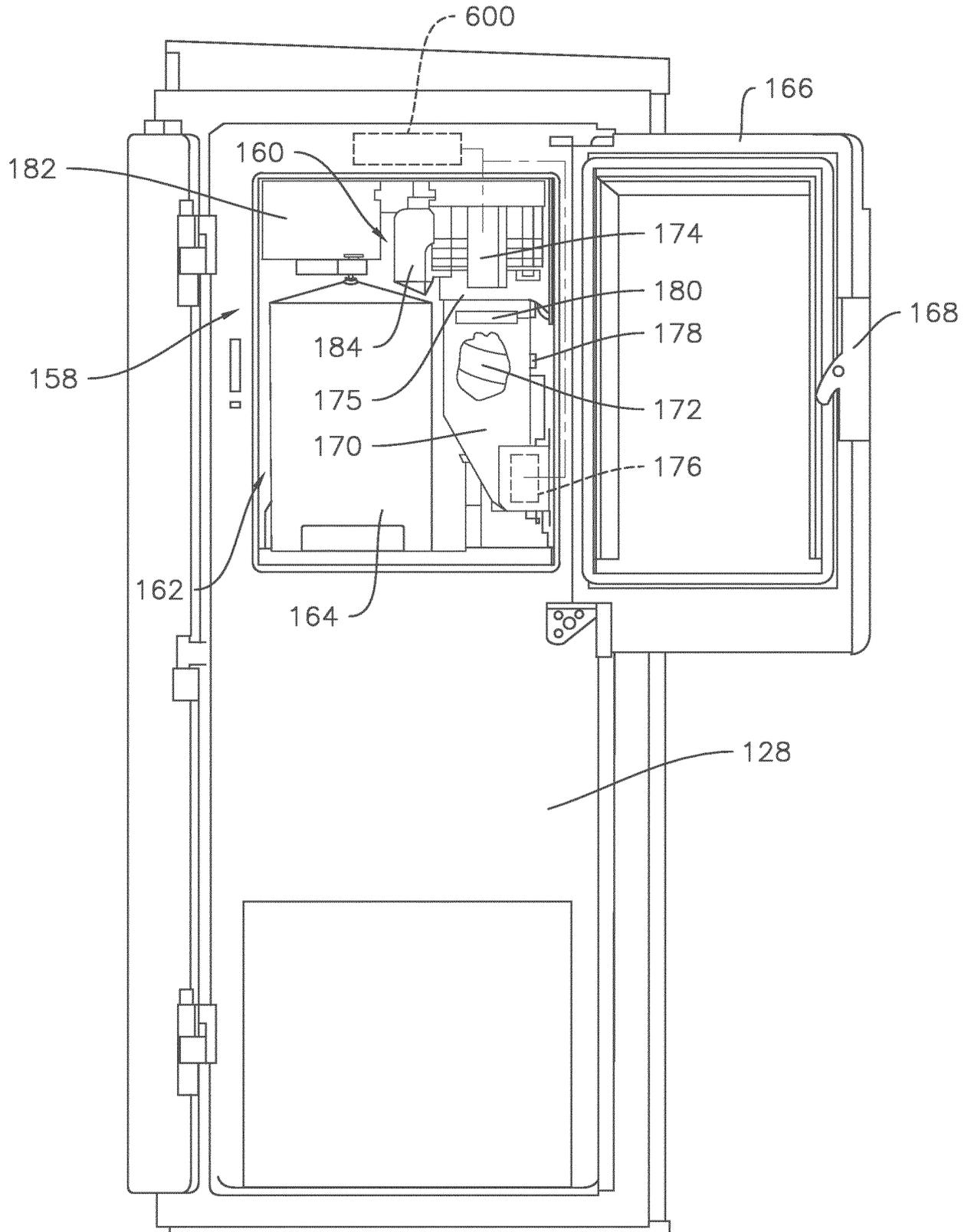


FIG. 3

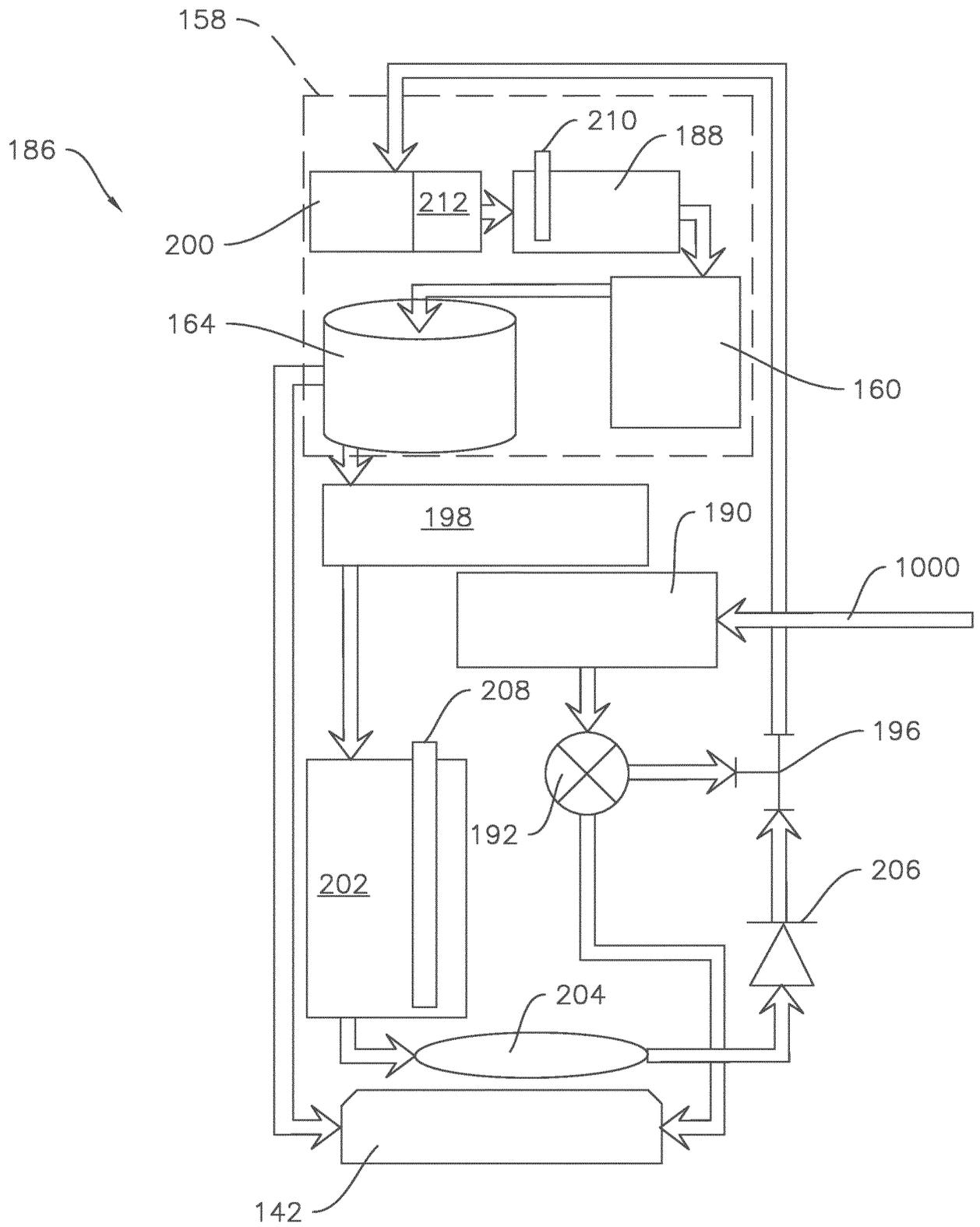


FIG. 4

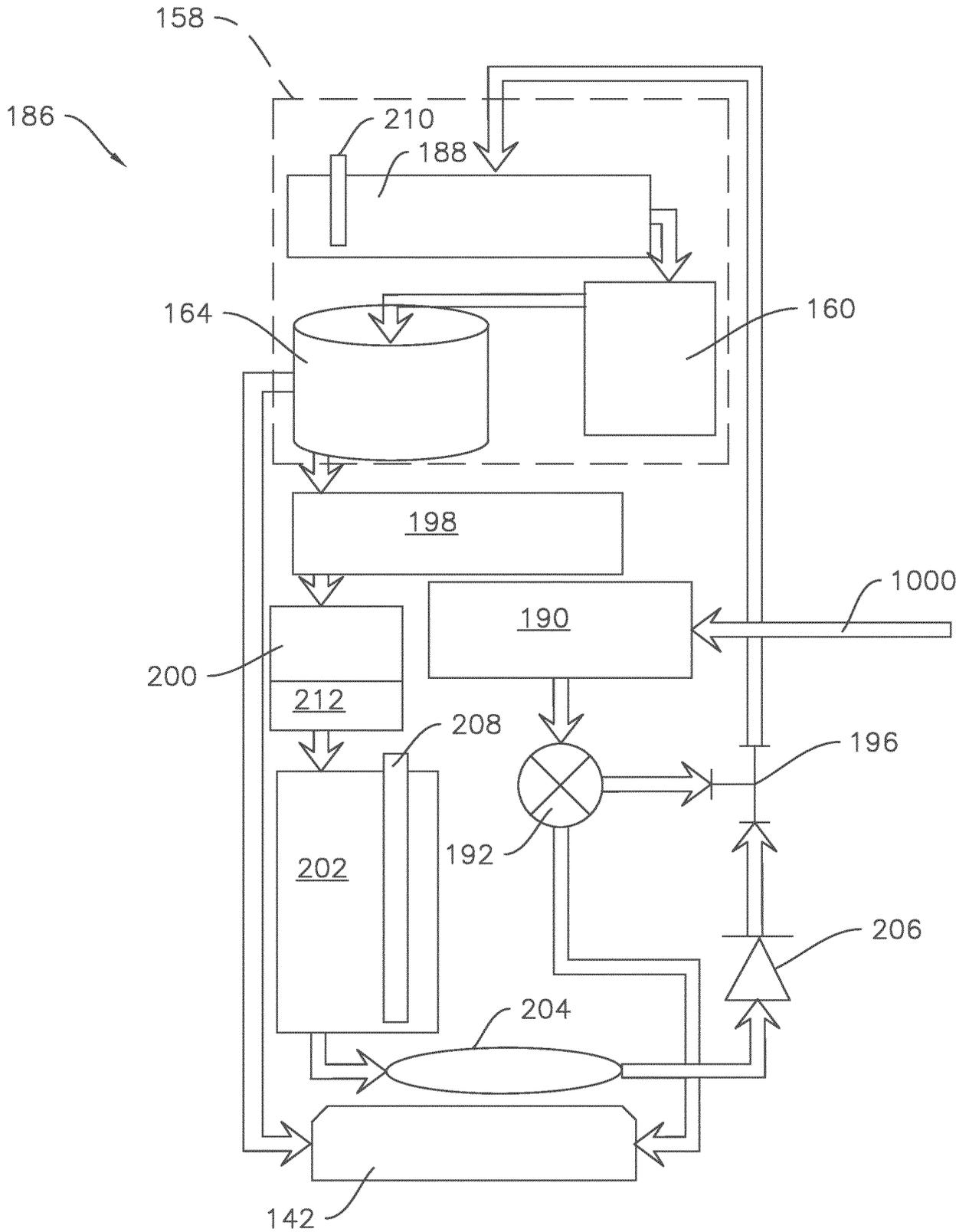


FIG. 5

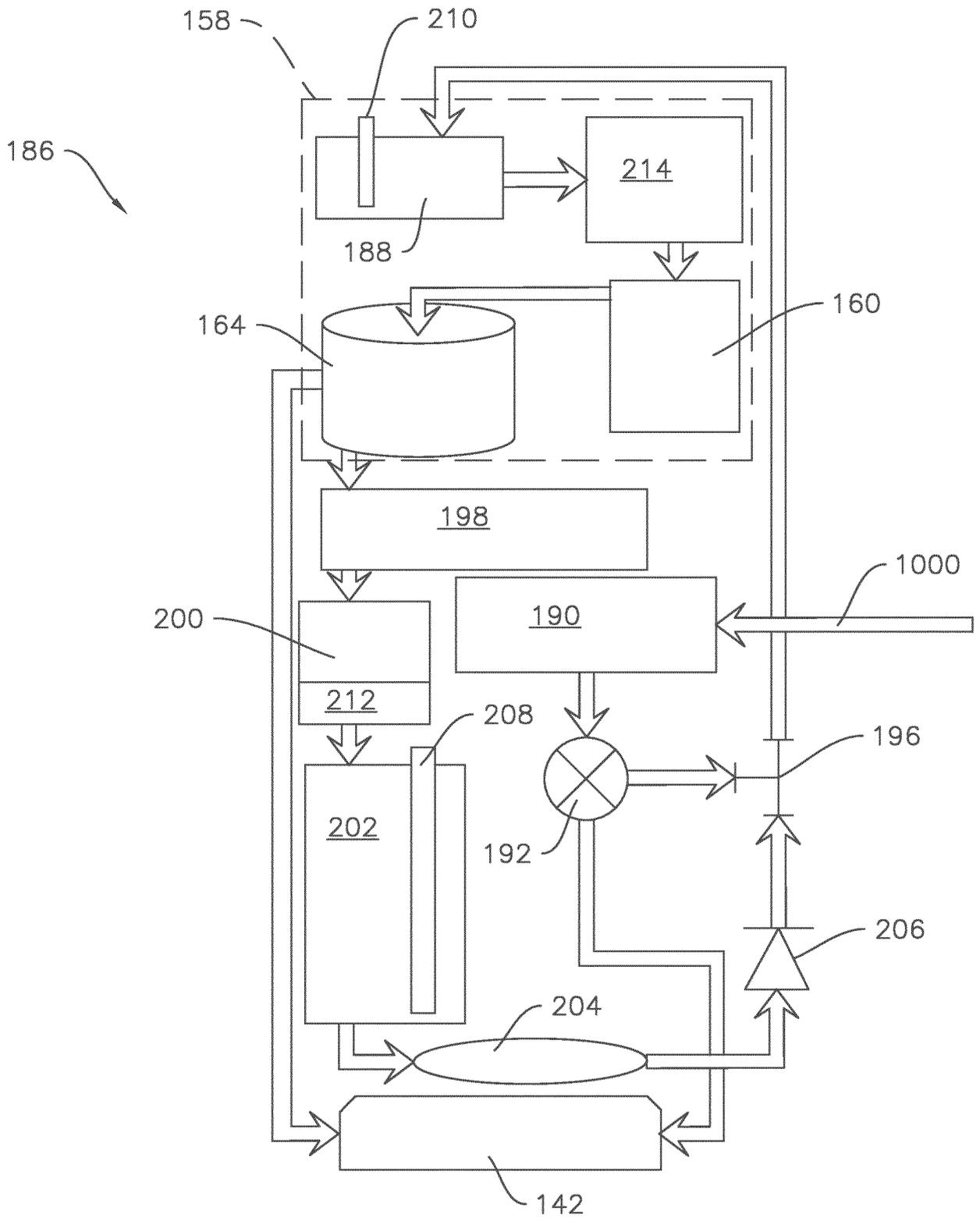


FIG. 6

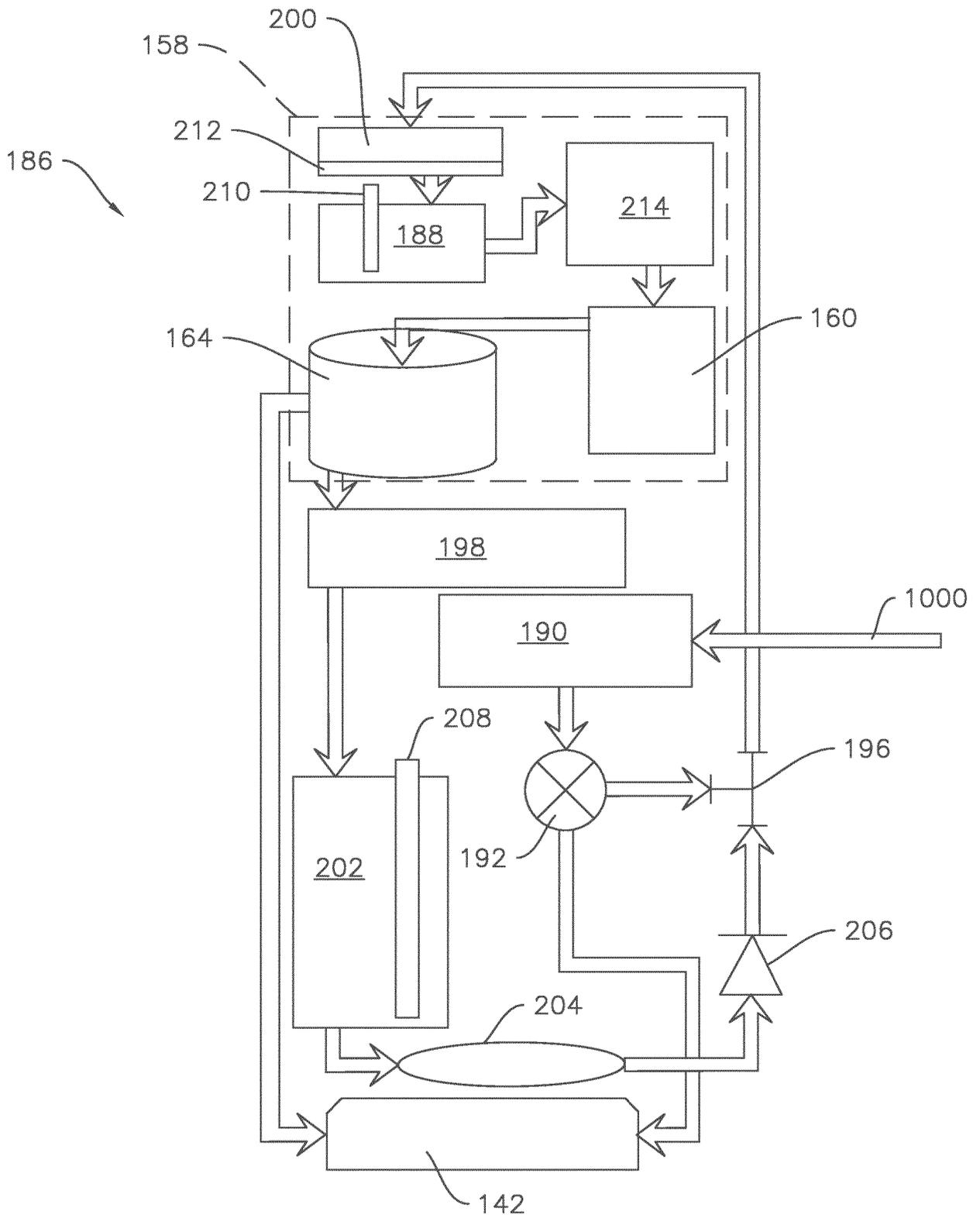


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2022/097920

5	A. CLASSIFICATION OF SUBJECT MATTER F25C 1/00(2006.01)i; C02F 1/72(2006.01)i	
	According to International Patent Classification (IPC) or to both national classification and IPC	
10	B. FIELDS SEARCHED	
	Minimum documentation searched (classification system followed by classification symbols) F25C1; C02F1	
	Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched	
15	Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) CNTXT, WPABS, ENTXTC, CJFD: 海尔, 制冰机, 消毒, 氧化剂, 杀菌, 臭氧, 再循环, 循环水, 氧化剂生成, 氧化剂发生, 臭氧发生, 臭氧生成, 臭氧分解, 臭氧过滤, 氧化剂分解, 氧化剂过滤, ozone or oxidant+ or oxidize+, ice maker	
	C. DOCUMENTS CONSIDERED TO BE RELEVANT	
20	Category*	Citation of document, with indication, where appropriate, of the relevant passages
	Y	CN 112460869 A (QINGDAO HAIER REFRIGERATOR CO., LTD. et al.) 09 March 2021 (2021-03-09) description, paragraphs 19-58, and figures 1-7
25	Y	CN 1955626 A (TOSHIBA K. K. et al.) 02 May 2007 (2007-05-02) description, pages 3-8, and figures 1-2
	A	CN 103120205 A (JIANGSU QIWU MARINE DEVELOPMENT CO., LTD. et al.) 29 May 2013 (2013-05-29) entire document
30	A	CN 112585418 A (QINGDAO HAIER REFRIGERATOR CO., LTD. et al.) 30 March 2021 (2021-03-30) entire document
	A	CN 113511706 A (BEIJING UNIVERSITY OF AGRICULTURE) 19 October 2021 (2021-10-19) entire document
35	A	CN 112739968 A (QINGDAO HAIER REFRIGERATOR CO., LTD. et al.) 30 April 2021 (2021-04-30) entire document
	<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.	
40	* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family
	Date of the actual completion of the international search 01 August 2022	Date of mailing of the international search report 29 August 2022
50	Name and mailing address of the ISA/CN China National Intellectual Property Administration (ISA/CN) No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088, China Facsimile No. (86-10)62019451	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2022/097920

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C. DOCUMENTS CONSIDERED TO BE RELEVANT		
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INTERNATIONAL SEARCH REPORT
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