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(54) **REFRIGERATION APPARATUS**

(57) A refrigeration apparatus (200) has a cooling chamber (204, 208) for receiving items to be cooled. The refrigeration apparatus (200) has an evaporator (202) in which in use a refrigerant evaporates to absorb heat from the cooling chamber (204, 208). The refrigeration apparatus (200) has a defrost chamber (210) for receiving an item to be defrosted. The defrost chamber (210) is in fluid communication with the exterior of the evaporator (202) for receiving water from the exterior of the evaporator (202) when frost on the exterior of the evaporator melts (202). The water assists in defrosting an item which is received in use in the defrost chamber (210).

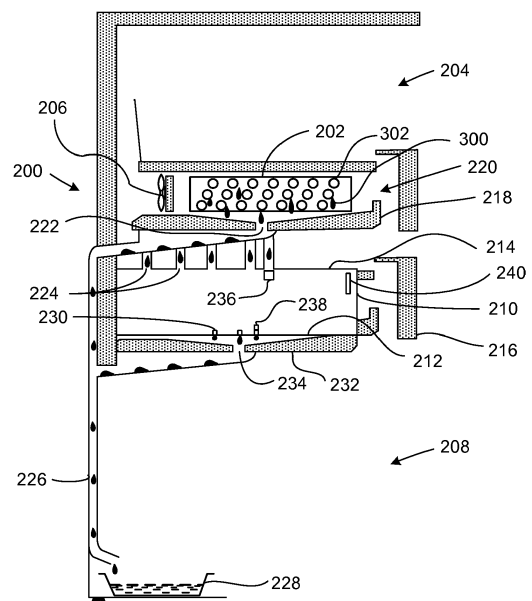


Figure 2

Description

Technical Field

[0001] The present disclosure relates to a refrigeration apparatus.

Background

[0002] It is often necessary or desirable to thaw (i.e. defrost) a frozen food item before the food item can be eaten or can be cooked prior to being eaten. In order to prevent or inhibit growth of bacteria on the food item whilst it is being thawed, it is often recommended to keep the food item in an environment that is at a low temperature whilst the food item is thawing. For example, it is often recommended to place the food item in a refrigerator or a bowl of cold water or under a stream of cold running water during thawing. However, known techniques have one drawback or another.

Summary

[0003] According to a first aspect disclosed herein, there is provided a refrigeration apparatus, the refrigeration apparatus comprising:

a cooling chamber for receiving items to be cooled; an evaporator in which in use a refrigerant evaporates to absorb heat from the cooling chamber; and a defrost chamber for receiving an item to be defrosted; the defrost chamber being in fluid communication with the exterior of the evaporator for receiving water from the exterior of the evaporator when frost on the exterior of the evaporator melts such that the water assists in defrosting an item received in use in the defrost chamber.

[0004] The refrigeration apparatus may be for example a freezer, a refrigerator, a combined "fridge-freezer" which has both a freezer compartment and a main cool compartment, etc.

[0005] In an example, the refrigeration apparatus comprises at least one valve for controlling the flow of water from the exterior of the evaporator into the defrost chamber.

[0006] In an example, the refrigeration apparatus comprises at least one valve for controlling the flow of water out of the defrost chamber.

[0007] In an example, the refrigeration apparatus comprises a temperature sensor for sensing the temperature in the defrost chamber and for causing the one or more valves to be operated to maintain the temperature in the defrost chamber at a predetermined level or within a predetermined range.

[0008] In an example, the refrigeration apparatus comprises a collection pan in fluid communication with the

defrost chamber for receiving water from the defrost chamber.

[0009] In an example, the collection pan is additionally in fluid communication with the exterior of the evaporator for receiving water from the exterior of the evaporator when frost on the exterior of the evaporator melts.

[0010] In an example, refrigeration apparatus is a frost-free refrigeration apparatus, which is arranged to apply defrosting automatically.

Brief Description of the Drawings

[0011] To assist understanding of the present disclosure and to show how embodiments may be put into effect, reference is made by way of example to the accompanying drawings in which:

Figure 1 shows schematically the main components of a known refrigeration apparatus; and

Figure 2 shows schematically a partially sectioned view of an example of a refrigeration apparatus in accordance with the present disclosure.

Detailed Description

[0012] As mentioned, it is often necessary or desirable to thaw a frozen food item before the food item can be eaten or can be cooked prior to being eaten. In order to prevent or inhibit growth of bacteria on the food item whilst it is being thawed, it is often recommended to keep the food item in an environment that is at a low temperature whilst the food item is thawing. Specifically, it is typically recommended to keep the food item at a temperature below around 5°C during the thawing process.

[0013] For example, it is often recommended to place the frozen food item in the main cool compartment of a refrigerator during thawing. One disadvantage of this is that it takes space in the main cool compartment of the refrigerator. Also, the frozen food item can bring down the overall temperature in the cool compartment of the refrigerator, which can cause other items in the cool compartment of the refrigerator to freeze, which may not be desirable. This is particularly the case when the frozen food item which is to be defrosted is large (such as a large piece of meat, etc.).

[0014] As another example, if the frozen food item is placed in a bowl of cold water to thaw, then it is typically necessary to replace the cold water from time to time (often frequently) as the cold water may warm up over time in the environment, such as a kitchen. Given that defrosting a large item can take several hours, this can be inconvenient. As a result, in practice people often do not change the water frequently enough or may simply forget to change the water. This can allow the temperature of the water to rise above the "safe" temperature of around 5°C, possibly allowing bacterial growth on the food item.

[0015] As another example, placing the frozen food item under a stream of cold running water during thawing may not be convenient as this will typically take up space in a kitchen sink or the like during the whole thawing process. Also, this can consume a lot of water, especially as, again, defrosting a large item can take several hours. Also, even if the running water is ostensibly "cold" water, the temperature may still be above the "safe" temperature of around 5°C, possibly allowing bacterial growth on the food item.

[0016] In examples described herein, a refrigeration apparatus has a defrost chamber for receiving an item to be defrosted. The defrost chamber is in fluid communication with the exterior of the evaporator of the refrigeration apparatus. The defrost chamber can receive water from the exterior of the evaporator when frost on the exterior of the evaporator melts. This water assists in defrosting an item received in use in the defrost chamber. The temperature of this water coming from the exterior of the evaporator is typically at or only just above the freezing point of water (0°C) and is therefore typically below the "safe" temperature of around 5°C which is recommended during thawing.

[0017] The refrigeration apparatus may be for example a freezer, a refrigerator, a combined "fridge-freezer" which has both a freezer compartment and a main cool compartment, etc. The refrigeration apparatus may be a conventional refrigeration apparatus, which has to be defrosted manually by a user. However, more conveniently, the refrigeration apparatus may be a so-called "frost-free" refrigeration apparatus, which applies defrosting automatically.

[0018] Referring now to Figure 1, this shows schematically the main components of a known refrigeration apparatus 100. The refrigeration apparatus 100 implements a vapour-compression refrigeration cycle to cool a space 110 within the refrigeration apparatus 100. Specifically, in this example the vapour-compression refrigeration cycle (described in more detail below) is implemented to cool a freezer portion 112 of the space 110 to below 0°C. Other portions of the space 110, including in particular the main cool compartment 114 of the refrigeration apparatus 100, will be cooled too depending on the temperature of the freezer portion 112 and the layout of the refrigeration apparatus 100. In any case, the freezer portion 112 represents a subsection of the space 110 in which substances and items, such as foodstuffs, may be placed to freeze them. The main cool compartment 114 is typically kept at a temperature of around 4°C or 5°C or so. More generally, the vapour-compression refrigeration cycle may be used to cool a space 110 of a refrigeration apparatus 100 even if the refrigeration apparatus 100 does not have a freezer portion as such.

[0019] The refrigeration apparatus 100 has a closed circuit of tubing 120 containing a selected refrigerant for cooling the interior of the space 110. Specifically, the circuit of tubing 120 includes an internal section 122 located within or adjacent the freezer portion 112 and an

external section 124 located outside the space 110.

[0020] The refrigerant is selected to have a temperature of vaporisation such that it will vaporise in the internal section 122 as it absorbs heat from the interior of the freezer portion 112. For this reason, the internal section 122 is also referred to as an evaporator (or evaporator section) 122.

[0021] A compressor 126 is provided to compress the vaporised refrigerant, which raises the temperature of the refrigerant significantly. The high pressure, high temperature refrigerant vapour passes from the compressor 126 through the "hot" external section 124 of the circuit 120. The external section 124 acts as a condenser in the refrigeration cycle, causing at least some of the refrigerant vapour to condense back to a liquid form by transferring heat from the hot refrigerant vapour to the environment (e.g. the room in which the refrigeration apparatus 100 is located). A heatsink and/or fan may be provided to improve the transfer of heat.

[0022] The high pressure refrigerant, now cooled and at least partially in liquid form, passes to an expansion valve 128 which causes the pressure of the refrigerant to drop, causing it to expand and therefore cool. The low pressure low temperature refrigerant then passes through the evaporator 122 within the freezer portion 112, acting as an evaporator in the refrigeration cycle, to absorb heat from the interior of the freezer portion 112. As a result, the cool refrigerant liquid passing through the evaporator 122 vaporises before passing on to the compressor 126 to complete the refrigeration cycle.

[0023] The compressor 126 may be driven by a low power DC motor, selected according to the refrigerant vapour pressure and temperature required in the external section 124 of the circuit and the rate of cooling required by the evaporator 122 of the circuit.

[0024] Because of the low temperatures of the evaporator 122 and within the freezer portion 112, humidity from the air within the freezer portion 112 and the refrigeration apparatus 100 generally may freeze to the exterior of the evaporator 122. This causes an ice layer to build up over time on the evaporator 122 and in the freezer portion 112 and/or other parts generally of the refrigeration apparatus 100. The ice build-up (also called "frost") on the evaporator 122 and/or in other parts of the refrigeration apparatus 100 is undesirable because it occupies space within the freezer portion 112 or other parts of the refrigeration apparatus 100, which could otherwise be used for storage (e.g. of foodstuffs), and reduces the efficiency of the refrigeration apparatus 100.

[0025] As a result, a user of the refrigeration apparatus may "defrost" the refrigeration apparatus 100 periodically. For this, the freezer portion 112 and/or the evaporator 122 is allowed to heat up to a point at which the ice on the evaporator 122 melts, and the resulting liquid water is collected and removed. Some known refrigeration apparatus, often called "frost-free" refrigeration apparatus, have an arrangement, such as a heating resistor or other heating element, for heating up the freezer portion 112

and/or the evaporator 122 briefly in order to melt the ice layer and thereby defrost the freezer portion 112. Such a "defrost process" is typically performed automatically in response to detection of build-up of frost and/or periodically on a cycle irrespective of how much frost has actually built up on the evaporator 122.

[0026] Referring now to Figure 2, this shows schematically a partially sectioned view of an example of a refrigeration apparatus 200 in accordance with the present disclosure. The refrigeration apparatus 200 may be for example a freezer, a refrigerator, a combined "fridge-freezer" which has both a freezer compartment and a main cool compartment, etc.

[0027] The main functional components, including the evaporator, condenser, compressor and tubing for the refrigerant, etc. may generally be as in a conventional refrigeration apparatus, such as described above with reference to Figure 1. Not all of the functional components of the refrigeration apparatus 200 are shown in Figure 2 for reasons of clarity. The refrigeration apparatus 200 may be a "frost-free" refrigeration apparatus, which automatically defrosts the refrigeration apparatus 200 as necessary (for example, in response to detection of build-up of ice or frost) or periodically (such as once or several times a day), or may be a refrigeration apparatus that needs to be defrosted manually.

[0028] Figure 2 shows the evaporator 202 of the refrigeration apparatus 200. The evaporator 202 is located towards the top of the refrigeration apparatus 200. In this example, the evaporator 202 is below a freezer compartment 204 of the refrigeration apparatus 200 and operates to remove heat from the freezer compartment 204 to keep the freezer compartment 204 below 0°C. (The recommended temperature for a freezer or for the freezer compartment of a fridge-freezer is -18°C.) In this example, an electric fan 206 blows air over the evaporator 202 to promote heat transfer. The refrigeration apparatus 200 in this example also has a main, cool compartment 208 for receiving food items that are to be kept cool but not frozen. (The recommended temperature for the main, cool compartment of a fridge or fridge-freezer is between around 1°C to 4°C.)

[0029] The refrigeration apparatus 200 has a defrost compartment or chamber 210 for receiving an item to be defrosted, as will be discussed further below. The defrost chamber 210 is separate from and in addition to the freezer compartment 204 and is separate from and in addition to the main, cool compartment 208 of the refrigeration apparatus 200. In this example, the defrost chamber 210 is located below the freezer compartment 204 and above the main, cool compartment 208.

[0030] The defrost chamber 210 has a base wall 212, a top wall 214 and one or more front, back and side walls. The interior of the defrost chamber 210 can be accessed through the front of the refrigeration apparatus 200. For example, there may be a compartment door 216 in front of the defrost chamber 210 which can be hinged or otherwise mounted to enable access to the interior of the

defrost chamber 210. The compartment door 216 may be accessed when a main front door (not shown) of the refrigeration apparatus 200 is opened. This allows a user to place a frozen item which is to be defrosted in the defrost chamber 210 and to remove the item when desired.

[0031] The defrost chamber 210 is arranged to be able to receive melt water 300 which is formed when ice or frost 302 on the evaporator 202 melts. Ice or frost 302 on the evaporator 202 melts when the refrigeration apparatus 200 is subject to defrosting, whether this is automatic defrosting as in a "frost-free" refrigerator or freezer or a manual defrosting process. As noted, in the case of a "frost-free" refrigeration apparatus 200, there may be an electrically resistive heater (not shown) on or around the coils of the evaporator 202 which is operated from time to time to melt frost or ice 302 which has formed on the evaporator 202.

[0032] To receive melt water 300 from the evaporator 202, in this example the defrost chamber 210 is located below the evaporator 202 so that melt water can flow under gravity to the defrost chamber 210. In addition, the lower wall 218 of the compartment or chamber 220 or other part of the refrigeration apparatus 200 where the evaporator 202 is located has one or more drain holes 222 to allow melt water 300 to exit the chamber 220 where the evaporator 202 is located. The lower wall 218 may be angled inwardly and downwardly towards the drain hole(s) 222 to facilitate the flow of melt water to and out of the drain hole(s) 222. In this respect, the lower wall 218 effectively acts as a drip tray or drain tray. In addition, the top wall 214 of the defrost chamber 210 has one or more inlet holes 224 which are arranged so as to receive the melt water that exits the drain hole(s) 222 of the evaporator chamber 220 and pass that melt water to the interior of the defrost chamber 210.

[0033] In this example, the one or more drain holes 222 of the evaporator chamber 220 also pass melt water via a drain tube 226 to a main collection pan 228. The drain tube 226 may be located towards or at the rear of the refrigeration apparatus 200. The collection pan 228 is located at the bottom of the refrigeration apparatus 200. The collection pan 228 may be located in a chamber or compartment in which the compressor (not shown) of the refrigeration apparatus 200 is located. Melt water that has collected in the collection pan 228 typically evaporates over time into the environment or room in which the refrigeration apparatus 200 is located. An electric fan (not shown) may be provided to blow air over the collection pan 228 to promote evaporation of the water in the collection pan 228. The same fan or another fan may be provided to blow air over the compressor to promote heat transfer.

[0034] In this example, the base wall 212 of the defrost chamber 210 has one or more drain holes 230 to allow water to exit the defrost chamber 210. The lower wall 232 of the compartment of the refrigeration apparatus 200 where the defrost chamber 210 is located has one or

more drain holes 234 to allow water to exit the compartment where the defrost chamber 210 located. The lower wall 232 may be angled inwardly and downwardly towards the drain hole(s) 234 to facilitate the flow of melt water to and out of the drain hole(s) 234. The one or more drain holes 234 pass water to the drain tube 226. The lower wall 232 of the compartment where the defrost chamber 210 is located effectively acts as a drip or drain tray.

[0035] In use when a frozen item, such as a foodstuff, is to be thawed, the user places the item in the defrost chamber 210. In some cases, it may be advisable to place the item inside a bag that is watertight and optionally also airtight. Melt water that has left the evaporator chamber 220 through the one or more drain holes 222 and entered the defrost chamber 210 through the one or more inlet holes 224 flows over the item. In some cases, depending on for example the rate of flow of melt water into and out of the defrost chamber 210, the melt water may build up somewhat in the defrost chamber 210 to at least partially immerse the item. In any event, the melt water, having only just melted, will typically be at or slightly above 0°C. This is higher than the temperature of the frozen item which is to be thawed. As a result, the item will thaw. Significantly, the temperature surrounding the item being thawed is low, typically being at or only slightly above 0°C, which helps to prevent or inhibit bacterial growth on the item whilst it is being thawed. In addition, because new melt water, at or only slightly above 0°C, can continue to enter the defrost chamber 210, the temperature surrounding the item being thawed can be maintained at or only slightly above 0°C more or less the whole time during the thawing process, again helping to prevent or inhibit bacterial growth during the thawing process. Once the item has fully or sufficiently thawed, the user can remove the item from the defrost chamber 210.

[0036] The rate of flow of melt water from the evaporator chamber 220 into the defrost chamber 210 and the rate of flow of water out of the defrost chamber 210 may be determined, at least in part, by the number and size of the one or more inlet holes 224 of the defrost chamber 210, the number and size of the one or more drain holes 230 of the defrost chamber 210, and the number and size of the one or more drain holes 234 of the compartment of the refrigeration apparatus 200 where the defrost chamber 210 is located.

[0037] To provide better control, one or more valves may be provided to control the rate of flow of melt water into and out of the defrost chamber 210. For example, one or more valves 236 may be located to control the flow of water into or out of the one or more inlet holes 224 of the defrost chamber 210 (one such valve 236 being shown schematically by way of example in Figure 2). If such one or more inlet valves 236 are closed, then melt water exiting the evaporator chamber 220 flows directly to the drain tube 226 to the collection pan 228. The one or more inlet valves 236 can be opened more fully to direct more melt water to the defrost chamber 210 when

desired. Similarly, one or more valves 238 may be located to control the flow of water out of the one or more drain holes 230 in the base wall 212 of the defrost chamber 210 and/or the one or more drain holes 234 of the base wall 212 of the defrost chamber 210 (one such valve 238 for the drain holes 230 in the base wall 212 of the defrost chamber 210 being shown schematically in Figure 2). The one or more outlet valves 238 may be progressively opened and closed to enable water to build up in the defrost chamber 210 so as to immerse the item that is being thawed more fully but without flooding the defrost chamber 210.

[0038] The opening and closing of the one or more inlet valves 236 and outlet valves 238 for the defrost chamber 210, if provided, may be carried out under control of a processor or the like or under direct control from one or more sensors or the like of the refrigeration apparatus 200. There may be for example a temperature sensor 240 which measures the temperature in the defrost chamber 210 and/or of the melt water in the defrost chamber 210. If it is found that the temperature of the melt water in the defrost chamber 210 or of the defrost chamber 210 itself has risen too high, that is above some threshold, which may be for example 4°C or 5°C say, then the outlet valve(s) may be (more fully) opened so that the relatively warm water is released from the defrost chamber 210 and, correspondingly, the inlet valve(s) may be (more fully) opened so that new, relatively cold melt water from the evaporator chamber 220 can enter the defrost chamber 210. In general, the valves may be operated so as to control the amount of melt water in the defrost chamber 210, how long that melt water remains in the defrost chamber 210, and the temperature of the melt water in the defrost chamber 210. A water level sensor may monitor the level of water in the defrost chamber 210 and cause the inlet valves 236 and outlet valves 238 to be operated as necessary so that the level of water in the defrost chamber 210 can be caused to stay at a desired or optimum level to surround the item that is being thawed.

[0039] In addition, especially in the case that the refrigeration apparatus 200 has some heater arrangement for heating the evaporator 202 to defrost the exterior of the evaporator 202, the heater arrangement can be controlled to cause more or less melt water to be generated to be passed to the defrost chamber 210 as required. Naturally, this can only be within the limits of there being ice or frost on the evaporator 202 which can be caused to melt, but this provides another level of control over the process of thawing the food or other item.

[0040] Examples described herein provide a defrost chamber in a refrigeration apparatus in which items to be defrosted or thawed can be located. The defrost chamber receives melt water that comes from the exterior of the evaporator of the refrigeration apparatus during defrosting. The melt water enters the defrost chamber and causes the item to thaw. The water in the defrost chamber can be replaced with new melt water from the evaporator.

In this way, the temperature in the defrost chamber and more particularly the temperature of the melt water in the defrost chamber can be maintained at a level that is high enough to enable the item to thaw but low enough to prevent or inhibit bacterial growth on the item during the thawing process. The melt water can be caused to flow through the defrost chamber more or less continuously (at least when the defrost chamber is being used to thaw an item), maintaining an optimum temperature at all times.

[0041] It will be understood that the processor or processing system or circuitry referred to herein may in practice be provided by a single chip or integrated circuit or plural chips or integrated circuits, optionally provided as a chipset, an application-specific integrated circuit (ASIC), field-programmable gate array (FPGA), digital signal processor (DSP), graphics processing units (GPUs), etc. The chip or chips may comprise circuitry (as well as possibly firmware) for embodying at least one or more of a data processor or processors, a digital signal processor or processors, baseband circuitry and radio frequency circuitry, which are configurable so as to operate in accordance with the exemplary embodiments. In this regard, the exemplary embodiments may be implemented at least in part by computer software stored in (non-transitory) memory and executable by the processor, or by hardware, or by a combination of tangibly stored software and hardware (and tangibly stored firmware).

[0042] The examples described herein are to be understood as illustrative examples of embodiments of the invention. Further embodiments and examples are envisaged. Any feature described in relation to any one example or embodiment may be used alone or in combination with other features. In addition, any feature described in relation to any one example or embodiment may also be used in combination with one or more features of any other of the examples or embodiments, or any combination of any other of the examples or embodiments. Furthermore, equivalents and modifications not described herein may also be employed within the scope of the invention, which is defined in the claims.

Claims

1. A refrigeration apparatus, the refrigeration apparatus comprising:

a cooling chamber for receiving items to be cooled;
 an evaporator in which in use a refrigerant evaporates to absorb heat from the cooling chamber;
 and
 a defrost chamber for receiving an item to be defrosted;
 the defrost chamber being in fluid communication with the exterior of the evaporator for receiving

ing water from the exterior of the evaporator when frost on the exterior of the evaporator melts such that the water assists in defrosting an item received in use in the defrost chamber.

2. A refrigeration apparatus according to claim 1, comprising at least one valve for controlling the flow of water from the exterior of the evaporator into the defrost chamber.
3. A refrigeration apparatus according to claim 1 or claim 2, comprising at least one valve for controlling the flow of water out of the defrost chamber.
4. A refrigeration apparatus according to claim 2 or claim 3, comprising a temperature sensor for sensing the temperature in the defrost chamber and for causing the one or more valves to be operated to maintain the temperature in the defrost chamber at a predetermined level or within a predetermined range.
5. A refrigeration apparatus according to any of claims 1 to 4, comprising a collection pan in fluid communication with the defrost chamber for receiving water from the defrost chamber.
6. A refrigeration apparatus according to claim 5, wherein the collection pan is additionally in fluid communication with the exterior of the evaporator for receiving water from the exterior of the evaporator when frost on the exterior of the evaporator melts.
7. A refrigeration apparatus according to any of claims 1 to 6, wherein the refrigeration apparatus is a frost-free refrigeration apparatus, which is arranged to apply defrosting automatically.

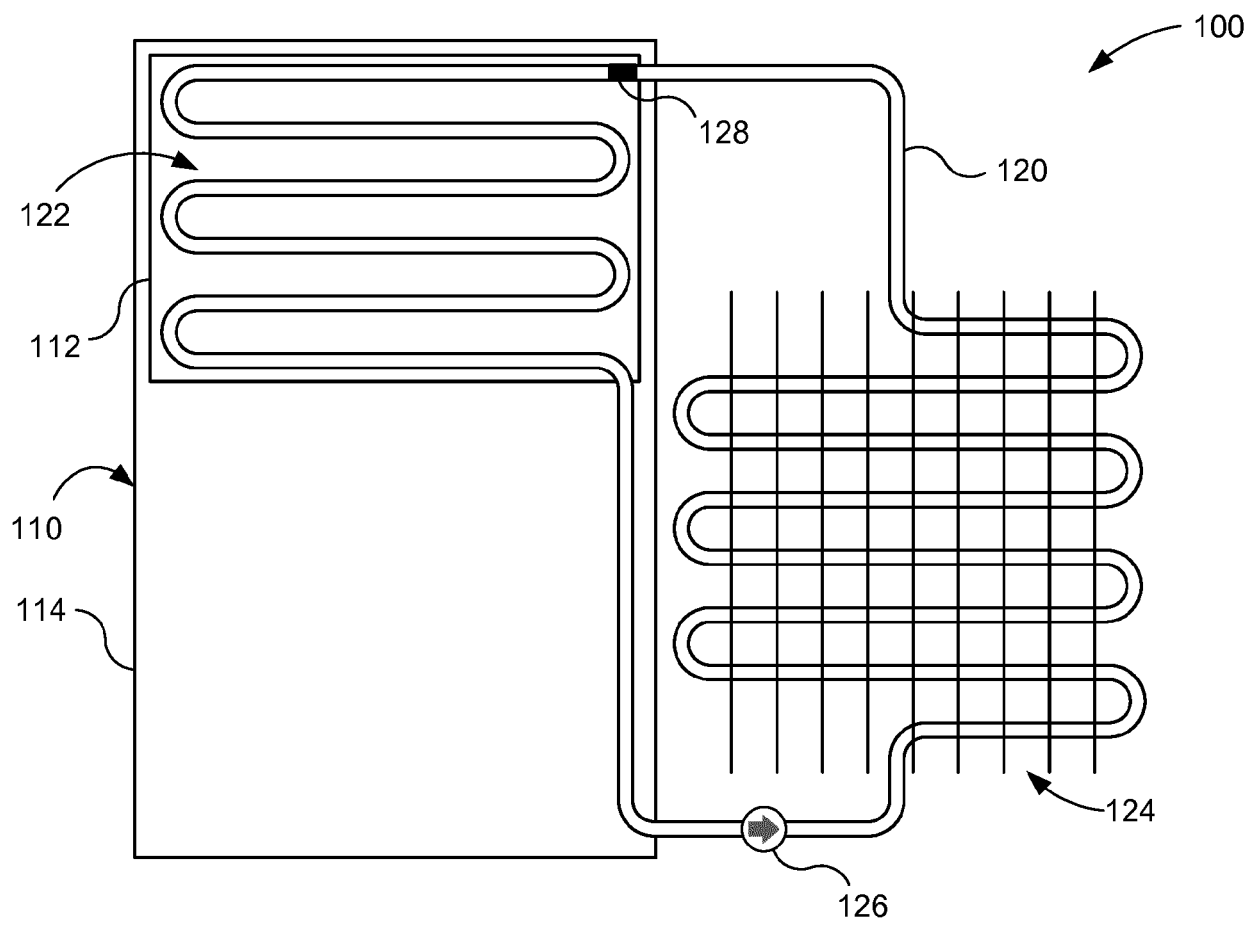


Figure 1
PRIOR ART

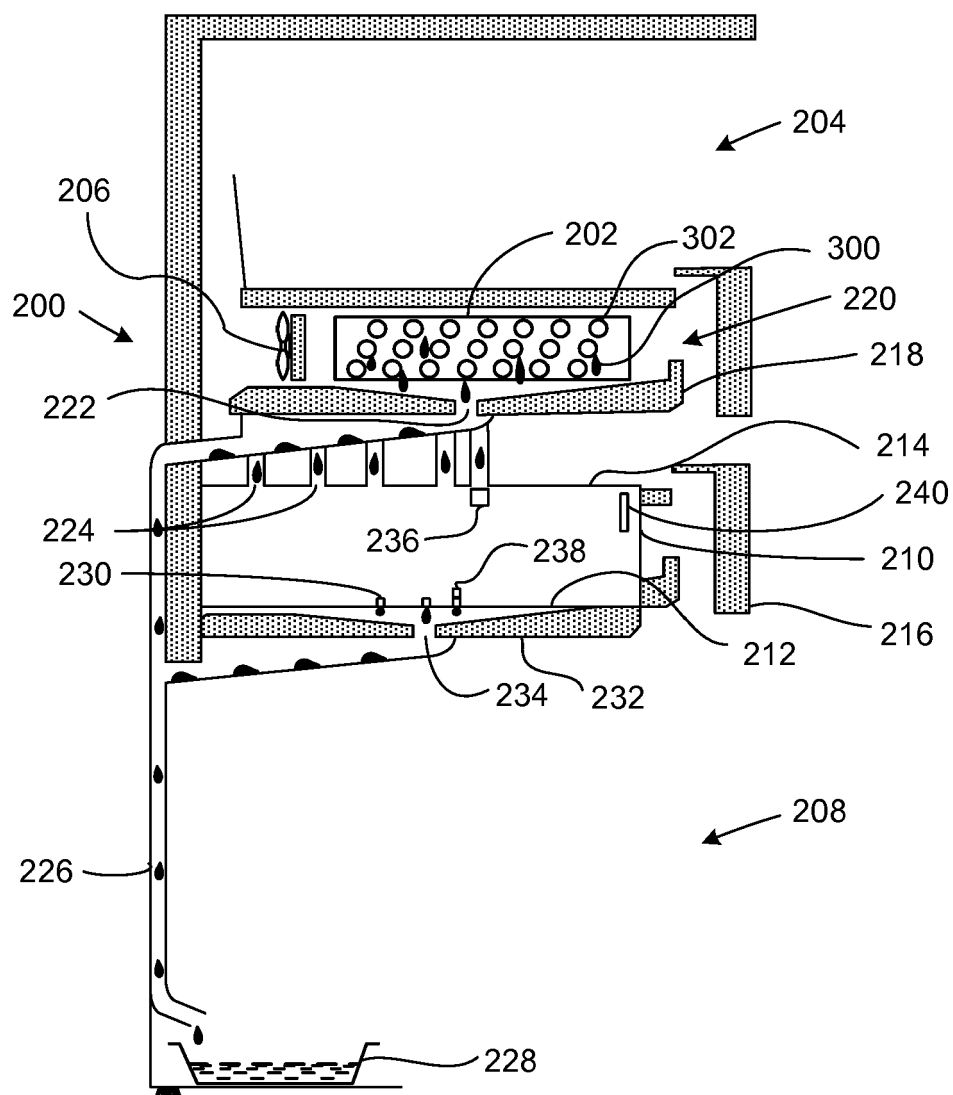


Figure 2



EUROPEAN SEARCH REPORT

 Application Number
 EP 18 21 1424

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 27 May 2019	Examiner de Graaf, Jan Douwe
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 18 21 1424

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82