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(54) REFRIGERATED CASE DEFROST WATER EVAPORATION

ENTFROSTUNGSWASSERVERDAMPFUNG AUS EINEM GEKÜHLTEN GEHÄUSE

ÉVAPORATION D'EAU DE DÉCONGÉLATION DE PRÉSENTOIR RÉFRIGÉRÉ

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EP 2 373 200 B1

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Description

[0001] The disclosure relates to refrigerated cases. More particularly, the disclosure relates to evaporation of defrost water.

[0002] Refrigerated cases typically feature an evaporator along a recirculating air flowpath to/from the refrigerated compartment of the case. Water from the air condenses on the evaporator and may freeze. Resulting frost may accumulate on the evaporator and may, in turn, block the airflow. Accordingly, from time to time, a defrost mode is initiated. Exemplary defrost modes may include use of an external heating element (e.g., an electric resistance element) to heat the evaporator and melt the frost. Alternatively, warm refrigerant may be used (e.g., via running the compressor in reverse or using multi-way valves to direct warm refrigerant to the evaporator (which may then function as a condenser or gas cooler in such a defrost mode)).

[0003] The defrost operation produces melt water which may pass to a drain and be collected in a pan or other vessel. The melt water, in turn, is then encouraged to evaporate by heating (e.g., by exposure to warm refrigerant). Evaporation may further be facilitated via partial immersion of sponge elements in the accumulation in the vessel. The sponge elements wick water out of the vessel and expose them to air along a large surface area.

[0004] US 1681242 discloses a show case refrigerator which comprises a drip outlet. The drip outlet comprising a gathering bowl having an upright wall adjacent a wall of the refrigerator, a conduit rising from the bottom of the gathering bowl and along its wall, and a lateral outlet for said conduit passing through the wall of the bowl.

[0005] US 2673455 relates to an open front refrigerator comprising a flue in communication with a motor compartment for conducting warm air along the front of the refrigerator and directing the warm air against a thermo pane glass panel and front panels of the refrigerator to eliminate and remove any moisture or condensate that may collect on the panels.

[0006] EP 1570772 discloses a refrigerated merchandiser with a container removably coupled with the case at a location below the bottom shelf. The container being adapted to collect debris falling below the bottom shelf.

[0007] US 5953929 discloses a refrigeration system comprising a base having an inlet and an outlet formed therein, an evaporator pan integrally formed in the base, an evaporator mounted above the evaporator pan, a condenser pan integrally formed in the base, a condenser mounted above the condenser pan, a compressor mounted to the base, an evaporator fan and a cover enclosing the inlet, the outlet and the evaporator.

[0008] The present invention provides a refrigerated case comprising: a body having: a refrigerated compartment; an air flowpath extending from an inlet positioned to receive air from the compartment to an outlet positioned to discharge air to the compartment; and a drain; a vessel positioned to receive water discharged from the drain; a refrigerant flowpath; and a refrigerant-air heat exchanger along the refrigerant flowpath and within the air flowpath, characterised in that: the vessel is supported to move between a lowered position and a raised position; and at least one spring is coupled to the vessel to bias the vessel from the lowered position toward the raised position.

[0009] In various implementations, the vessel may have a plurality of compartments including: a first compartment positioned to receive said water from the drain; and at least one additional compartment positioned to receive overflow from the first compartment.

[0010] The present invention also provides a method for using such a case. A case is operated in a cooling mode wherein refrigerant is delivered to the refrigerant-air heat exchanger along the refrigerant flowpath to cool air along the air flowpath, causing condensate from the air flowpath to freeze onto the refrigerant-air heat exchanger. The case is operated in a defrost mode wherein the ice is melted, causing the melted ice to flow to the drain and be discharged from the drain as said water. Receipt of the water by the vessel increases an accumulation within the vessel and causes the vessel to descend.

[0011] The details of one or more preferred embodiments are set forth, by way of example only, in the accompanying drawings and the description below. Other features, objects, and advantages will be apparent from the description and drawings, and from the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 is a simplified view of a refrigerated case.

[0013] FIG. 2 is a simplified vertical front-to-back sectional view of the case of FIG. 1.

[0014] FIG. 3 is a schematic view of a refrigeration system of the case of FIG. 1.

[0015] FIG. 4 is a schematic top view of an evaporation pan of the case of FIG. 1.

[0016] FIG. 5 is a simplified vertical sectional view of the pan of FIG. 4 in a relatively unfilled state.

[0017] FIG. 6 is a view of the pan of FIG. 5 in an intermediate fill state.

[0018] FIG. 7 is a view of the pan of FIG. 5 in a relatively filled state.

[0019] Like reference numbers and designations in the various drawings indicate like elements.

[0020] FIGS. 1 and 2 show a refrigerated case 20 having a body 22 at least partially enclosing a refrigerated compartment (interior) 24. The exemplary case/body is an open-front case having a left wall 26 at a left side 28, a right wall 30 at a right side 32, a top panel (wall) 34 at a top 36, a base 38 at a bottom 40, and a rear (back) panel 42 at a back (rear end) 44. An opening 46 extends at least partially along a front of 48 of the case. In the exemplary case, a vertical array of shelves 50 is positioned within the compartment 24.

[0021] The exemplary case 20 includes a refrigeration system 60 (FIG. 3). The refrigeration system comprises

a compressor 62 along a refrigerant flowpath 64. The compressor has an inlet (suction port) 66 and an outlet (discharge port) 68. The refrigeration system includes a first refrigerant-air heat exchanger 70 and a second refrigerant-air heat exchanger 72. An expansion device 74 may be along the refrigerant flowpath 64 between the heat exchangers 70 and 72 opposite the compressor. Fans 80 and 82 may respectively drive airflows 84 and 86 across the heat exchangers 70 and 72.

[0022] In a cooling mode of operation, refrigerant compressed by the compressor exits the outlet 68 and proceeds to the first heat exchanger 70 which acts as a condenser or gas cooler (heating the air flow 84 to reduce the temperature of refrigerant as it flows through the first heat exchanger 70). Refrigerant proceeds downstream along the refrigerant flowpath 64 to the expansion device 74 where it is expanded and its temperature further reduced. The cold refrigerant enters the second heat exchanger 72 (which acts as an evaporator, absorbing heat from the airflow 86 and heating the refrigerant as it flows through the second heat exchanger 72). Refrigerant discharged from the second heat exchanger 72 returns to the compressor inlet 66. Other details, including accumulators, valves, and sensors may be present but are not shown for ease of illustration.

[0023] FIG. 2 shows further details of an air flowpath 100 and exemplary positioning of components of the refrigeration system 60. In the exemplary case 20, the compressor 62 and first heat exchanger 70 are positioned within a compartment 102 of the base 38. The second heat exchanger 72 is positioned within a rear duct 104 between the rear wall 42 and the compartment 24. The rear duct 104 extends from a base duct 106 at a lower end of the compartment which has an inlet 108 at a lower end of the front opening. The rear duct 104 feeds a top duct 110 which has an outlet 112. The flow 86 produces a discharge flow 114 from the outlet which may initiate/form an air curtain along the opening 46. Additional branching flows (not shown) may branch off the flow 86 and pass into the compartment 24. At least a portion of the flow 114 and any branching flows returns to the inlet 108 as an inlet flow 116. In the exemplary embodiment, the fan 82 is positioned proximate a junction of the rear duct 104 and base duct 106.

[0024] In a cooling mode, moisture in the inlet flow 116 may freeze on the heat exchanger 72 and may produce a frost accumulation which may lead to a blockage. Accordingly, a defrost mode may be initiated. Exemplary defrost may be via a heating element 117 (e.g., an electric resistance element 128) and/or via directing hot refrigerant to the heat exchanger 72 (instead of cold refrigerant). The defrost operation melts the frost which may flow downward as a flow 130 (e.g., of droplets) and reach a drain 132. An exemplary drain is formed proximate a lower end of the rear duct 104. The drain may include a trap 134 (e.g., a conventional J or S trap or a more complex trap such as that shown in JP2004353909). The drain, in turn, discharges water as one or more flows 140 into an evaporation vessel 142.

[0025] The exemplary vessel 142 has a plurality of compartments. The top/plan view of FIG. 4 shows an exemplary vessel 142 as having a first compartment 200 positioned to receive the water 140 from the drain (e.g., positioned immediately below the drain outlet). There are an exemplary two additional compartments 202 and 204 which, in the exemplary embodiment, are adjacent to the compartment 200 on opposite sides thereof. Compartments 202 and 204 are separated from compartment 200 by a wall 210 which may be lower than a perimeter wall 212 of the vessel 142. This permits overflow 220 from the compartment 200 to pass into the compartments 202 and 204.

[0026] The exemplary vessel 142 is supported by springs 230 to allow the vessel to move between a relatively raised (high) position (e.g., FIG. 5) and a relatively lowered (low) position (e.g., FIG. 7). One or more of these positions may be determined by stops (e.g., 232 at the lowered position). The exemplary springs 230 are tension springs (e.g., metal tension coil springs) suspending the vessel from the upper wall of the base compartment 102. Exemplary layout of such springs is one spring at each of four corners of a rectangular planform vessel 142. In an exemplary embodiment, the at least one spring is sized such that a height at which the vessel is empty is at least 40mm above a height at which the vessel is full of water, more narrowly 50-100mm or 60-90mm (e.g., about 70mm). This may define a vertical range of motion which may be dictated by the stops.

[0027] The vessel 142 may be in its relatively raised position when there is no water accumulation. As water accumulates, the weight of the water will tend to drive the vessel 142 downward toward the lowered position (e.g., immediately or, with stops, after a certain threshold level of water has been collected). The received water initially fills the first chamber 200. Eventually, the chamber 200 fills, initiating the overflow 220 to the chambers 202 and 204, thereby beginning to fill those chambers. Eventually, those chambers may fill. If stops are present for the lowered position, the vessel may reach the lowered position before complete filling.

[0028] To encourage evaporation of the water, a heating element 240 (FIG. 4) may be positioned to contact the water accumulation in the vessel 142. The exemplary heating element is at a fixed position so that, as water accumulates the vessel, the vessel lowers relative to the heating element maintaining the heat element relatively near the surface of the water accumulation. The exemplary heating element may be formed as a portion of a refrigerant line along the refrigerant flowpath. For example, the springs may be sized and the heating element positioned so that at least half of the cross-section of the relevant portion of the heating element along the vessel 142 is immersed during at least half of the range of movement of the vessel 142.

[0029] One or more wicking elements 244 (e.g., sponges) may be positioned to be partially immersed in a water

accumulation at least one of the compartments 200, 202, 204. An exemplary wicking element is filled relative to the body at a fixed height and has sufficient height so that its lower end is partially immersed in any accumulation in the vessel.

[0030] The exemplary heating element is formed as a portion of the discharge line 250 (FIG. 3) of the refrigerant flowpath 64. The discharge line extends between the compressor outlet 68 and the inlet to the first heat exchanger 70. During normal cooling mode operation, this will represent the warmest refrigerant in the system and is thus best able to facilitate evaporation of the water in the vessel 142. The particular implementation of FIG. 4 shows a cooling mode refrigerant flow 260 entering and exiting the heating element 240. In this cooling mode, a relatively downstream section 262 of the element and refrigerant flowpath is positioned within/along the first chamber 200. Relatively upstream sections 264 and 266 are in/along the chambers 204 and 202. The exemplary heating element configuration places the section 266 upstream of the section 264 in the cooling mode.

[0031] The effect of such a configuration is that water in the chamber 200 (which was received in the defrost mode) is preheated and overflows to the adjacent chambers 202 and 204. In the chambers 202 and 204 because the heating element is yet hotter than in the chamber 200 and because there is less depth of water, evaporation principally occurs from those chambers 202 and 204 rather than from the first chamber 200.

[0032] Although an embodiment is described above in detail, such description is not intended for limiting the scope of the present disclosure. It will be understood that various modifications may be made without departing from the scope of the invention defined by the attached claims. For example, when implemented in the reengineering of an existing system configuration, details of the existing configuration may influence or dictate details of any particular implementation. Accordingly, other embodiments are within the scope of the following claims.

Claims

1. A refrigerated case (20) comprising:

a body (22) having:

a refrigerated compartment (24);
an air flowpath (100) extending from an inlet (108) positioned to receive air from the compartment to an outlet (112) positioned to discharge air to the compartment; and
a drain (132);

a vessel (142) positioned to receive water (140) discharged from the drain;
a refrigerant flowpath (64); and
a refrigerant-air heat exchanger (72) along the refrigerant flowpath and within the air flowpath,

characterised in that:

the vessel is supported to move between a lowered position and a raised position; and
at least one spring (230) is coupled to the vessel to bias the vessel from the lowered position toward the raised position.

2. The refrigerated case of claim 1 wherein the vessel (142) has a plurality of compartments including:

a first compartment (200) positioned to receive said water from the drain; and
at least one additional compartment (202, 204) positioned to receive overflow (220) from the first compartment.

3. The refrigerated case of claim 2 comprising:

at least one wicking element (244) positioned to be partially immersed in a water accumulation in at least one of the first compartment and the additional compartments.

4. The refrigerated case of claim 1 wherein:

the at least one spring comprises a plurality of tension coil springs suspending the vessel.

5. The refrigerated case of claim 1 wherein:

at least one spring is sized so that a height at which the vessel is empty is at least 40mm above a height at which the vessel is full of water.

6. The refrigerated case of claim 1 further comprising:

a refrigeration system comprising:

said refrigerant flowpath (64);
a compressor (62) along the refrigerant flowpath downstream of the refrigerant-air heat exchanger (72) in a cooling mode of operation;
a first refrigerant-air-heat exchanger (70) being a heat rejection heat exchanger in the cooling mode and downstream of the compressor;
said refrigerant-air heat exchanger (72) as a second heat exchanger and being a heat absorption heat exchanger in the cooling mode; and
an expansion device (74) along the refrigerant flowpath, downstream of the first refrigerant-air heat exchanger and upstream of the second refrigerant-air heat exchanger

in the cooling mode.

7. The refrigerated case of claim 1 wherein:

the vessel has a plurality of compartments including:

a first compartment (200) that is positioned to receive said water from the drain; and
at least one additional compartment (202, 204) positioned to receive overflow from the first compartment; and
a refrigerant line, along the refrigerant flowpath (64), has respective sections in the first compartment (200) and the at least one additional compartment (202,204).

8. A method for using the case of claim 1, the method comprising:

operating in a cooling mode wherein refrigerant is delivered to the refrigerant-air heat exchanger (72) along the refrigerant flowpath (64) to cool air along the air flowpath (100), causing condensate from the air flowpath to freeze onto the refrigerant-air heat exchanger as ice; and
operating in a defrost mode wherein the ice is melted, causing the melted ice to flow to the drain (132) and be discharged from the drain as said water,

wherein:

receipt of the water by the vessel (142) increases an accumulation within the vessel and causes the vessel to descend.

9. The method of claim 8 further comprising:

heating the accumulation via refrigerant in at least one refrigerant line section (262, 264, 266) in the vessel.

10. The method of claim 9 wherein:

the at least one refrigerant line section remains stationary while the vessel descends and subsequently ascends.

Patentansprüche

1. Kühlregal (20), aufweisend:

einen Körper (22) mit:

einem gekühlten Raum (24);
einem Luftströmungsweg (100), der sich von einem Einlass (108), der zum Aufnehmen von Luft aus dem Raum positioniert ist, zu einem Auslass (112) erstreckt, der zum Abgeben von Luft in den Raum positioniert ist; und
einem Ablauf (132);

einen Behälter (142), der zum Aufnehmen von von dem Ablauf abgegebenen Wasser (140) positioniert ist;
einen Kältemittel-Strömungsweg (64); und
einen Kältemittel-Luft-Wärmetauscher (72) entlang des Kältemittel-Strömungswegs und innerhalb des Luftströmungswegs,

dadurch gekennzeichnet,
dass der Behälter zum Ausführen einer Bewegung zwischen einer abgesenkten Position und einer angehobenen Position gehaltert ist; und
dass mindestens eine Feder (230) mit dem Behälter gekoppelt ist, um den Behälter von der abgesenkten Position in Richtung auf die angehobene Position vorzuspannen.

2. Kühlregal nach Anspruch 1,
wobei der Behälter (142) eine Mehrzahl von Kammern aufweist, die Folgendes beinhalten:

eine erste Kammer (200), die zum Aufnehmen des Wassers von dem Ablauf ausgebildet ist; und
mindestens eine zusätzliche Kammer (202, 204), die zum Aufnehmen von Überlauf (220) von der ersten Kammer positioniert ist.

3. Kühlregal nach Anspruch 2,
aufweisend:

mindestens ein Element (244) mit Dochtwirkung, das derart angeordnet ist, dass es teilweise in eine Wasseransammlung in mindestens einer von der ersten Kammer und den zusätzlichen Kammern eingetaucht ist.

4. Kühlregal nach Anspruch 1,
wobei die mindestens eine Feder eine Mehrzahl von Zug-Schraubenfedern aufweist, an denen der Behälter aufgehängt ist.

5. Kühlregal nach Anspruch 1,
wobei mindestens eine Feder derart dimensioniert ist, dass eine Höhe, bei der der Behälter leer ist, mindestens 40 mm über einer Höhe liegt, bei der der Behälter voll mit Wasser ist.

6. Kühlregal nach Anspruch 1,
weiterhin aufweisend:

ein Kühlsystem, aufweisend:
den Kältemittel-Strömungsweg (64);
einen Verdichter (62) entlang des Kältemittel-Strömungswegs strömungsabwärts von dem Kältemittel-Luft-Wärmetauscher (72) in einem Kühlbetriebsmodus;
wobei ein erster Kältemittel-Luft-Wärmetauscher (70) ein wärmeabgebender Wärmetauscher im Kühlbetriebsmodus ist und strömungsabwärts von dem Verdichter vorgesehen ist;
den Kältemitte-Luft-Wärmetauscher (72) als zweiten Wärmetauscher, bei dem es sich um einen wärmeabsorbierenden Wärmetauscher im Kühlbetriebsmodus handelt; und
eine Expansionsvorrichtung (74) entlang des Kältemittel-Strömungswegs strömungsabwärts von dem ersten Kältemittel-Luft-Wärmetauscher und strömungsaufwärts von dem zweiten Kältemittel-Luft-Wärmetauscher im Kühlbetriebsmodus.

7. Kühlregal nach Anspruch 1,
wobei der Behälter eine Mehrzahl von Kammern aufweist, die Folgendes beinhalten:

eine erste Kammer (200), die zum Aufnehmen von Wasser von dem Ablauf positoniert ist; und mindestens eine weitere Kammer (202, 204), die zum Aufnehmen von Überlauf von der ersten Kammer positioniert ist; und
wobei eine Kältemittelleitung entlang des Kältemittel-Strömungswegs (64) jeweilige Abschnitte in der ersten Kammer (200) und der mindestens einen weiteren Kammer (202, 204) aufweist.

8. Verfahren zum Verwenden des Regals nach Anspruch 1,
wobei das Verfahren folgende Schritte aufweist:

in einem Kühlbetriebsmodus, in dem dem Kältemittel-Luft-Wärmetauscher (72) Kältemittel entlang des Kältemittel-Strömungswegs (64) zugeführt wird, um Luft entlang des Luft-Strömungswegs (100) zu kühlen, wird Kondensat aus dem Luft-Strömungsweg dazu veranlasst, an dem Kältemittel-Luft-Wärmetauscher als Eis zu gefrieren; und
in einem Abtaubetriebsmodus, in dem das Eis zum Schmelzen gebracht wird, wird das geschmolzene Eis dazu veranlasst, zu dem Ablauf (132) zu fließen und als Wasser aus dem Ablauf auszutreten,

wobei:

die Aufnahme des Wassers durch den Behälter (142) eine Ansammlung desselben in dem Behälter erhöht und eine Bewegung des Behälters nach unten veranlasst.

9. Verfahren nach Anspruch 8,
das weiterhin Folgendes aufweist:

Erwärmen der Ansammlung über Kältemittel in mindestens einem Kältemittel-Leitungsabschnitt (262, 264, 266) in dem Behälter.

10. Verfahren nach Anspruch 9,
wobei der mindestens eine Kältemittel-Leitungsabschnitt stationär bleibt, während sich der Behälter nach unten bewegt und anschließend nach oben bewegt.

Revendications

1. Boîtier réfrigéré (20) comprenant :

un corps (22) comportant :

un compartiment réfrigéré (24) ;
un trajet d'écoulement d'air (100) s'étendant d'une admission (108) positionnée pour recevoir de l'air en provenance du compartiment à un refoulement (112) positionné pour évacuer l'air vers le compartiment ; et
un drain (132) ;
un récipient (142) positionné pour recevoir de l'eau (140) évacuée du drain ;
un trajet d'écoulement de fluide frigorigène (64) ; et
un échangeur de chaleur fluide frigorigène-air (72) le long du trajet d'écoulement de fluide frigorigène et à l'intérieur du trajet d'écoulement d'air,

caractérisé en ce que :

le récipient est supporté pour se déplacer entre une position abaissée et une position relevée ; et
au moins un ressort (230) est couplé au récipient pour solliciter le récipient de la position abaissée vers la position relevée.

2. Boîtier réfrigéré selon la revendication 1, dans lequel le récipient (142) comporte une pluralité de compartiments comprenant :

un premier compartiment (200) positionné pour recevoir ladite eau du drain ; et
au moins un compartiment additionnel (202, 204) positionné pour recevoir le trop-plein (220) du premier compartiment.

3. Boîtier réfrigéré selon la revendication 2, comprenant :

au moins un élément à effet mèche (244) positionné pour être partiellement immergé dans une accumulation d'eau dans au moins l'un du premier compartiment et des compartiments additionnels.

4. Boîtier réfrigéré selon la revendication 1, dans lequel :

le au moins un ressort comprend une pluralité de ressorts de traction hélicoïdale mettant en suspension le récipient.

5. Boîtier réfrigéré selon la revendication 1, dans lequel :

au moins un ressort est dimensionné de sorte qu'une hauteur au niveau de laquelle le récipient est vide est au moins 40 mm au-dessus d'une hauteur au niveau de laquelle le récipient est rempli d'eau.

6. Boîtier réfrigéré selon la revendication 1, comprenant en outre :

un système de réfrigération comprenant :

ledit trajet d'écoulement de fluide frigorigène (64) ;
un compresseur (62) le long du trajet d'écoulement de fluide frigorigène en aval de l'échangeur de chaleur fluide frigorigène-air (72) dans un mode de fonctionnement de refroidissement ;
un premier échangeur de chaleur fluide frigorigène-air (70) étant un échangeur de chaleur à rejet de chaleur dans le mode de refroidissement et en aval du compresseur ;
ledit échangeur de chaleur fluide frigorigène-air (72) en tant que second échangeur de chaleur et étant un échangeur de chaleur à absorption de chaleur dans le mode de refroidissement ; et
une vanne de détente (74) le long du trajet d'écoulement de fluide frigorigène, en aval du premier échangeur de chaleur fluide frigorigène-air et en amont du second échangeur de chaleur fluide frigorigène-air dans le mode de refroidissement.

7. Boîtier réfrigéré selon la revendication 1, dans lequel :

le récipient comporte une pluralité de compartiments comprenant :

un premier compartiment (200) qui est positionné pour recevoir ladite eau du drain ; et
au moins un compartiment additionnel (202, 204) positionné pour recevoir le trop-plein du premier compartiment ; et
une conduite de fluide frigorigène, le long du trajet d'écoulement de fluide frigorigène (64), comporte des sections respectives dans le premier compartiment (200) et le au moins un compartiment additionnel (202, 204).

8. Procédé d'utilisation du boîtier selon la revendication 1, le procédé comprenant :

le fonctionnement dans un mode de refroidissement où un fluide frigorigène est délivré à l'échangeur de chaleur fluide frigorigène-air (72) le long du trajet d'écoulement de fluide frigorigène (64) pour refroidir l'air le long du trajet d'écoulement d'air (100), provoquant la congélation du condensat provenant du trajet d'écoulement d'air sur l'échangeur de chaleur fluide frigorigène-air sous forme de glace ; et
le fonctionnement dans un mode de dégivrage où la glace est fondue, provoquant l'écoulement de la glace fondue vers le drain (132) et son évacuation du drain en tant que ladite eau,
dans lequel :

la réception de l'eau par le récipient (142) augmente une accumulation dans le récipient et provoque la descente du récipient.

9. Procédé selon la revendication 8, comprenant en outre :

le chauffage de l'accumulation via le fluide frigorigène dans au moins une section de conduite de fluide frigorigène (262, 264, 266) dans le récipient.

10. Procédé selon la revendication 9, dans lequel :

la au moins une section de conduite de fluide frigorigène reste stationnaire pendant la descente et la montée ultérieure du récipient.

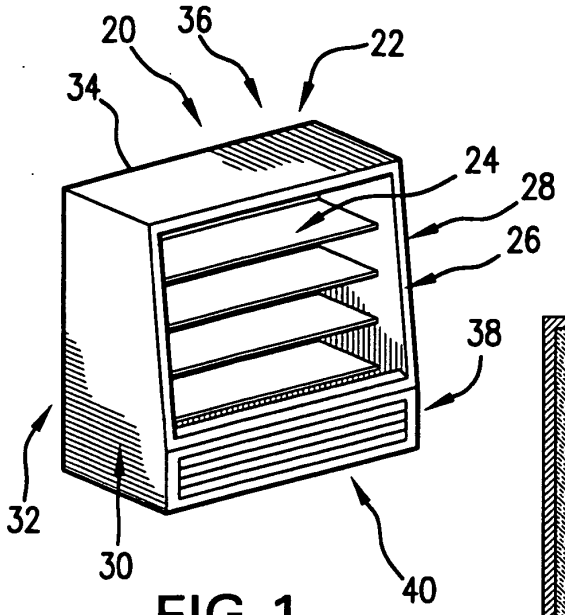

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FIG. 1

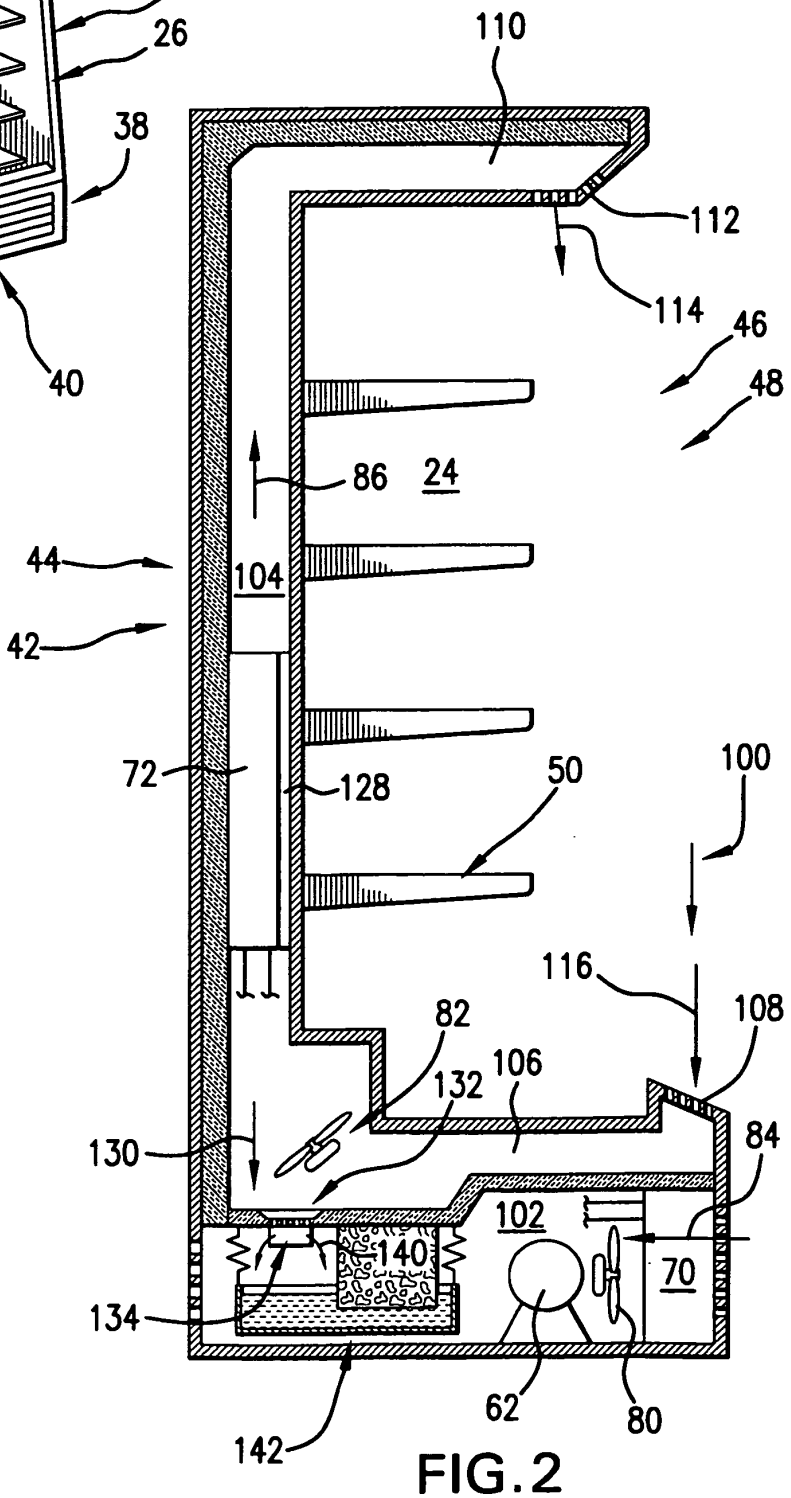

110
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128
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116
108
82
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132
130
84
102
140
70
134
62
80
142

FIG. 2

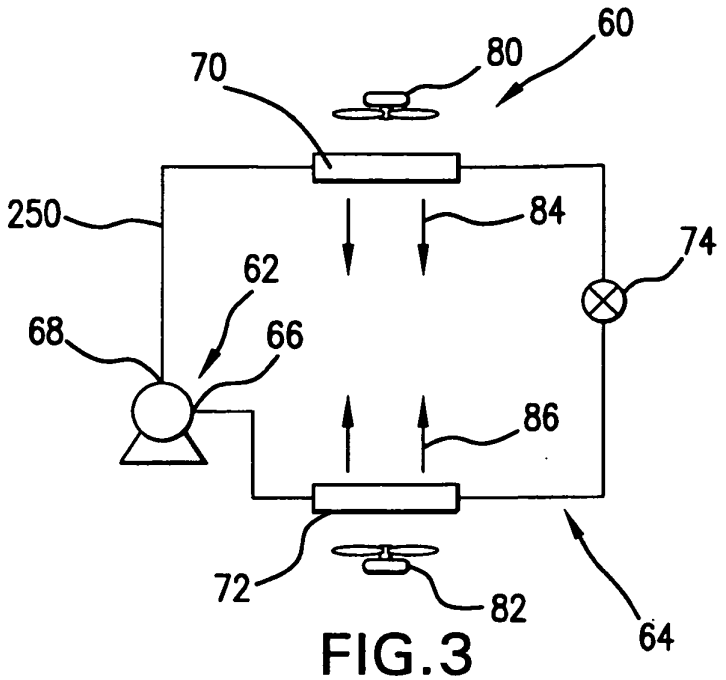


FIG.3

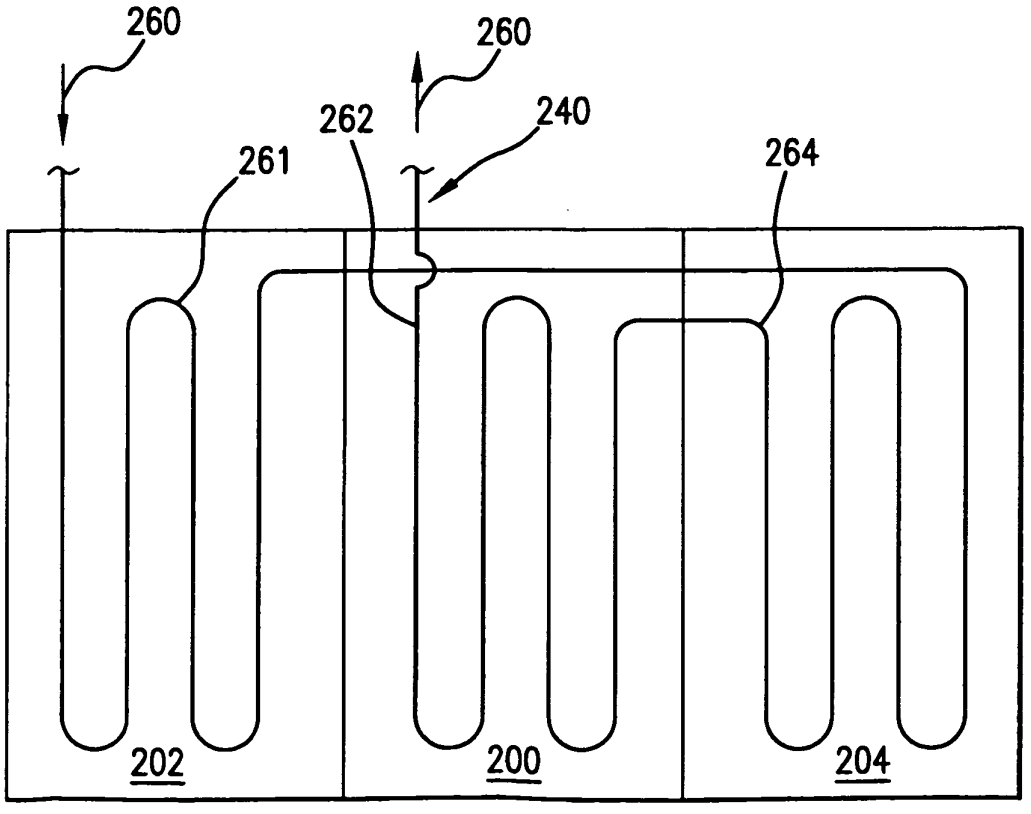


FIG.4 142

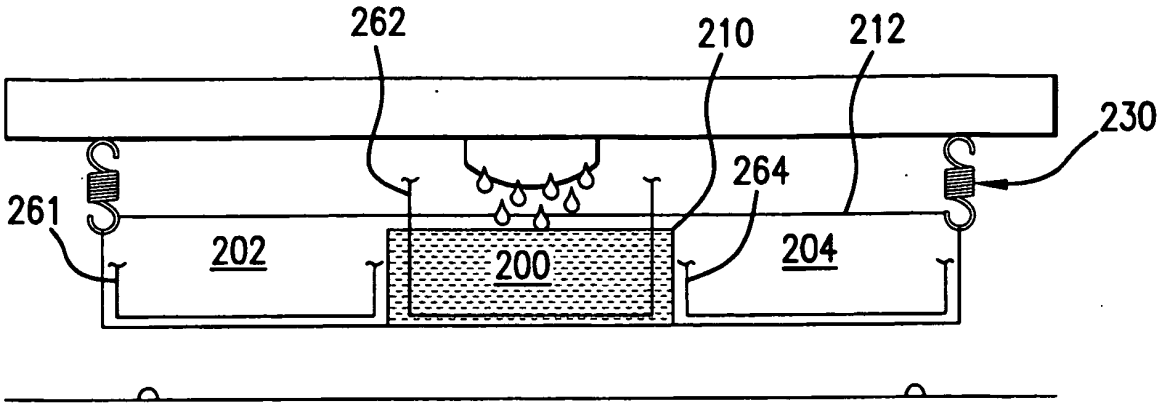


FIG.5

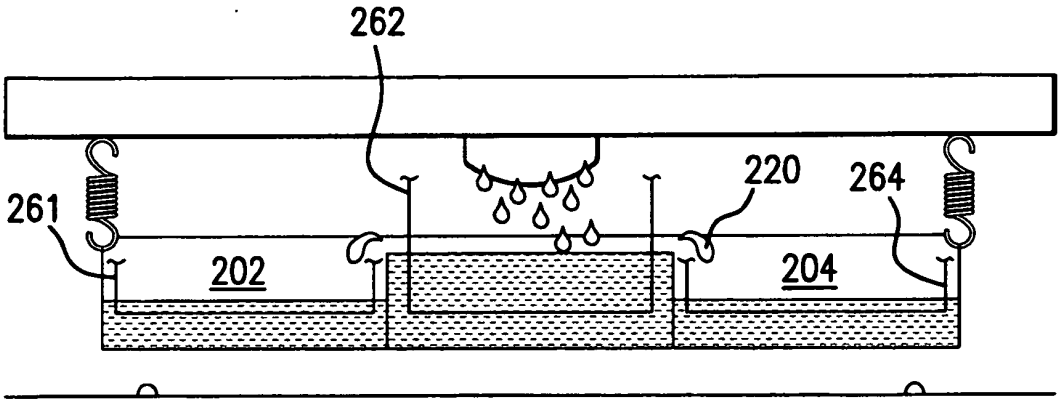


FIG.6

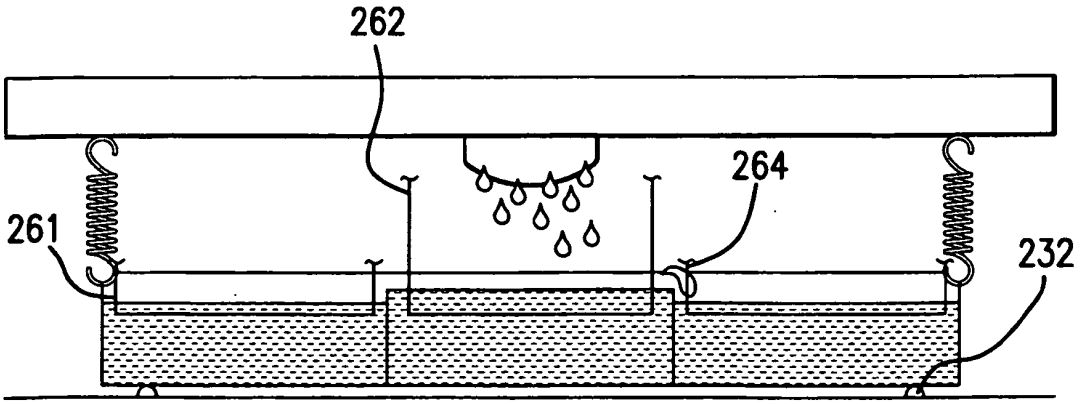


FIG.7

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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