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(54) **COOLING SYSTEM**

KÜHLSYSTEM

SYSTÈME DE REFROIDISSEMENT

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Description

[0001] This disclosure relates generally to a cooling system according to claim 1.

BACKGROUND

[0002] Coolers are used in many industries including for use in cooling food and beverages. Coolers generally take a long time to chill a product inside of the cooler. For example, some coolers can take upwards of 12 to 24 hours to cool the entire contents of a cooler. Additionally, current coolers can be large and inefficient. This inefficiency can be magnified in certain countries where power availability is not continuous and it is available only for a part of the day. In such cases, current coolers cannot provide cold food and beverages to consumers at the point of purchase. A need exists for a quick chilling and energy efficient cooler.

[0003] GB 2514622 A discloses a refrigerator that uses a phase change material as a thermal store.

[0004] Further relevant prior art documents are US2275323A, EP1878986A1, US2203991A, GB2301172A, US2005/241333A1, WO97/33504A1, WO2011/007960A2, US6763677B1, CN103625781A, JP2003254659A and JP2013011420A.

BRIEF SUMMARY

[0005] The present invention is disclosed in the independent claim 1. Further embodiments are disclosed in the dependent claims.

[0006] The cooling system is configured to provide a substantially uniform temperature distribution in the cooling chamber.

[0007] According to another embodiment, the airflow through each of the one or more openings in the cooling system can be substantially similar.

[0008] According to another embodiment, the one or more openings can be sized, shaped, and/or spaced to provide substantially similar airflow through them.

[0009] According to another embodiment, the cooling system can include one or more baffles, including a plurality of baffles, located in the cool air duct, wherein the baffles are configured to adjust the airflow within the cool air duct.

[0010] According to another embodiment, the cooling chamber surface or floor including at least a first region with one or more openings having at least a first opening characteristic and a second region with one or more openings having at least a second opening characteristic different from the first opening characteristic.

[0011] It will be appreciated by those skilled in the art, given the benefit of the following description of certain exemplary embodiments of the cooling system disclosed herein, that at least certain embodiments disclosed herein have improved configurations suitable to provide enhanced benefits. These and other aspects, features and

advantages of this disclosure or of certain embodiments of the disclosure will be further understood by those skilled in the art from the following description of exemplary embodiments taken in conjunction with the following drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] A more complete understanding of the present disclosure and the advantages thereof may be acquired by referring to the following description in consideration of the accompanying drawings, in which like reference numbers indicate like features, and wherein:

FIG. 1 is a perspective view of a cooling system according to aspects of this disclosure.

FIG. 2 is a top view of a cooling system according to aspects of this disclosure.

FIG. 3 is a front view of a cooling system according to aspects of this disclosure.

FIG. 4 is a left side view of a cooling system according to aspects of this disclosure.

FIG. 5 is a right side view of a cooling system according to aspects of this disclosure.

FIGS. 6A - 6D are simplified perspective cross-sectional views taken along the plane 6-6 of FIG. 1 showing various cooling systems examples according to aspects of this disclosure.

FIG. 6E is a simplified perspective cross-sectional view of a cooling system according to aspects of this disclosure.

FIG. 7 is a cross-sectional view taken along the line 7-7 of the cooling system of FIG. 3 according to aspects of this disclosure.

FIGS. 8A-8E are top views of exemplary surfaces or floors according to aspects of this disclosure.

FIG. 8F is a cross-sectional view taken along the line 8F-8F of the floor of FIG. 8E according to aspects of this disclosure.

DETAILED DESCRIPTION OF certain exemplary embodiments

[0013] Figures 1-5, 6B-6E, 7 and 8A-8F show embodiments being useful for understanding the invention, which are outside the subject-matter of the claims. Figure 6A shows an embodiment according to the present invention, which disclose a cooling system according to claim 1.

[0014] In the following description of the various embodiments, reference is made to the accompanying drawings, which form a part hereof, and in which is shown by way of illustration, various embodiments of the disclosure that may be practiced.

[0015] In the following description of various examples, reference is made to the accompanying drawings, which form a part hereof. Also, while the terms "top," "bottom," "front," "back," "side," "rear," and the like may be used in

this specification to describe various example features and elements of the invention, these terms are used herein as a matter of convenience, e.g., based on the example orientations shown in the figures or the orientation during typical use. Additionally, the term "plurality," as used herein, indicates any number greater than one, either disjunctively or conjunctively, as necessary, up to an infinite number. Also, the reader is advised that the attached drawings are not necessarily drawn to scale.

[0016] It is understood that the cooling systems may contain components made of several different materials. Additionally, the components may be formed by various forming methods.

[0017] The various figures in this application illustrate examples of cooling systems according to this disclosure. When the same reference number appears in more than one drawing, that reference number is used consistently in this specification and the drawings refer to the same or similar parts throughout.

[0018] A cooling system 100 according to aspects of this disclosure is shown in at least FIGS. 1-7. The cooling system 100 generally includes a housing 101, and as will be discussed in more detail below, an internal cooling chamber 200, and a refrigeration system 300. In one exemplary embodiment, the cooling system 100 is configured to cool a plurality of containers including, for example, beverage containers such as soda bottles, water bottles, tetrapacks, beverage cans and other similar beverage and/or food containers including any related packaging. It is understood, however, that the cooling system 100 can be configured to cool other items.

[0019] As shown in FIG. 1, the cooling system 100 can have a housing 101 having a generally rectangular box shape including a front side 102, a back side 104, a top side 106, a bottom side 108 and two sidewalls 109, 110. Although the housing 101 shown in FIG. 1 is a rectangular box shape, any other suitable housing shapes and sizes can be used, such as, a pyramid shape, spherical shape, and cylinder shape. The cooling system housing 101 can include outer walls 120, 122, 124, 126, 128, as shown for example in FIGS. 1-5. The outer walls can be constructed of any suitable materials including, for example, sheet metal, plastics and /or composites.

[0020] In one example, the housing 101 can be in the range of about 400 mm to about 700 mm tall; in the range of about 300 mm to about 600 mm deep; and in the range of about 600 mm to about 900 mm wide. Thus, the outer dimensions of the housing can define a volume of, for example, in the range of about 0.14m³ to about 0.24 in³. However, the above dimensions are provided only as an example. As previously discussed the housing can be any suitable size and shape.

[0021] The cooling system 100 also includes an access door 112 for providing access to one or more interior chambers of the cooling system 100. As shown in at least FIG. 1, the top side 106 includes an access door 112 hingedly connected to the back side 104 of the housing 101 for providing selective access to one or more interior

chambers of the cooling system 100. While the door 112 shown in FIG. 1 is shown connected to the back side 104 using hinges 114, any other system can be used to provide access to the interior of the cooling system 100. In some embodiments, for example, the door 112 can be slidably connected to portions of the housing 101, and in other embodiments the door 112 may not be structurally connected to the housing 101 and may simply be removable.

[0022] As shown in FIG. 1, the door 112 can form a substantial portion, or in some cases more than 50%, of the top side 106 of the housing. In other embodiments the door 112 can be larger or smaller or any size suitable to provide access to an interior portion of the cooling system 100. Additionally, in other embodiments, the door 112 can also be included on any other surface of the housing 101. For example, in some embodiments a door 112 can alternatively be included on the front 102, back 104, or sides 109, 110 of the housing. In still other embodiments, the cooling system 100 may include multiple access doors 112. Such multiple access doors 112 may provide multiple ways to access a single internal compartment or may provide access to multiple internal compartments.

[0023] The door 112 can also include a gasket 113 that forms a seal between the door 112 and the remainder of the housing 101 and acts to restrict heat from outside of the cooling system 100 from entering the cooling system 100. The gasket can be manufactured of rubber or any other material suitable for forming a seal between the door and the remainder of the cooling system 100. The access door 112 and connection mechanisms discussed herein are provided merely as examples, and any suitable access door 112 and/or mechanism to connect the door 112 to the housing 101 can be used.

[0024] As shown in at least the embodiment of the present invention in fig. 6A and in an example in fig. 7, the cooling system 100 also includes insulation 140 between the cool area 150 of the cooling system 100 and the outside environment, including warmer areas 152 of the cooling system 100. The insulation material 140 can be any suitable material. In one example, the insulation 140 is a low cost material such as polyurethane foam, but any other suitable materials can be used such as polystyrene foam. As shown in the embodiment of the present invention in fig. 6A and in an example in fig. 7, the door 112 includes insulation material 140 throughout the entire door which may increase the efficiency of the cooling system 100. However, in other embodiments, the door may be composed at least partially of glass or other similar material such that a user can see through the door to the interior of the cooling system 100.

[0025] As described above, the cooling system 100 includes at least one interior cooling chamber 200. As shown in the embodiment of the present invention in fig. 6A and in an example in fig. 7, the cooling chamber 200 is defined by surfaces such as a top wall 202 (which as shown in FIGS. 6A and 7 can be an interior wall of the door 112), a bottom wall 205, and sidewalls 206, 208, 210, 212.

The cooling chamber 200 also includes a surface or floor 204 that is substantially horizontal and is configured to hold a product to be cooled. As will be described in more detail below, the surface or floor 204 can include a one or more openings, or a plurality of openings, to permit air flow through the bottom of the cooling chamber 200. The surfaces, such as, interior walls 202, 205, 206, 208, 210, 212 of the chamber 200 can be constructed of any suitable material such as sheet metal or plastic. As shown in FIG. 7, the bottom wall 205 may be made at a slight angle relative to the horizontal direction and may be operably associated with a drain 215. Any liquid which falls through the floor 204 to the bottom wall 205 can be forced through gravity towards the drain 215 which can have an outlet on the exterior of the cooling system 100.

[0026] The interior cooling chamber 200 used for cooling a product defined by the top wall 202, sidewalls 206, 208, 210, 212, and the surface or floor 204 in some examples can be in the range of about 200 mm to about 600 mm tall, in the range of about 200 mm to about 600 mm deep, and in the range of about 200 mm to about 600 mm wide. Thus, the cooling chamber 200 can define a volume of, for example, in the range of about 0.008 m³ to about 0.22 m³. The above dimensions of the interior cooling chamber 200 are provided only as an example. The cooling chamber 200 discussed herein can be any suitable size and shape.

[0027] As discussed above, in other embodiments the cooling system 100 can include more than one cooling chamber 200. For example, in some embodiments the cooling chamber 200 can include multiple cooling chambers 200 each having a separate access door 112. In such embodiments, each separate cooling chamber 200 can be configured to cool products to the same temperature or different temperatures as the other chambers, and at the same cooling rate or different cooling rate as the other cooling chambers. In some embodiments, for example, one or more cooling chambers can be shut off such that no cooling air flows to that cooling chamber. In some embodiments, this may increase the overall efficiency of the cooling system.

[0028] The cooling system 100 also includes a refrigeration system 300 used to cool the cooling chamber 200. The refrigeration system 300 can be located within the housing 101. In some embodiments the refrigeration system can be separate from the cooling chamber 200 and in other embodiments portions of the refrigeration system 300 can be separate from the cooling chamber 200. In still other embodiments, portions of the refrigeration system 300 can be separate from the housing 101.

[0029] The cooling system according to claim 1 includes a compressor, condenser, and evaporator.

[0030] According to the embodiment of the present invention in FIG. 6A, the refrigeration system 300 includes a compressor 302, a condenser 304 and an evaporator 306. The compressor 302 and condenser 304 as shown in FIG. 6A are located outside or separate from the cooling chamber 200 and can be located in fluid

communication with ambient air outside of the cooling system 100. As shown in FIG. 6A, the evaporator 306 is located outside of the cooling chamber 200 but in fluid communication with cooling chamber 200.

[0031] The refrigeration system 300, shown in FIG. 6A, contains a refrigerant, which is usually a fluid. The refrigerant can be any material sufficient for use in a refrigeration cycle. This can include materials such as ammonia, sulfur dioxide, and propane.

[0032] In a typical refrigeration cycle the refrigerant generally arrives at the compressor 302 as a cool, low-pressure gas. The compressor 302 compresses the refrigerant raising the temperature of the refrigerant. The refrigerant then generally exits the compressor 302 as a hot, high pressure gas and flows into the condenser 304. The condenser 304 can include a condenser fan 310 that can be used to direct air over the condenser 304 and direct warm air 312 out of the cooling system 100. The warm air 312 can exit the cooling system housing 101 through a vent 313 in one or more of the outer walls 120, 122, 124, 126, 128, 130 of the housing 101.

[0033] The refrigerant then flows to the evaporator 306 where it can change from a liquid to a gas. This process can reduce the temperature of the refrigerant, thus cooling the evaporator 306. The evaporator 306 may include a plurality of coils and/or fins or other heat sink devices that can improve the efficiency of the evaporator 306.

[0034] The refrigeration system 300, includes a fan 308. The fan 308 can be upstream of the evaporator as shown in FIG. 6A or down downstream of the evaporator, and is used to draw (or in some embodiments, push) air 314 from the cooling chamber 200 and direct air over the evaporator 306, thus cooling the air 314. The fan 308 also directs cool air 318 out of the evaporator 306 and back into the cooling chamber 200.

[0035] As is well known, warm air rises and cool air sinks, thus, most conventional cooler systems introduce cool air from an evaporator or other cold surface near the top of a cooling chamber and intake air to an evaporator or other cold surface through a vent toward the bottom of the cooling chamber. As shown in FIGS. 6A and 7, however, the cooling system 100 includes an air intake vent 320 positioned in an upper portion of the cooling chamber 200. The intake vent 320 can be centered at least in the top 50% of the cooling chamber 200, or at least in the top 33% of the cooling chamber 200, or at least in the top 25% of the cooling chamber 200, or at least in the top 10% of the cooling chamber. As discussed above, in some embodiments the direction of air flow may be reversed. In such embodiments it is understood that the intake vent 320 acts as an exhaust or discharge vent.

[0036] In one exemplary embodiment, the intake vent 320 can be a circular opening having a diameter in the range of about 100 mm to about 140 mm. In other embodiments the intake vent 320 can be any other suitable size or shape including square, rectangular shapes, oval and other shapes. In some embodiments, the intake vent 320 can include a screen 321 or other

device restricting particles and other objects from accessing the fan 308 from the cooling chamber 200.

[0037] As discussed above, the fan 308 pulls (or in some embodiments, pushes) air 314 through the evaporator (or other cold surface) 306 which cools the air. The cool air 318 is then directed through a duct 322. However, as discussed above, and as will be discussed in more detail below, in some embodiments, the direction of air flow can be reversed.

[0038] As shown in FIG. 6A, the duct 322 can have a substantially vertical section 323 wherein air from the evaporator 306 travels in a substantially vertical downward direction adjacent to the cooling chamber 200, and a substantially horizontal section 324 wherein air from the evaporator 306 travels in a substantially horizontal direction below the cooling chamber 200. The substantially vertical portion of the duct 322 can be defined by a rear wall 325, a forward wall 326, and sidewalls 327 and 328. In some embodiments the forward wall 326 can be the opposite side of an internal wall 210 of the cooling chamber 200 as shown in FIG. 6. In some embodiments, the rear wall 325 can include one or more portions that are inclined and not substantially vertical. The sidewalls 327 and 328 can define the width of the duct 322. The width may, in some embodiments, be similar to the width of the cooling chamber 200, but in other embodiments the width may be greater than or less than the width of the cooling chamber.

[0039] The substantially horizontal portion 324 of the duct 322 passes under the cooling chamber 200. The substantially horizontal portion 324 of the duct 322 can be defined by sidewalls 327, 328, the bottom wall 205 and a bottom side of the floor 204.

[0040] The duct 322 can also include one or more mechanisms to affect the flow of air within the duct 322. For example, the duct 322 can include one or more baffles 325. The baffles 325 as shown in FIG. 7, are arranged in the direction of air flow and can act to separate the flow of air within the duct 322. As shown in FIG. 7, the baffles are located between the floor 204 and the bottom wall 205; however baffles 325 may be placed at any location within the duct 322. The baffles 325 can be constructed of any suitable material such as sheet metal or plastic.

[0041] As shown in FIGS. 6A and 7, the duct 322 has a generally rectangular cross-sectional shape. However, in other embodiments, the duct 322 may have other cross-sectional shapes, such as circular. In still other embodiments, there may be, two or more ducts to direct cool airflow from the evaporator 306 to the cooling chamber 200. In still other embodiments, the duct 322 may have any other suitable size, shape, and/or configuration.

[0042] As discussed above, the surface or floor 204 includes a one or more openings or a plurality of openings 326. The openings 326 can be configured such that the airflow from the duct 322, or refrigeration system 300, through each individual opening of the plurality of openings 326 is substantially similar. In embodiments of the

cooling system 100 described herein air flow across the entire cross-section of the cooling chamber 200 may be substantially equal. Additionally, the openings 326 and/or floor 204 can be configured such that there is uniform temperature distribution within the cooling chamber 200 which can uniformly cool packages or containers within the cooling chamber 200 to substantially uniform temperatures. Substantially equal airflow through each of the openings 326 can be accomplished by varying characteristics of the openings 326 such as the opening size, shape, and spacing arrangement, and through use of the baffles 325 to channel the flow of air within the duct 322. For example the openings 326 can have varying sizes, shapes, and/or locations or spacing arrangements such that the air flow through each of the plurality of openings is substantially similar.

[0043] As shown in FIG. 8A, the openings 326 can be spaced in a grid pattern and each of the openings can be substantially circular in shape. As shown in FIG. 8A a first portion 328 of the plurality of the openings 326 can have a first size, shape, and/or spacing arrangement and a second portion of the openings 330, which is downstream in the direction of air flow of the first portion, can have a second size, shape, and/or spacing arrangement. As shown in FIG. 8A, the shape of the openings 326 in the first and second portions 328, 330 can be similar, but in other embodiments the shape of the openings 326 of the first and second portions can be different. As shown in FIG. 8A, the size of the openings 326 in the first and second portions 328, 330 can be different. In some embodiments, the openings 326 in the first portion 328 can be smaller than the openings 326 in the second portion 330. For example, the first portion of openings 328 can have a diameter of about 16 mm or in the range of about 12 mm to 20 mm and the second portion of openings 330 can have a diameter of about 20 mm or in the range of about 16 mm to about 24 mm. Similarly, in some embodiments, the spacing arrangement of the plurality of openings 326 in each of the first and second portions can be similar or can be different. In some embodiments, for example, the plurality of openings 328 in the first portion may be spaced closer together or further apart than the plurality of openings 330 in the second portion.

[0044] In other embodiments, examples of which are shown in FIGS. 8B, 8C, 8D, and 8E-F the openings 326 in the surface or floor 204 can have other sizes, shapes, and/or locations that can provide substantially similar air flow through each of the plurality of openings 326. Similarly these surfaces or floors 204 can be configured such that there is uniform temperature distribution within the cooling chamber 200 which can uniformly cool packages or containers within the cooling chamber 200 to substantially uniform temperatures. For example, as shown in FIG. 8B, the plurality of openings can be circular having a different arrangement and different sizes than that shown in FIG. 8A. Additionally, as shown in FIGS. 8C and 8D the plurality of openings can have different shapes, sizes, and configurations. As shown in Fig. 8C, for example, the

plurality of openings can be square or rectangular shaped, and as shown, for example in FIG. 8D, the plurality of openings 324 can be hexagonal shaped. Any other suitable shapes can be used including, for example, triangular openings, and octagonal openings. Similarly, any suitable spacing arrangement and sized openings 326 can be used.

[0045] In some embodiments, the floor 204 can have a thickness greater than that shown in, for example, FIG. 6A. For example, as shown in FIG. 8E, a cross-section of which is shown in FIG. 8F, the floor 204 can include a packed bed. The packed bed can be composed of any suitable material such that air 318 can flow through the packed bed. Similar to the floors 204 discussed above, the packed bed includes openings 326 through which air 318 from the refrigeration system 300 can flow. Cool air flow 318 through the packed bed can be uniform and can result in uniform temperature distribution within the cooling chamber 200.

[0046] In some embodiments, the plurality of openings 326 can be adjustable. Adjustable openings may be used to adjust the cooling system 200 depending on the type and/or size of item to be cooled. For example soda cans may be cooled more efficiently with a floor 204 having openings 326 which are smaller and/or more closely spaced together than a floor 204 used for soda bottles.

[0047] In some embodiments, the floor 204 may be removably engaged within the cooling chamber 200 such that a user could install a first floor 204 suited to cool a first product or install a separate second floor 204 when cooling a second product. In other embodiments, the floor opening configuration may be adjustable within the cooling system 100. For example, in some embodiments, the floor 204 may be comprised of a first piece and a second piece that are slidably engaged with each piece having a plurality of openings. In such a configuration movement of one of the floor pieces can open, close, enlarge, or decrease the size of the plurality of openings 326 through which air can pass. The opening pattern can thus be adjusted to provide the most efficient air flow possible. In such a system, the adjustment of the floor openings 326 can be manual or automatic. For example, in a manual arrangement, a user can manually slide one of the first and second floor pieces. In an automatic system the cooling system 100 may include one or more sensors to that can determine the optimum floor arrangement and adjust the floor to the optimum floor arrangement.

[0048] As discussed above, cooling system 100, cooling chamber 200, and refrigeration system 300 can be any suitable size and shape. As shown in FIG. 6A the refrigeration system 300 includes a compressor, condenser, and evaporator. Other embodiments of the cooling system 100 are schematically shown in FIGS. 6B-6E.

[0049] As shown in FIG. 6B, the refrigeration system 300 can be any system suitable for providing cooling air flow 318 to the cooling chamber 200. As discussed above, the refrigeration system 300 is a compressor

based cooling system as shown in FIG. 6A.

[0050] In still other embodiments, as shown in FIG. 6C, the direction of airflow can be reversed compared to the airflow shown in FIGS. 6A and 6B. As shown in FIG. 6C, cooling airflow 318 can exit the refrigeration system 300 and enter the cooling chamber 200 in an upper portion of the cooling chamber 200. The cooling air 318 can then flow in a generally downward direction through the openings 326 in the floor 204 and return to the refrigeration system 300.

[0051] Additionally, in some examples as shown in FIG. 6D, the cooling system 100 can include one or more openings or a plurality of openings 326 in one or more surfaces including sidewalls 206, 208, 210, 212 through which cool air flow 318 from the refrigeration system 300 can flow. In some embodiments there can be openings in surfaces including the floor 204 and at least one of the sidewalls 206, 208, 210, 212. In such embodiments cool airflow 318 through the openings 326 in the floor 204 and openings 326 in the sidewalls 206, 208, 210, 212 may be substantially similar which can allow for uniform temperature distribution in the cooling chamber 200. In other embodiments, there may be openings 326 in only at least one of the sidewalls 206, 208, 210, 212 and not the floor 204. In such embodiments cool airflow 318 through the one or more openings 326 in the at least one sidewall can be substantially similar which can allow for uniform temperature distribution in the cooling chamber 200.

[0052] In still other embodiments, and as discussed above, the cooling system 100 can have any other suitable size and/or configuration. As shown in FIG. 6E, the cooling chamber 200 can, for example, be located above the refrigeration system 300. Cool air 318 from the refrigeration system 300 can flow upwards or downwards through the floor 204 and return to the refrigeration system through an inlet in the cooling chamber 200.

[0053] In some embodiments, the cooling system 100 can also include a temperature sensor 402 (not shown), for measuring temperature inside the cooling system 100. The refrigeration system 300 can be controlled based on the temperature sensed by the temperature sensor 402. For example, the refrigeration system 300 can turn on when the temperature sensor 402 senses a temperature that is too high and turn off when the temperature sensor 402 senses that a set point temperature has been reached. In some embodiments, the set point temperature may be in a range of about 10 °C to about 0 °C. Automatic control of the refrigeration system 300 using a temperature sensor 402 can, in some embodiments, improve the efficiency of the cooling system.

[0054] In some embodiments, the cooling system 100 can include a logo or other design on one or more of the outer walls 120, 122, 124, 126, 128. In some embodiments the logo or other design can include one or more lights, such as, a light-emitting diode (LED). In still other embodiments, the lights or LEDs can surround a logo or other design. The lights or LEDs may be turned on or off and in some embodiments may flash in particular pat-

terns. For example, in one embodiment the lights or LEDs may surround the logo or other design and may be turned on for a first period of time, blink for a second period of time, and certain portions may be turned on while certain portions are turned off during a third period of time. In one embodiment the first period of time may be about 15 seconds or in the range of about 10 to 30 seconds, the second period of time may be about 15 seconds or in the range of about 10 to 30 seconds, and the third period of time may be about 15 seconds or in the range of about 10 to 30 seconds. This sequence can be repeated. Additionally, in other embodiments, the first period of time, second period of time, and third period of time may occur in any order.

[0055] Cooling systems 100 as described herein provide several advantages. In some embodiments, a cooling system as described herein can significantly reduce the time to cool a product within the cooling system 100. For example, in some embodiments, cooling systems as described herein can cool beverage bottles from a range of about 50 °C to 30 °C to a range of about 10 °C to 0 °C in about 3 to 6 hours. Thus, in some embodiments, cooling systems 100 as described herein can cool products at least five times faster than other cooling systems.

[0056] As discussed above, warm air rises and cool air sinks, thus, most conventional cooler systems introduce cool air from an evaporator or other cold surface toward the top of a cooling chamber and intake air to an evaporator or other cold surface through a vent toward the bottom of the cooling chamber. Cooling systems described herein intake air to an evaporator or other cold surface from a top portion of the cooling chamber 200 and force cool air through the floor 204 of the cooling chamber. Forcing cool air to move from the bottom to the top of the cooling chamber, against its natural flow, can increase the contact time the cool air has with a product within the cooling chamber 200 and can increase the cooling efficiency of the cooling system 100. Cooling systems 100 as discussed herein can reduce the amount of time required to cool a product by at least 15%, or at least 20%, or at least 25% compared to a cooling system that introduces cool air in an upper portion of a cooling chamber. However, as discussed herein, in some embodiments, the direction of airflow can be reversed such that cool air enters through a vent in the cooling chamber and is pushed out of the floor of the cooling chamber.

[0057] Additionally, cooling systems described herein can retain the temperature within the cooling chamber after the refrigeration system is turned off better than current cooling systems. In some embodiments, for example, the cooling system 100 may warm at substantially lower rate compared to a normal cooler. For example, the cooling systems described herein may warm the product only to 10 °C to 15 °C after six hours without turning on the refrigeration system. The cooling system 100, portions of the cooling chamber 200 include a phase change material. Many phase materials are known including salt hydrates, fatty acids, esters, paraffins, and ionic liquids.

Phase change materials are generally encapsulated within a pouch, bag, or similar enclosure. When the refrigeration system 300 is active the phase change material can be allowed to cool and/or freeze. Once the refrigeration system 300 is turned off, the phase change material can help to retain the cool temperature within the cooling system 100 by absorbing heat as the phase change material changes from a solid to a liquid. The phase change material is incorporated into any portion of the cooling chamber including into the top wall 202, bottom wall 205, sidewalls 206, 208, 210, 212, and/or floor 204. Use of a phase change material in the cooling chamber 200 increases the ability of the cooling system 100 to retain a cool temperature without use of the refrigeration system 300.

[0058] Additionally, because the time required to cool down a product within the cooler may be reduced, this can increase overall cooler efficiency based on the amount of product cooled. For example, in some embodiments the cooling systems as described herein can reduce operating costs for the same amount of product throughput very significantly compared to existing cooling systems by reducing the electricity usage of the cooling system. Additionally, because of its simplified structure and operation, the cooling system 100 is less expensive to fabricate, operate and maintain.

[0059] The appended claims are intended to cover all modifications and alternative embodiments. It should be understood that the use of a singular indefinite or definite article (e.g., "a," "an," "the," etc.) in this disclosure and in the following claims follows the traditional approach in patents of meaning "at least one" unless in a particular instance it is clear from context that the term is intended in that particular instance to mean specifically one and only one. Likewise, the term "comprising" is open ended, not excluding additional items, features, components, etc.

Claims

1. A cooling system (100) comprising:

a cooling chamber (200) defined by sidewalls (206, 208, 210, 212), a floor (204), and a top wall (202), wherein at least one surface of the cooling chamber defines one or more openings (326) and is configured to hold at least one container; wherein the cooling system (100) further comprises a phase change material disposed in at least one of the sidewalls (206, 208, 210, 212), the floor (204), or the top wall (202) of the cooling chamber; and

wherein the cooling system (100) further comprises

a refrigeration system (300) configured to cool the cooling chamber (200) by forcing cool airflow through the one or more openings (326), where-

- in the refrigeration system (300) further comprises a condenser (304) disposed laterally adjacent to the cooling chamber (200) at a vertical wall defining a cool air duct (322) configured to fluidly connect the refrigeration system and the openings (326), wherein the cool air duct (322) is disposed between the condenser (304) and the cooling chamber (200), wherein the refrigeration system (300) further comprises a compressor (302) and an evaporator (306) disposed above a plane defined by the floor and positioned such that at least one sidewall is between the evaporator (306) and the cooling chamber (200), wherein the refrigeration system (300) further comprises a fan (310) and an air intake vent (320) in a top portion of the cooling chamber (200), the air intake vent being disposed in the at least one sidewall. wherein the cool air duct (322) includes a substantially vertical portion located at least partially adjacent to the cooling chamber (200) and a substantially horizontal portion located at least partially below the surface, wherein the refrigeration system (30) is configured to cool the cooling chamber (200) by forcing cool airflow through the cool air duct (322) and through the one or more openings (326), and wherein the phase change material is configured to maintain a desired temperature in the cooling chamber when the refrigeration system is not operational.
2. The cooling system (100) of claim 1, wherein the airflow through each of the one or more openings (326) is substantially similar.
 3. The cooling system (100) of claim 2, wherein the cooling system (100) is configured to provide a substantially uniform temperature distribution in the cooling chamber (200).
 4. The cooling system (100) of claim 2, wherein the at least one surface comprises the at least one sidewall.
 5. The cooling system (100) of claim 2, wherein each of the one or more openings (326) are sized to provide substantially similar airflow through them.
 6. The cooling system (100) of claim 2, wherein each of the one or more openings (326) are shaped to provide substantially similar airflow through them.
 7. The cooling system (100) of claim 2, wherein each of the openings (326) are spaced to provide substantially similar airflow through them.
 8. The cooling system (100) of claim 1, wherein the at

least one surface comprises a packed bed.

9. The cooling system (100) of claim 2, wherein at least some of the one or more openings (326) are circular.
10. The cooling system (100) of any of the preceding claims, further comprising one or more baffles (325) located in the cool air duct (322), wherein the one or more baffles (325) are configured to adjust the airflow within the cool air duct (322).
11. The cooling system (100) of claim 10, wherein the substantially vertical portion of the cool air duct (322) located at least partially adjacent to the cooling chamber (200) separates the cooling chamber (200) from the condenser (304).
12. The cooling system (100) of claim 2, wherein the cooling system (100) is configured to cool beverage bottles in the cooling chamber (200) from a range of about 30 °C - 50 °C to a range of about 10 °C - 0°C in 1.5 to 6 hours.
13. The cooling system (100) of claim 1, wherein the surface further includes at least a first region with one or more openings (326) having at least a first opening characteristic and a second region with one or more openings (326) having at least a second opening characteristic different from the first opening characteristic, wherein the surface is configured to hold at least one container; wherein the airflow through each of the one or more openings (326) is substantially similar.

Patentansprüche

1. Kühlsystem (100), umfassend:

eine Kühlkammer (200), die von Seitenwänden (206, 208, 210, 212) definiert ist, einen Boden (204) und eine obere Wand (202), wobei mindestens eine Fläche der Kühlkammer eine oder mehrere Öffnungen (326) definiert und eingerichtet ist, um mindestens einen Behälter zu halten; wobei das Kühlsystem (100) ferner ein Phasenwechselmaterial umfasst, das in mindestens einer der Seitenwände (206, 208, 210, 212), dem Boden (204) oder der oberen Wand (202) der Kühlkammer angeordnet ist; und wobei das Kühlsystem (100) ferner eine Kühlanlage (300) umfasst, die eingerichtet ist, um die Kühlkammer (200) zu kühlen, indem ein kalter Luftstrom durch die eine oder die mehreren Öffnungen (326) gezwungen wird, wobei die Kühlanlage (300) ferner einen Kondensator (304) umfasst, der seitlich benachbart zu der

- Kühlkammer (200) an einer vertikalen Wand angeordnet ist, die einen Kaltluftkanal (322) definiert, der eingerichtet ist, um die Kühlanlage und die Öffnungen (326) in Fluidverbindung zu bringen,
- wobei der Kaltluftkanal (322) zwischen dem Kondensator (304) und der Kühlkammer (200) angeordnet ist, wobei die Kühlanlage (300) ferner einen Verdichter (302) und einen Verdampfer (306) umfasst, der oberhalb einer Ebene angeordnet ist, die von dem Boden definiert ist, und derart positioniert ist, dass sich die mindestens eine Seitenwand zwischen dem Verdampfer (306) und der Kühlkammer (200) befindet,
- wobei die Kühlanlage (300) ferner einen Ventilator (310) und eine Lufteinlassöffnung (320) in einem oberen Abschnitt der Kühlkammer (200) umfasst, wobei die Lufteinlassöffnung in der mindestens einen Seitenwand angeordnet ist, wobei der Kaltluftkanal (322) einen im Wesentlichen vertikalen Abschnitt, der zumindest teilweise benachbart zu der Kühlkammer (200) angeordnet ist, und einen im Wesentlichen horizontalen Abschnitt aufweist, der zumindest teilweise unterhalb der Fläche angeordnet ist, wobei die Kühlanlage (30) eingerichtet ist, um die Kühlkammer (200) zu kühlen, indem ein kalter Luftstrom durch den Kaltluftkanal (322) und durch die eine oder mehreren Öffnungen (326) gezwungen wird, und
- wobei das Phasenwechselmaterial eingerichtet ist, um eine gewünschte Temperatur in der Kühlkammer aufrechtzuerhalten, wenn das Kühlsystem nicht in Betrieb ist.
2. Kühlsystem (100) nach Anspruch 1, wobei der Luftstrom durch jede der einen oder mehreren Öffnungen (326) im Wesentlichen ähnlich ist.
 3. Kühlsystem (100) nach Anspruch 2, wobei das Kühlsystem (100) eingerichtet ist, um eine im Wesentlichen gleichmäßige Temperaturverteilung in der Kühlkammer (200) bereitzustellen.
 4. Kühlsystem (100) nach Anspruch 2, wobei die mindestens eine Fläche die mindestens eine Seitenwand umfasst.
 5. Kühlsystem (100) nach Anspruch 2, wobei jede der einen oder mehreren Öffnungen (326) so bemessen ist, dass sie einen im Wesentlichen ähnlichen Luftstrom durch sie hindurch bereitstellt.
 6. Kühlsystem (100) nach Anspruch 2, wobei jede der einen oder mehreren Öffnungen (326) so geformt ist, dass sie einen im Wesentlichen ähnlichen Luftstrom durch sie hindurch bereitstellt.
 7. Kühlsystem (100) nach Anspruch 2, wobei jede der Öffnungen (326) so platziert ist, dass sie einen im Wesentlichen ähnlichen Luftstrom durch sie hindurch bereitstellt.
 8. Kühlsystem (100) nach Anspruch 1, wobei die mindestens eine Fläche ein gepacktes Bett umfasst.
 9. Kühlsystem (100) nach Anspruch 2, wobei mindestens einige der einen oder mehreren Öffnungen (326) kreisförmig sind.
 10. Kühlsystem (100) nach einem der vorhergehenden Ansprüche, ferner umfassend eine oder mehrere Leitbleche (325), die sich in dem Kaltluftkanal (322) befinden, wobei das eine oder die mehreren Leitbleche (325) eingerichtet sind, um den Luftstrom innerhalb des Kaltluftkanals (322) anzupassen.
 11. Kühlsystem (100) nach Anspruch 10, wobei der im Wesentlichen vertikale Abschnitt des Kaltluftkanals (322), der zumindest teilweise benachbart zur Kühlkammer (200) angeordnet ist, die Kühlkammer (200) von dem Kondensator (304) trennt.
 12. Kühlsystem (100) nach Anspruch 2, wobei das Kühlsystem (100) eingerichtet ist, um Getränkeflaschen in der Kühlkammer (200) von einem Bereich von etwa 30 °C bis 50 °C auf einen Bereich von etwa 10 °C bis 0 °C in 1,5 bis 6 Stunden zu kühlen.
 13. Kühlsystem (100) nach Anspruch 1, wobei die Fläche ferner mindestens einen ersten Bereich mit einer oder mehreren Öffnungen (326) mit mindestens einem ersten Öffnungsmerkmal und einen zweiten Bereich mit einer oder mehreren Öffnungen (326) mit mindestens einem zweiten Öffnungsmerkmal, das sich vom ersten Öffnungsmerkmal unterscheidet, aufweist, wobei die Fläche eingerichtet ist, um mindestens einen Behälter zu halten; wobei der Luftstrom durch jede der einen oder mehreren Öffnungen (326) im Wesentlichen ähnlich ist.
- Revendications**
1. Système de refroidissement (100) comprenant :
 - une chambre de refroidissement (200) définie par des parois latérales (206, 208, 210, 212), un plancher (204), et une paroi supérieure (202), dans lequel au moins une surface de la chambre de refroidissement définit une ou plusieurs ouvertures (326) et est configurée pour contenir au moins un récipient ;
 - dans lequel le système de refroidissement (100) comprend en outre un matériau à changement de phase disposé dans au moins l'un parmi les

- parois latérales (206, 208, 210, 212), le plancher (204), ou la paroi supérieure (202) de la chambre de refroidissement ; et
 dans lequel le système de refroidissement (100) comprend en outre un système de réfrigération (300) configuré pour refroidir la chambre de refroidissement (200) en forçant un flux d'air froid à travers la ou les ouvertures (326), dans lequel le système de réfrigération (300) comprend en outre un condenseur (304) disposé latéralement à côté de la chambre de refroidissement (200) au niveau d'une paroi verticale définissant un conduit d'air froid (322) configuré pour relier de manière fluide le système de réfrigération et les ouvertures (326), dans lequel le conduit d'air froid (322) est disposé entre le condenseur (304) et la chambre de refroidissement (200), dans lequel le système de réfrigération (300) comprend en outre un compresseur (302) et un évaporateur (306) disposés au-dessus d'un plan défini par le plancher et positionnés de telle sorte que l'au moins une paroi latérale se trouve entre l'évaporateur (306) et la chambre de refroidissement (200),
 dans lequel le système de réfrigération (300) comprend en outre un ventilateur (310) et un événement d'admission d'air (320) dans une partie supérieure de la chambre de refroidissement (200), l'événement d'admission d'air étant disposé dans l'au moins une paroi latérale, dans lequel le conduit d'air froid (322) inclut une partie sensiblement verticale située au moins partiellement à côté de la chambre de refroidissement (200) et une partie sensiblement horizontale située au moins partiellement sous la surface, dans lequel le système de réfrigération (30) est configuré pour refroidir la chambre de refroidissement (200) en forçant un flux d'air froid à travers le conduit d'air froid (322) et à travers la ou les ouvertures (326), et
 dans lequel le matériau à changement de phase est configuré pour maintenir une température souhaitée dans la chambre de refroidissement lorsque le système de réfrigération n'est pas opérationnel.
2. Système de refroidissement (100) selon la revendication 1, dans lequel le flux d'air à travers chacune de la ou des ouvertures (326) est sensiblement similaire.
 3. Système de refroidissement (100) selon la revendication 2, dans lequel le système de refroidissement (100) est configuré pour fournir une répartition de la température sensiblement uniforme dans la chambre de refroidissement (200).
 4. Système de refroidissement (100) selon la revendication 2, dans lequel l'au moins une surface comprend l'au moins une paroi latérale.
 5. Système de refroidissement (100) selon la revendication 2, dans lequel chacune de la ou des ouvertures (326) est dimensionnée pour fournir un flux d'air sensiblement similaire à travers elles.
 6. Système de refroidissement (100) selon la revendication 2, dans lequel chacune de la ou des ouvertures (326) est formée pour fournir un flux d'air sensiblement similaire à travers elles.
 7. Système de refroidissement (100) selon la revendication 2, dans lequel chacune des ouvertures (326) est espacée pour fournir un flux d'air sensiblement similaire à travers elles.
 8. Système de refroidissement (100) selon la revendication 1, dans lequel l'au moins une surface comprend un lit tassé.
 9. Système de refroidissement (100) selon la revendication 2, dans lequel au moins certaines de la ou des ouvertures (326) sont circulaires.
 10. Système de refroidissement (100) selon l'une quelconque des revendications précédentes, comprenant en outre un ou plusieurs déflecteurs (325) situés dans le conduit d'air froid (322), dans lequel le ou les déflecteurs (325) sont configurés pour ajuster le flux d'air dans le conduit d'air froid (322).
 11. Système de refroidissement (100) selon la revendication 10, dans lequel la partie sensiblement verticale du conduit d'air froid (322) située au moins partiellement à côté de la chambre de refroidissement (200) sépare la chambre de refroidissement (200) du condenseur (304).
 12. Système de refroidissement (100) selon la revendication 2, dans lequel le système de refroidissement (100) est configuré pour refroidir des bouteilles de boissons dans la chambre de refroidissement (200) d'une plage d'environ 30 °C à 50 °C à une plage d'environ 10 °C à 0 °C en 1,5 à 6 heures.
 13. Système de refroidissement (100) selon la revendication 1, dans lequel la surface inclut en outre au moins une première région avec une ou plusieurs ouvertures (326) ayant au moins une première caractéristique d'ouverture et une seconde région avec une ou plusieurs ouvertures (326) ayant au moins une seconde caractéristique d'ouverture différente de la première caractéristique d'ouverture, dans lequel la surface est configurée pour contenir au moins un récipient ;

dans lequel le flux d'air à travers chacune de la ou des ouvertures (326) est sensiblement similaire.

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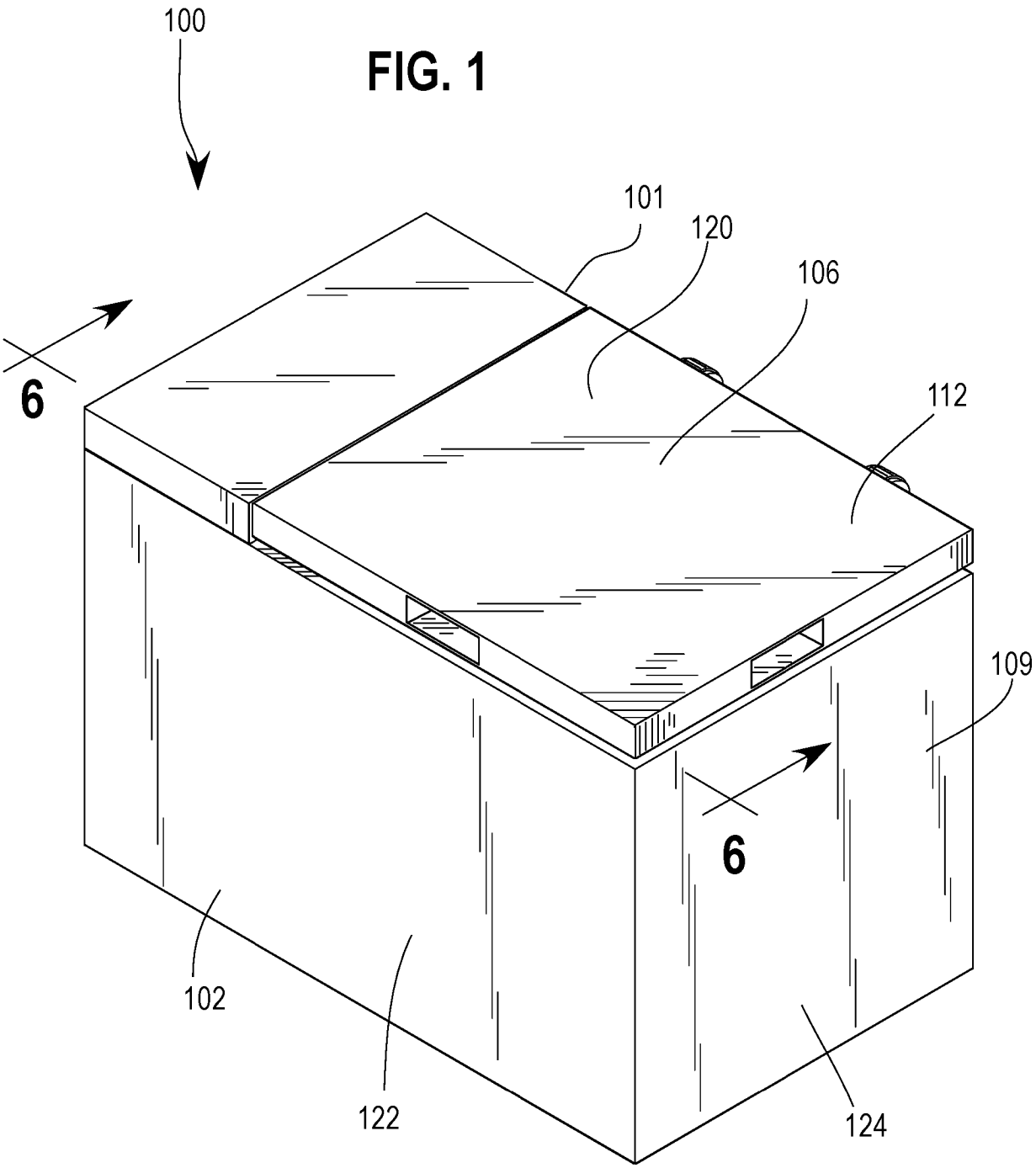


FIG. 2

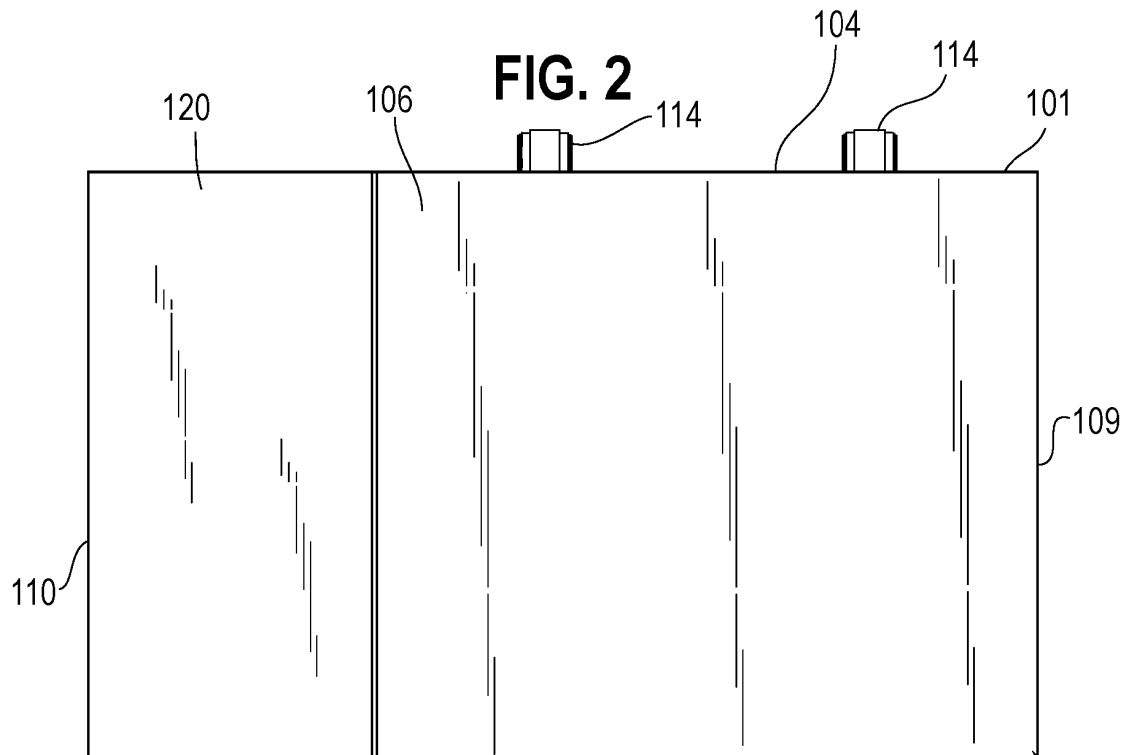


FIG. 3

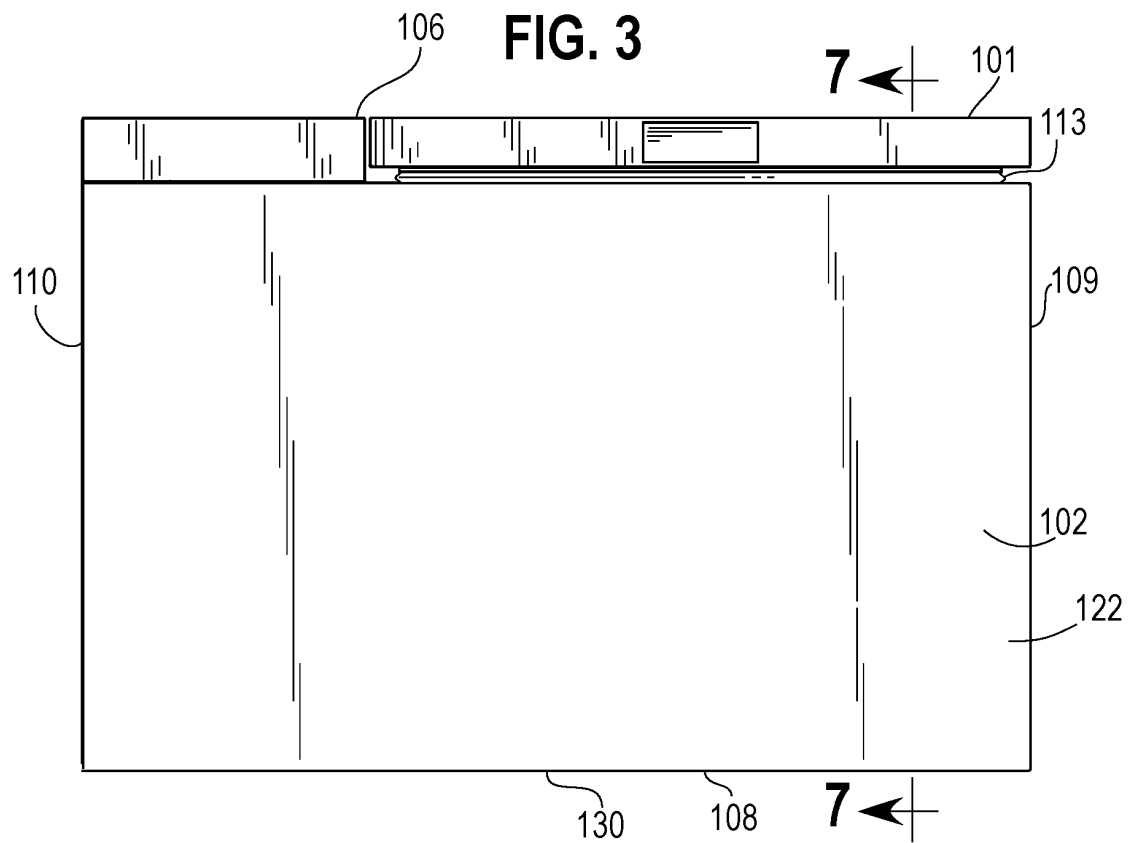


FIG. 4

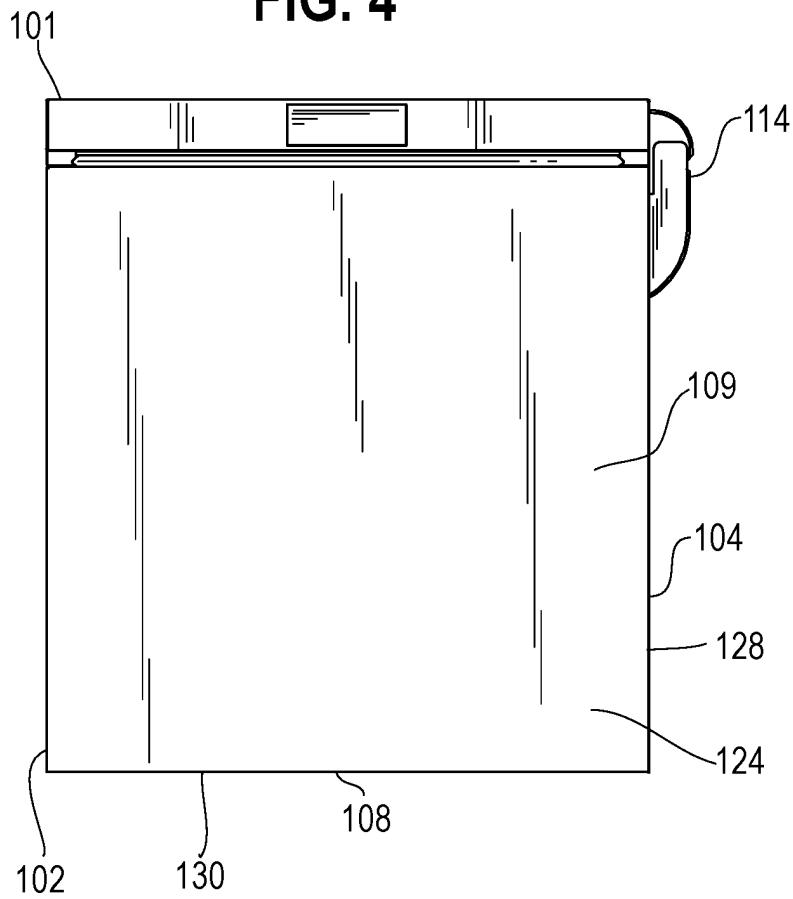
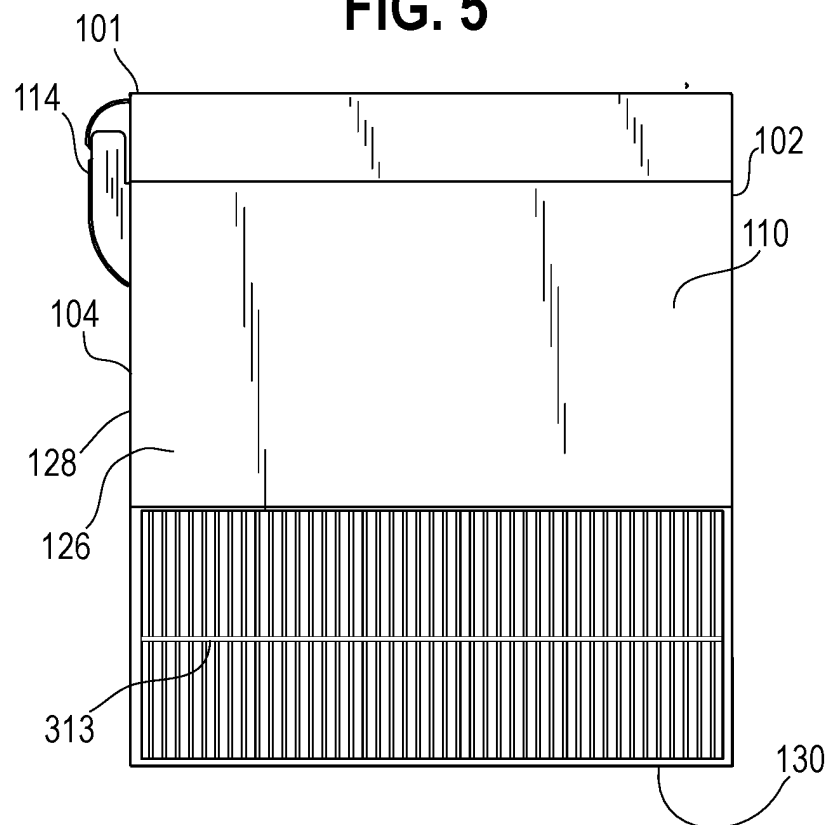
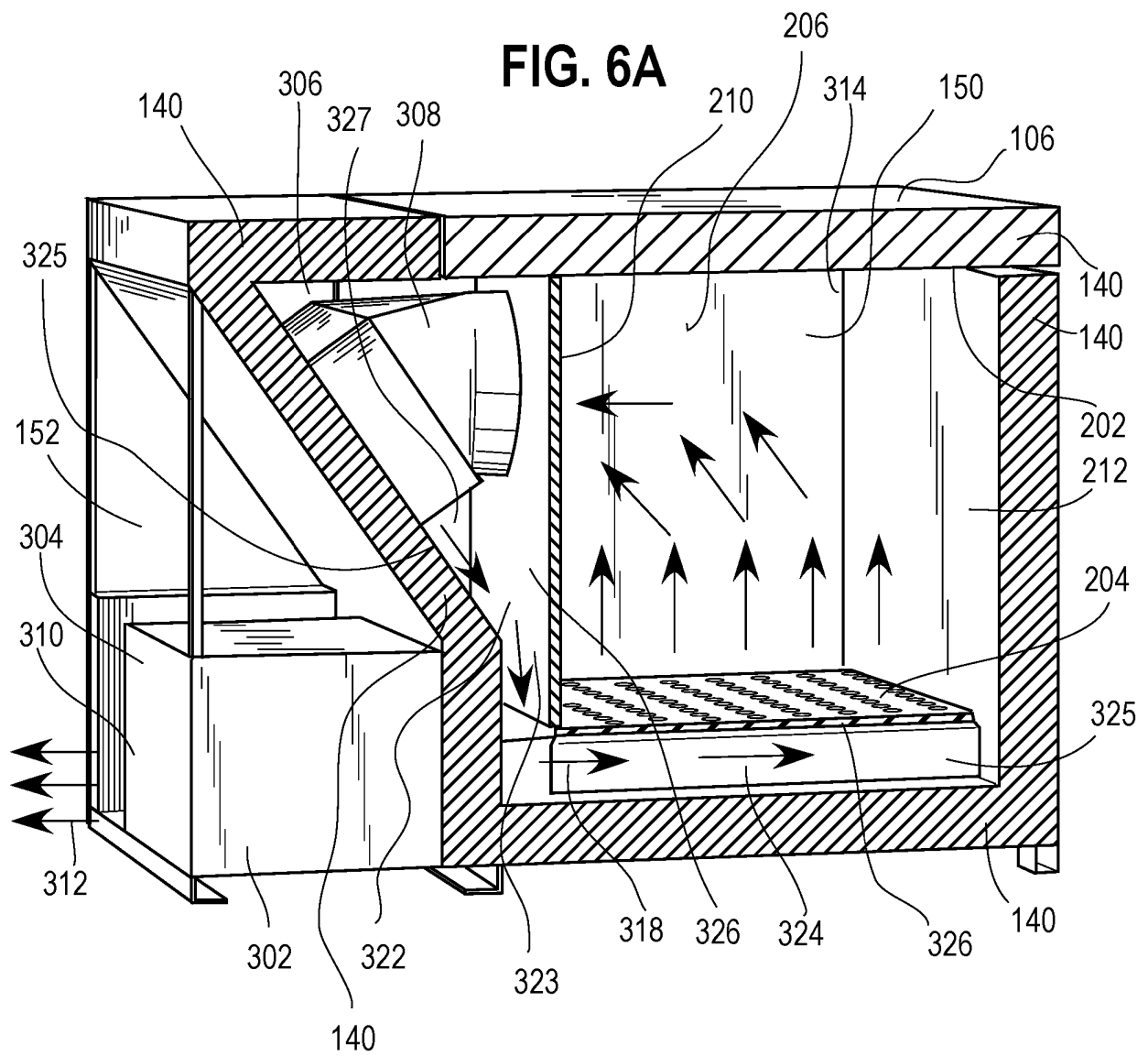


FIG. 5





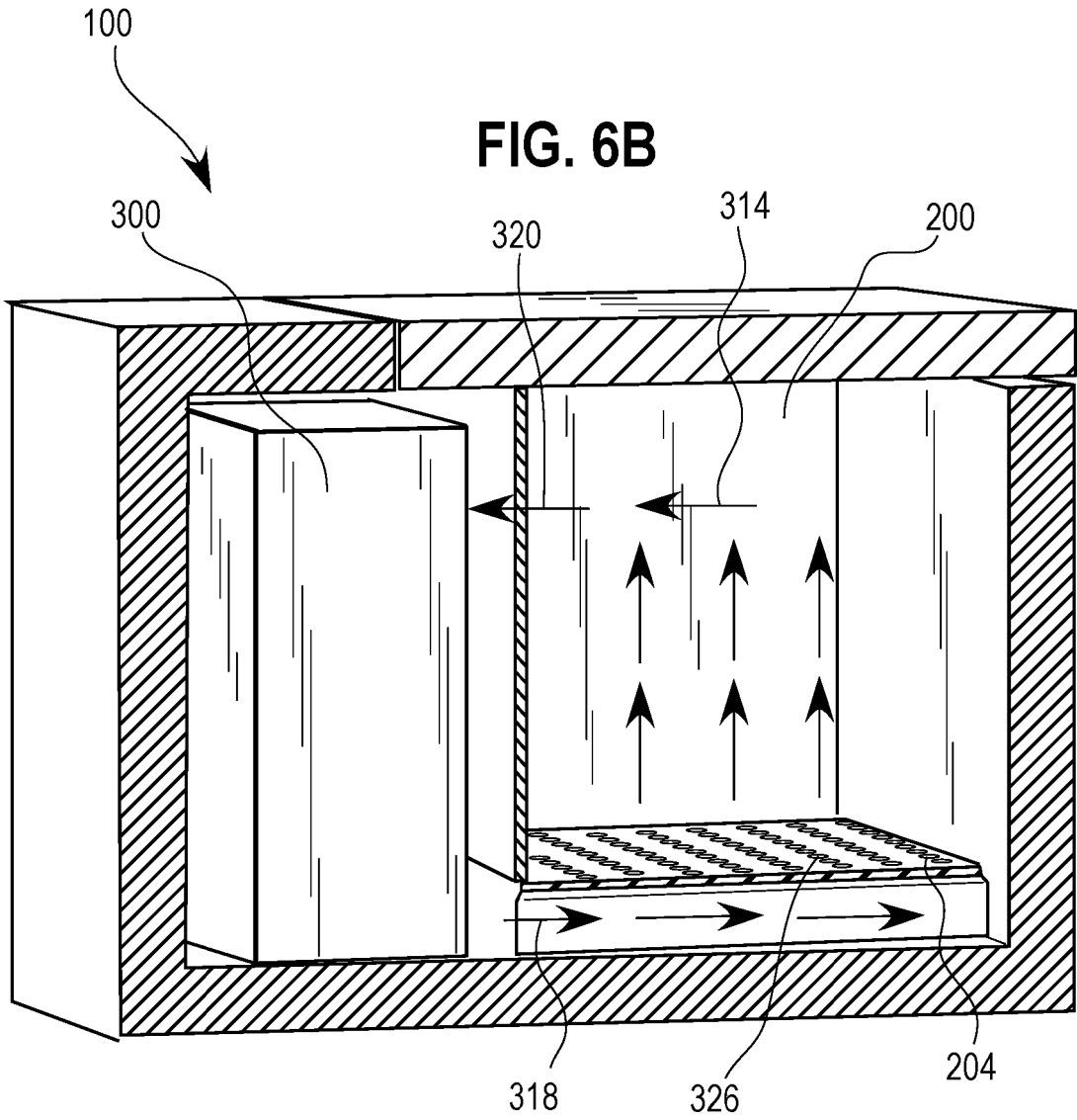
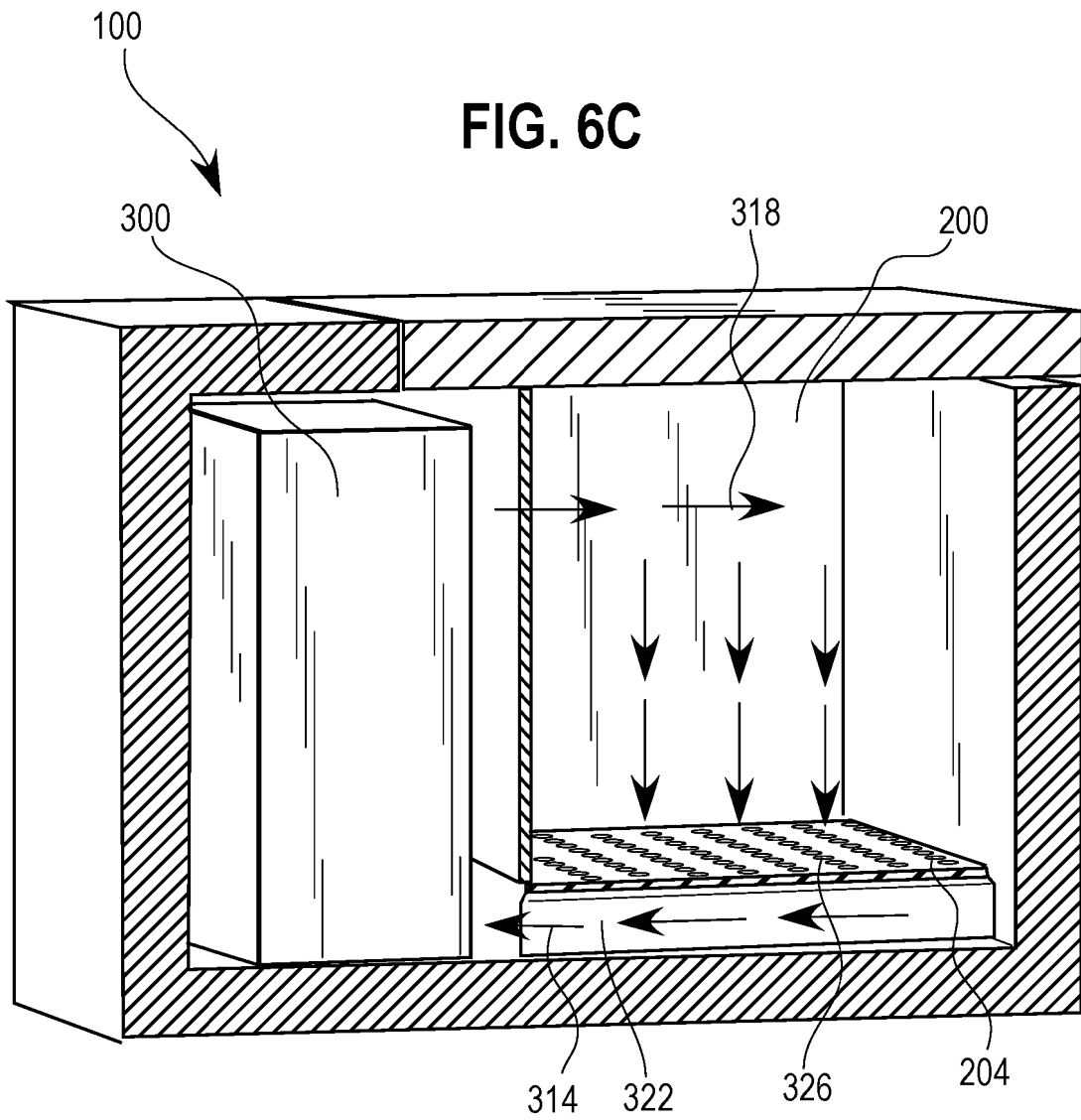


FIG. 6C



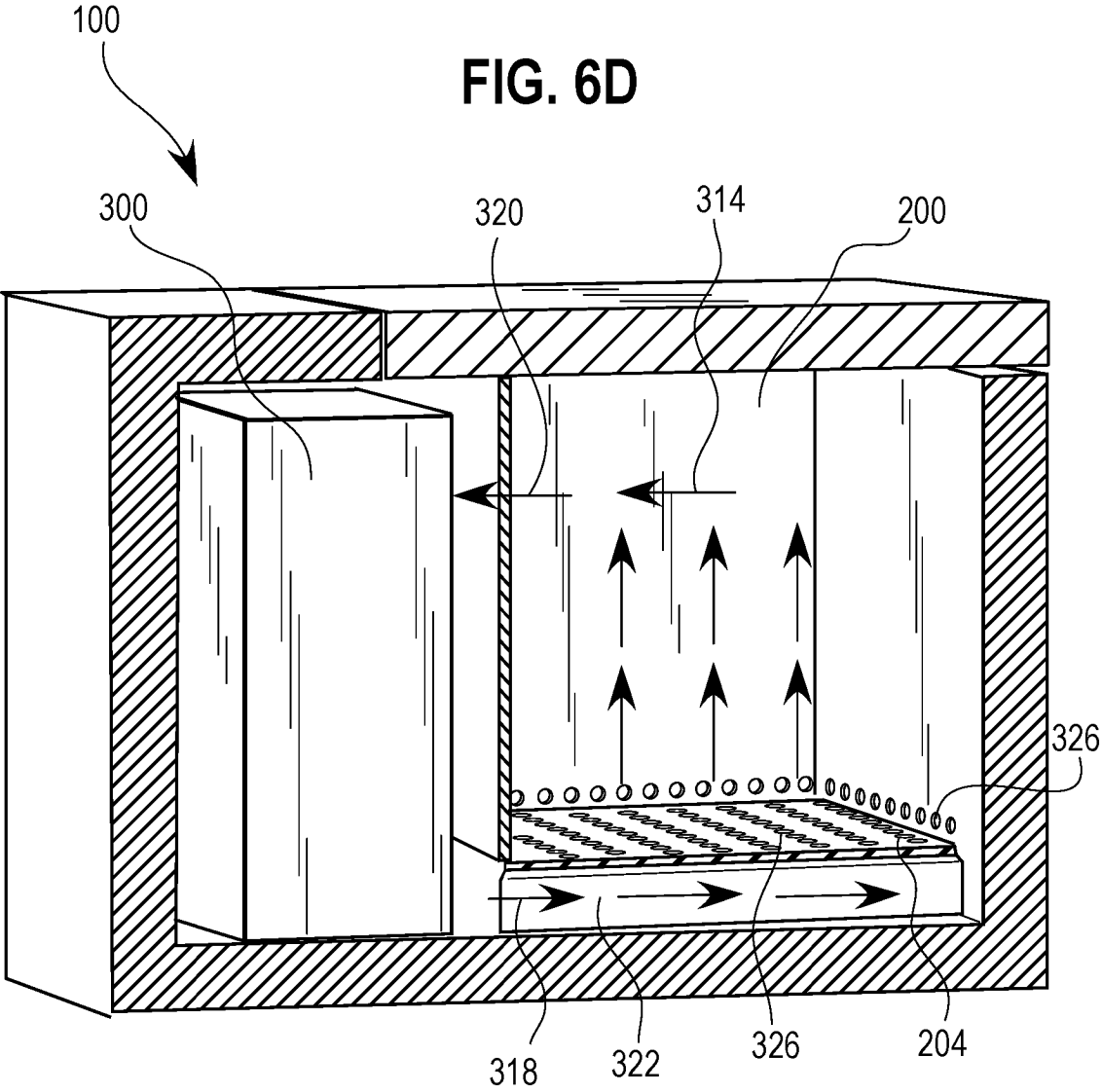


FIG. 6E

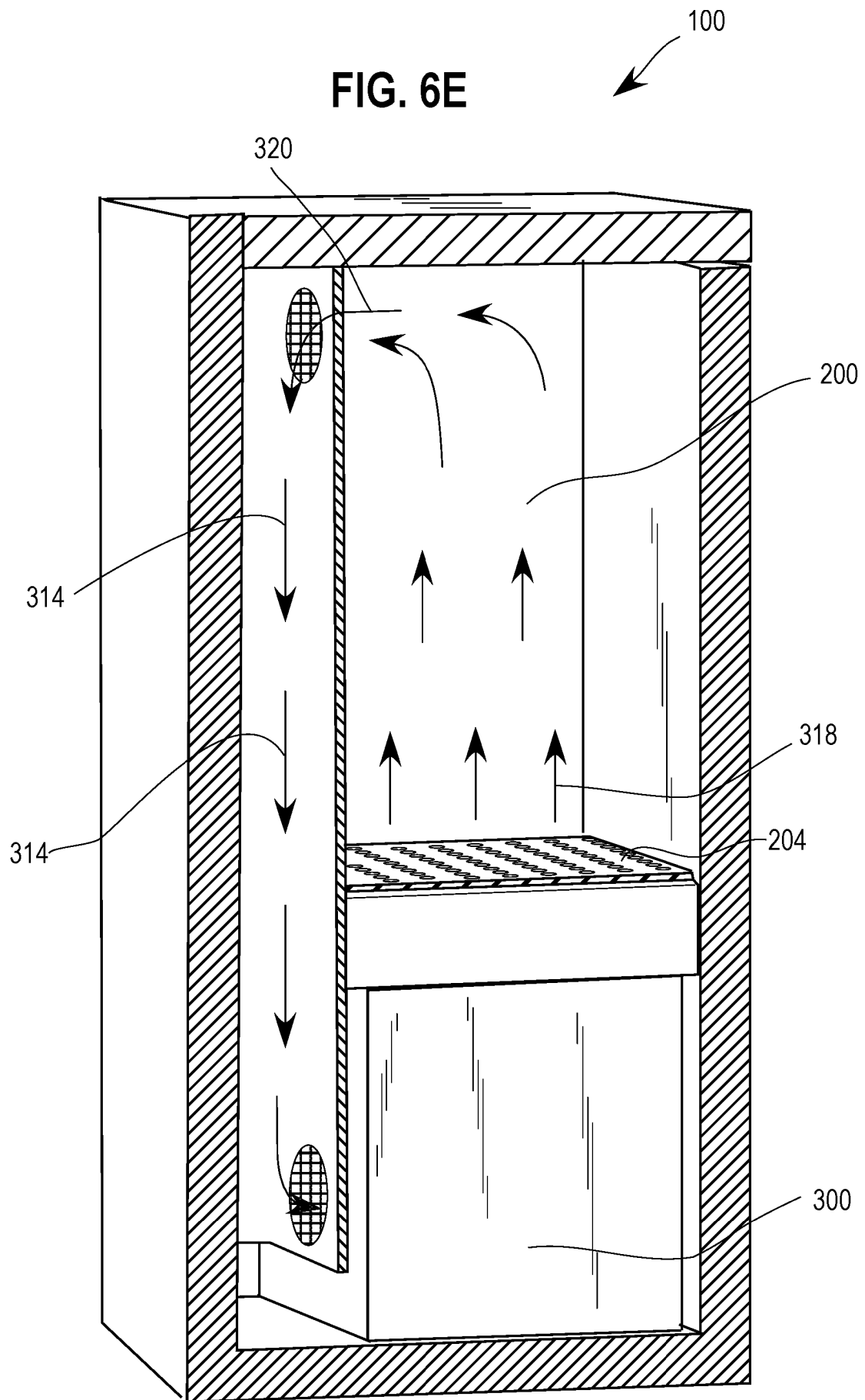


FIG. 7

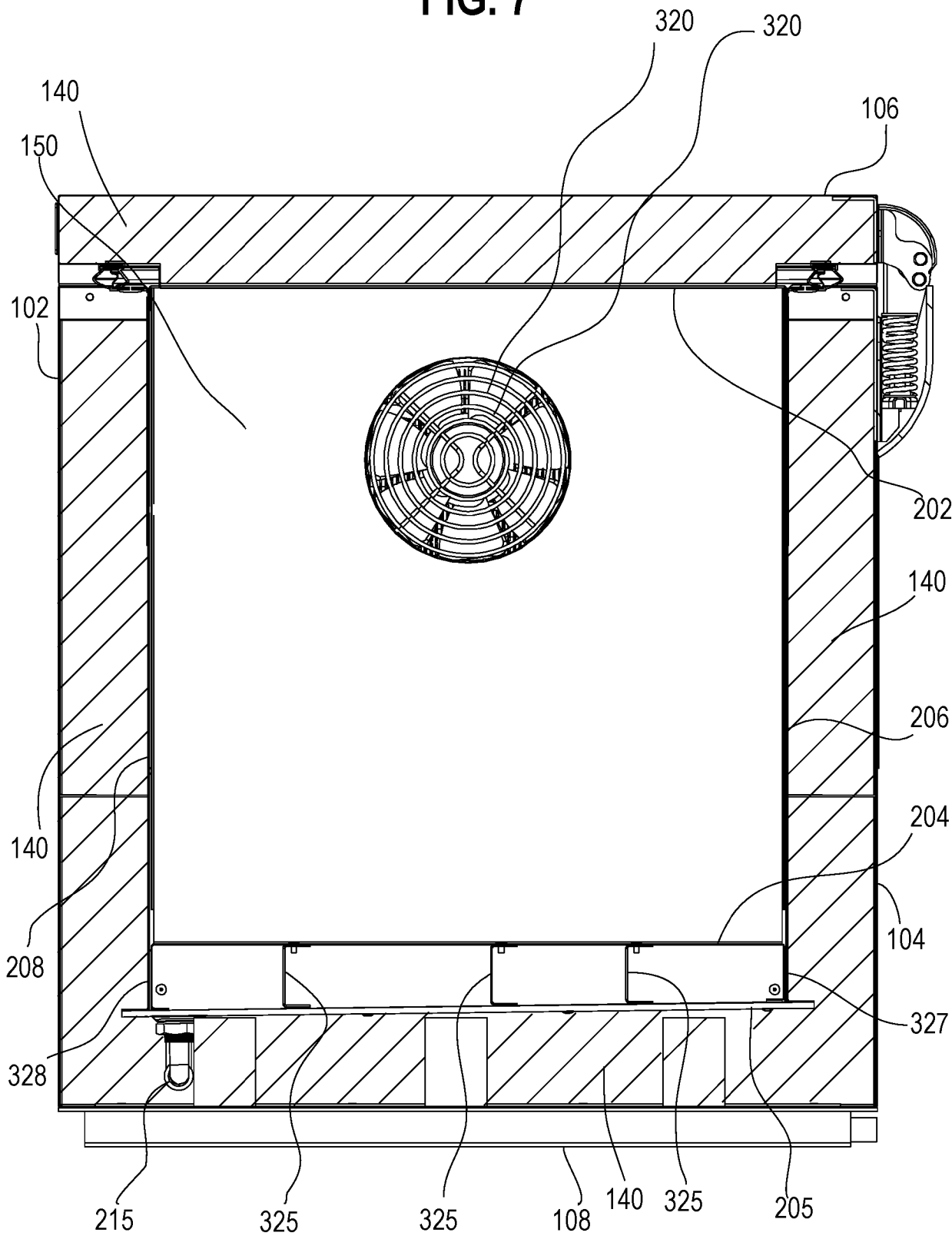


FIG. 8A

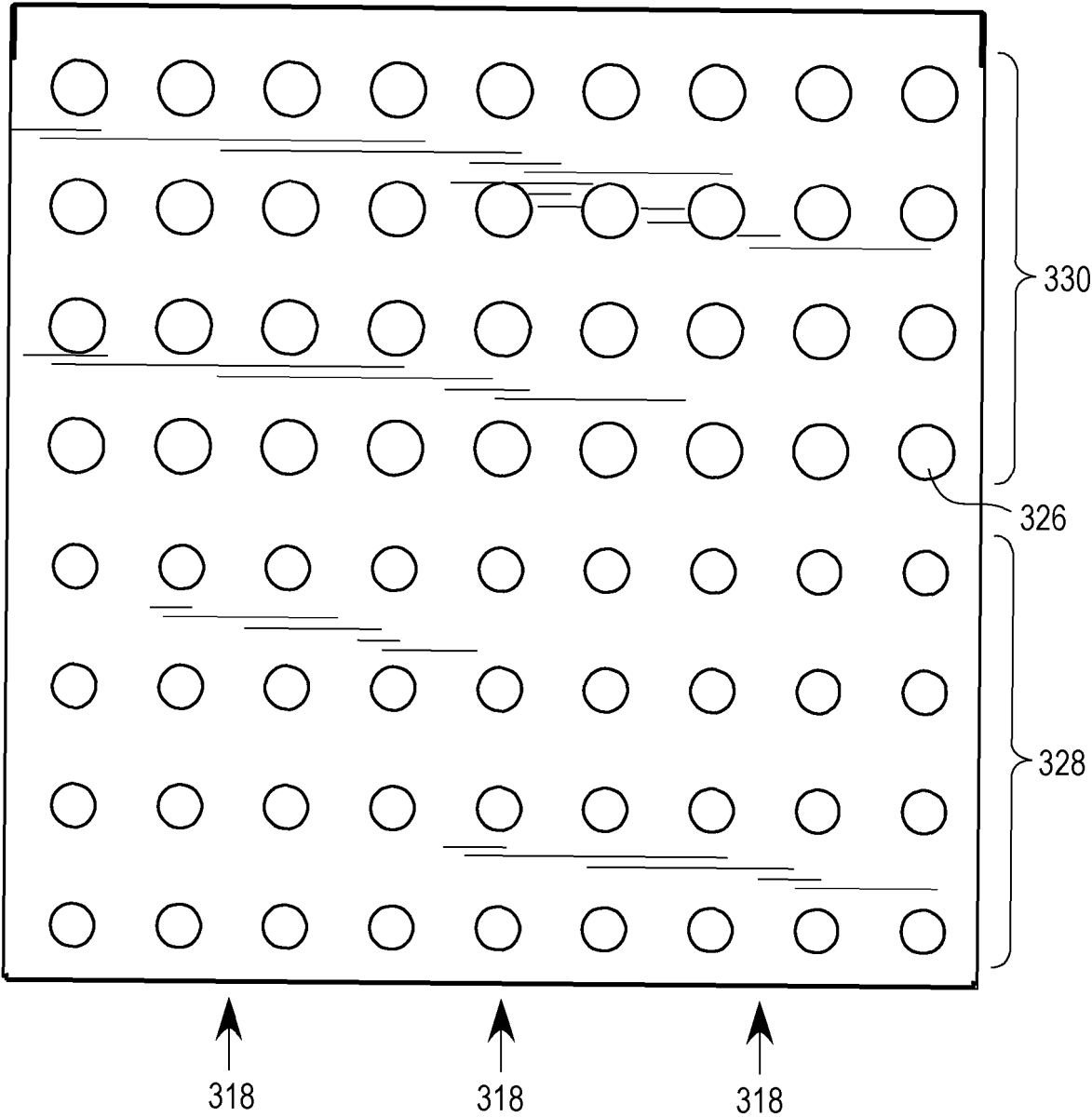
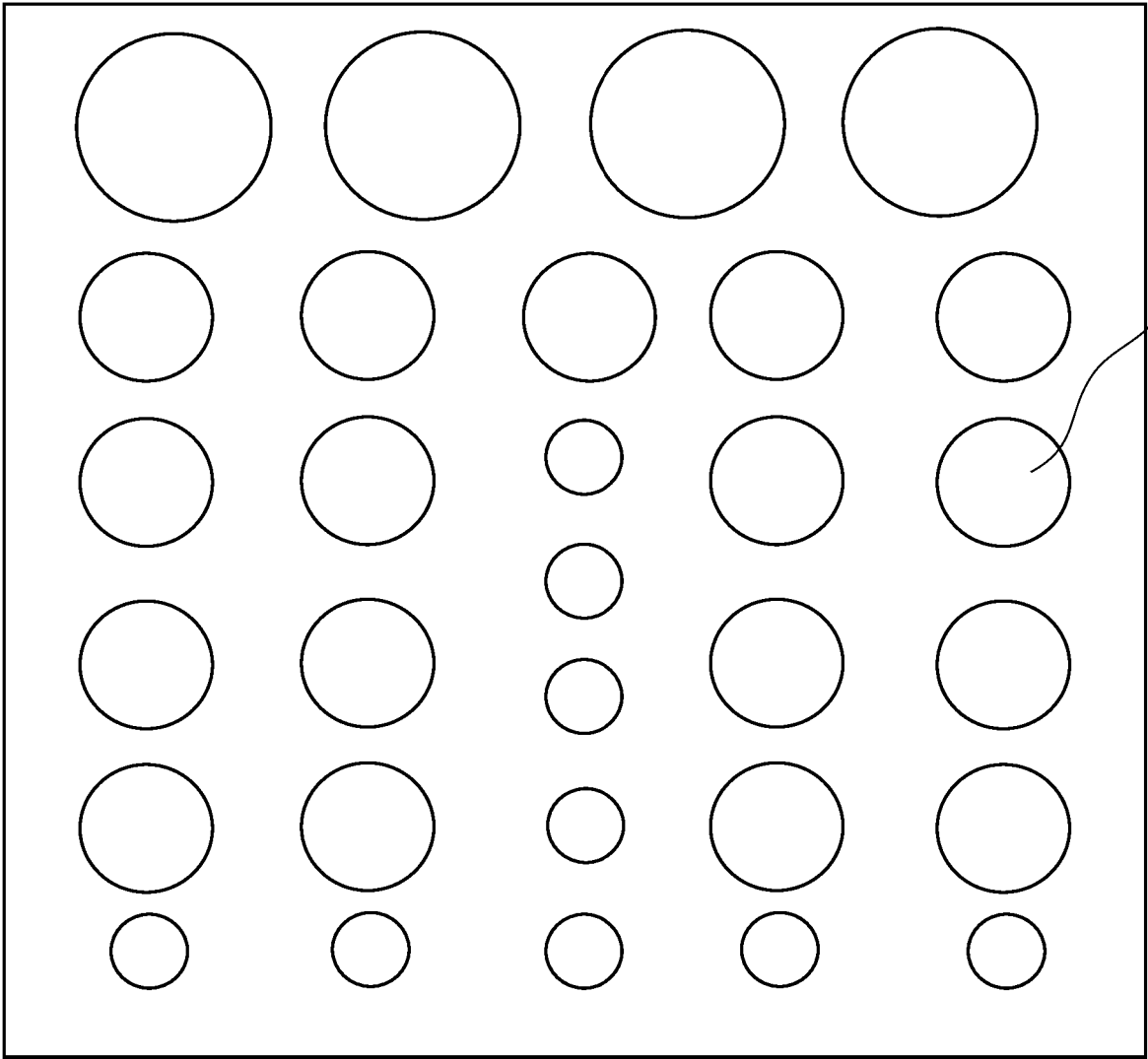


FIG. 8B



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FIG. 8C

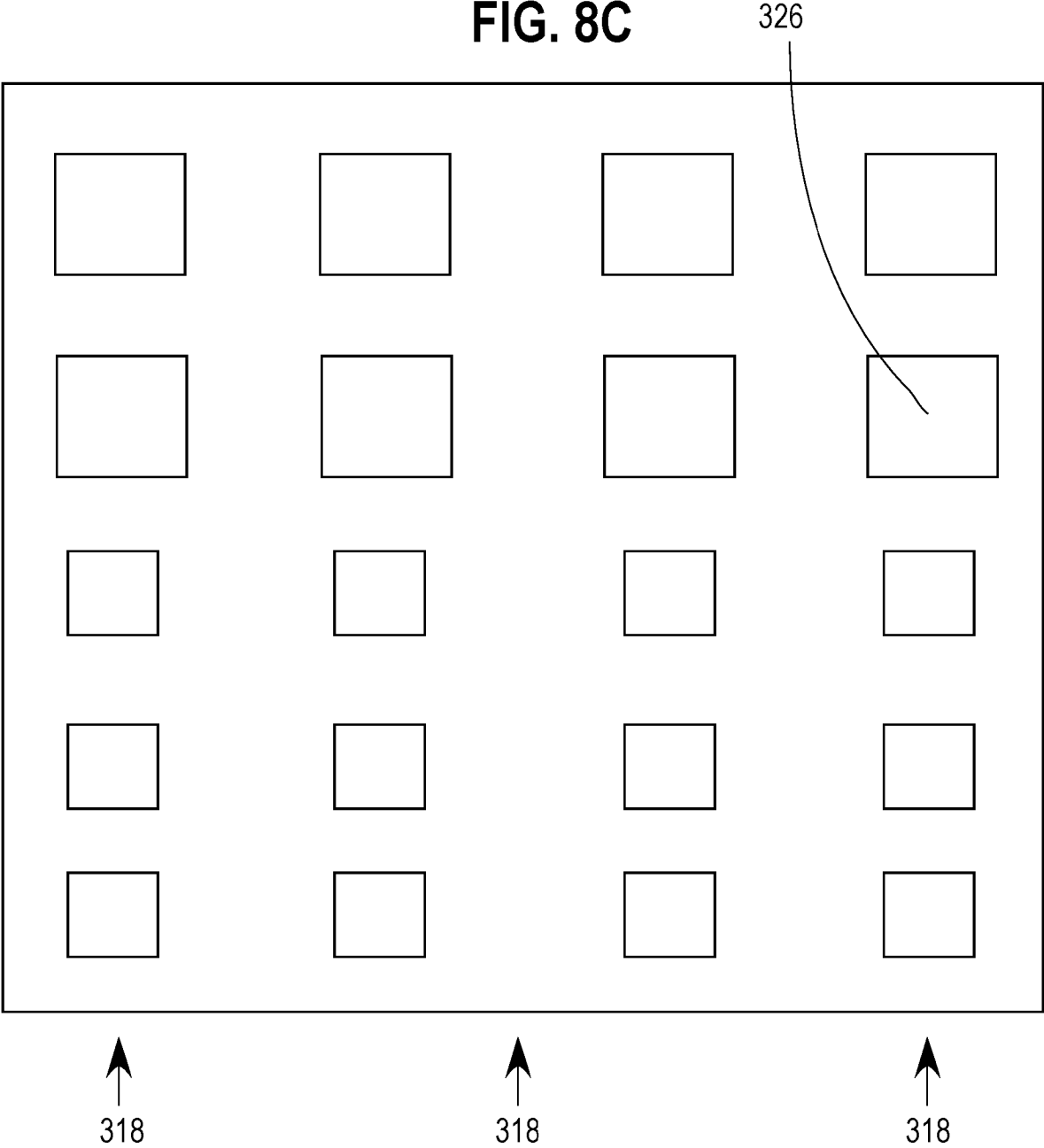


FIG. 8D

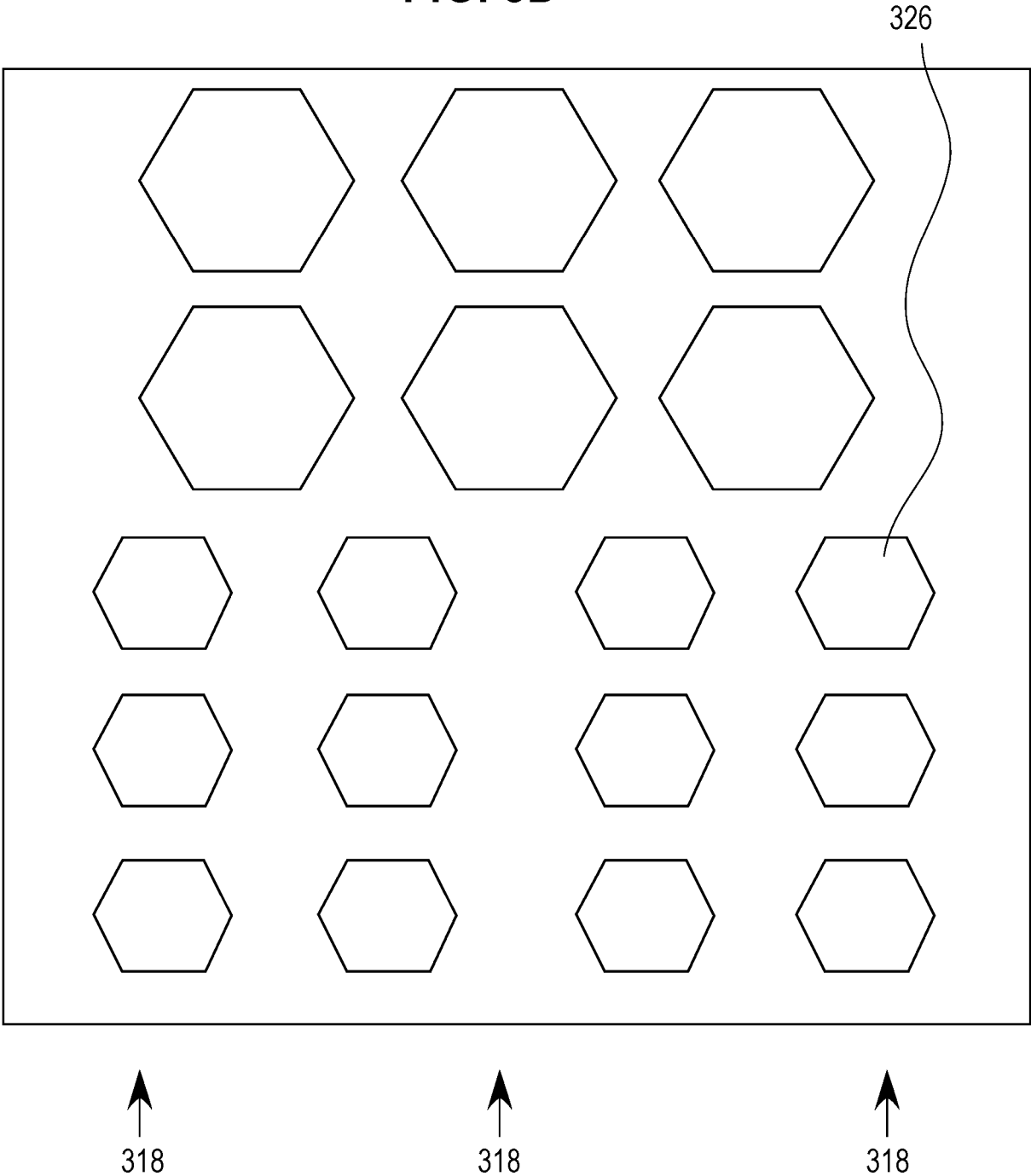


FIG. 8E

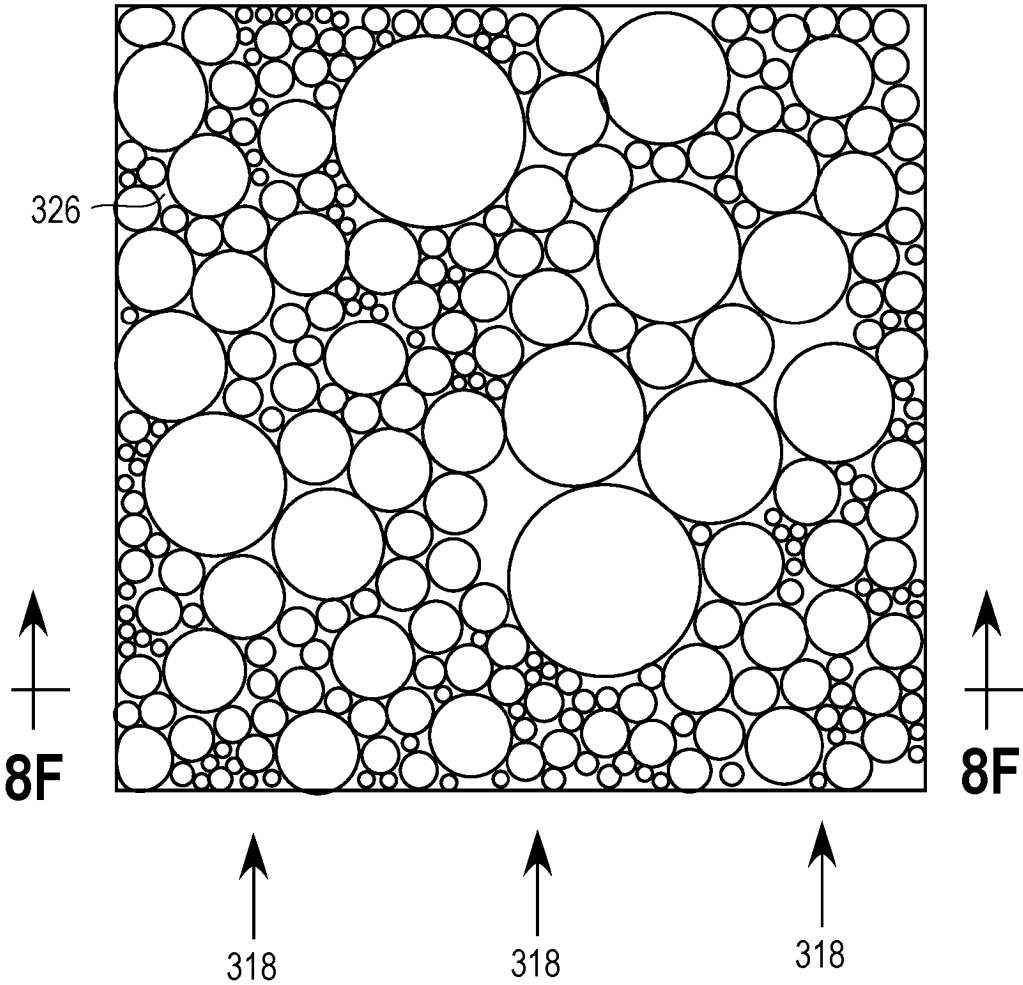
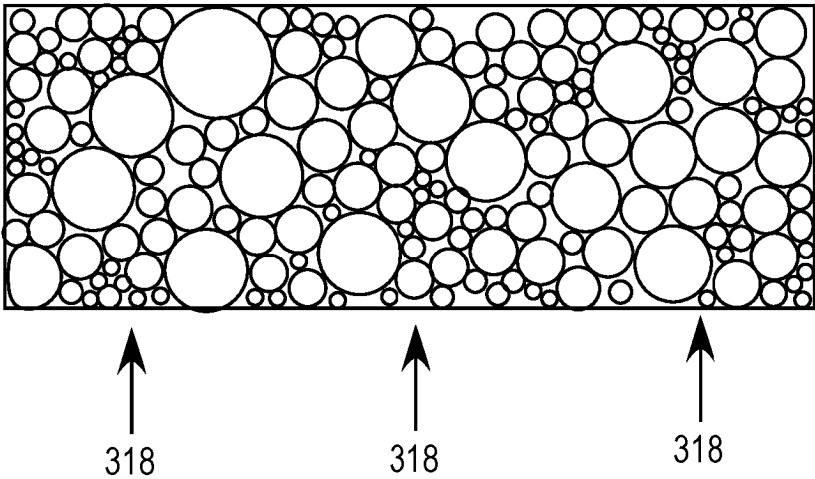


FIG. 8F



REFERENCES CITED IN THE DESCRIPTION

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