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(54) NO-FROST REFRIGERATOR APPLIANCE

(57) A refrigerator appliance (100) comprises a refrigerator compartment (111) and a freezer compartment (112) that are separated from each other by an insulating wall (113), a refrigerating chamber (130) accommodating an evaporator (131) and a fan (132) and an air duct (140) in fluid communication with said refrigerating chamber (130), said air duct (140) stretching out in a vertical direction (Z) and having a plurality of outlet ports (141) fluidly communicating with the refrigerator compartment (111) and the freezer compartment (112). The refrigerator appliance further comprises at least one inlet duct (150) crossing the insulating wall (113), said inlet duct (150) including a channel (151) one end of which faces the refrigerator compartment (111), while the opposite end fluidly communicates with the refrigerating chamber (130).

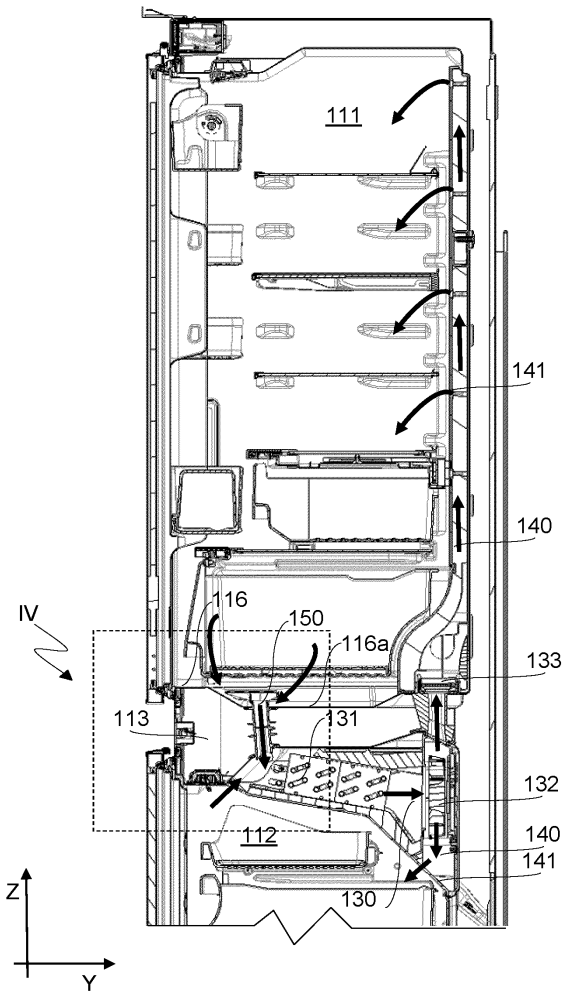


Fig.3

EP 3 945 270 A1

Description

Technical field of the invention

[0001] The present invention generally relates to household refrigerator appliances and more particularly to built-in refrigerator appliances of the so called no-frost type.

Background

[0002] Known no-frost refrigerating appliances typically comprise a cabinet wherein two inner compartments separated by a thermally insulating wall are formed. The two compartments are kept at different temperatures, thereby allowing to store food under different conditions. More particularly, a refrigerator compartment is typically operated at a temperature comprised between 1°C and 10°C, which is suitable to preserve fresh food, while a freezer compartment generally operates at temperatures ranging between -15°C and -30°C to preserve food in a frozen condition.

[0003] Traditional refrigerating appliances employ evaporator elements associated with the external surfaces of the walls of refrigerator and freezer compartments, respectively, and rely on natural air convection. Differently, in no-frost refrigerating appliances thermal exchange with food items occurs and is promoted by forced air convection. More particularly, a flow of cool, dry air is generated in a refrigerating chamber comprising an evaporator and a fan, which is arranged e.g. below the thermally insulating wall separating the refrigerator compartment and the freezer compartment. Cool air is fed to both compartments through an air-duct that fluidly communicates with them by way of a plurality of outlet ports.

[0004] No-frost refrigerating appliances typically comprise at least one inlet duct allowing to suck warm air resulting from the heat exchange with food items stored in the refrigerator compartment and to supply it to the refrigerating chamber where the evaporator is located. The warm air can thus be cooled and dehumidified before it is made to recirculate back to the refrigerator compartment and the freezer compartment.

[0005] Known no-frost refrigerating appliances of the type above are generally free-standing products, wherein the inlet duct allowing to suck warm air from the refrigerator compartment is housed in a side wall or in the rear wall thereof. However, this arrangement is not possible in built-in refrigerating appliances, because, in order to be mounted in a cavity of a kitchen furniture, their peripheral walls are generally thinner than those of a free-standing appliance and offer little room or no space at all for air ducts. On the other hand, a possible arrangement of air ducts in the peripheral walls of a built-in refrigerating appliance would heavily reduce the thickness of insulating material, thereby penalizing thermal insulation and resulting in a poorer energy performance.

[0006] For these reasons, built-in no-frost refrigerating appliances have been developed, wherein cool air generated in the refrigerating chamber is only supplied to a freezer compartment, whereas the refrigerator compartment is cooled by way of a traditional evaporator arranged on its rear wall, hence by way of natural air convection, possibly improved by a fan arranged inside the refrigerator compartment to promote air circulation. These built-in no-frost refrigerating appliances are sometimes defined "hybrid" compared to the "full" or "total" no-frost freestanding appliances because of the combination between a freezer compartment with forced convection of cool air and a refrigerator compartment cooled by way of with a traditional evaporator that generates natural air convection.

[0007] In built-in "hybrid" no-frost refrigerating appliances the freezer compartment needs no defrosting cycle as it happens in "full no-frost" freestanding appliances, whereas the refrigerator compartment must be periodically defrosted in a traditional way.

[0008] In light of the above a need still exists to improve built-in appliances, particularly as far as cooling and defrosting of the refrigerator compartment are concerned.

Summary of the invention

[0009] The technical problem underlying and solved by the present invention is therefore to provide a total no-frost, built-in refrigerating appliance that allows to overcome the drawbacks mentioned above with reference to the prior art.

[0010] This problem is solved by a refrigerating appliance according to the independent claim 1. Preferred features of the present invention are set forth in the dependent claims.

[0011] An idea of solution underlying the invention is provide a total no-frost, built-in refrigerating appliance with an air-duct stretching out in a vertical direction and having a plurality of outlet ports fluidly communicating with the refrigerator compartment and the freezer compartment, so that air cooled in a refrigerating chamber is made to circulate towards both said compartments by way of a fan accommodated in the refrigerating chamber together with an evaporator. It is also an idea underlying the invention to arrange an inlet duct at the bottom of the refrigerator compartment so as to allow suction of warm air into the evaporator compartment.

[0012] Thanks to these features, the peripheral walls of the built-in refrigerating appliance are not affected by the provision of the inlet duct, thus not penalizing thermal insulation and the resulting energy performance of the appliance.

[0013] The inlet duct comprises a channel that crosses the insulating wall separating the refrigerator compartment from the freezer compartment. According to an embodiment of the invention, the end of the channel facing the refrigerator compartment is arranged in a recessed portion of its bottom wall. This configuration allows to have a clearance under the crisper drawer that is typically

slidably arranged on the bottom wall, thereby facilitating suction of warm air into the refrigerating chamber. This configuration also allows to completely hide the inlet duct from the users' view, thus not affecting the overall aesthetic appearance of the refrigerating appliance.

[0014] In order to prevent suction of fluids and solid items into the inlet duct, which would jeopardize operation of the evaporator, the end of the channel facing the refrigerator compartment protrudes from its bottom wall. A septum in the form of a mesh or grid may advantageously be arranged inside the channel to hold possible solid items falling into it.

[0015] A cover member featuring a plurality of apertures allowing suction of warm air into the inlet duct may advantageously be arranged atop the end of its channel that faces the refrigerator compartment. This contributes to prevent suction of fluids and solid items into the inlet duct.

[0016] The cover member may advantageously have a mushroom shape in cross section, which allows to divert away from the inlet duct possible fluids and/or solid items falling onto the bottom wall of the refrigerator compartment. This configuration further contributes to prevent suction of fluids and solid items into the inlet duct.

[0017] Further advantages, features and operation modes of the present invention will become clear from the following detailed description of embodiments thereof, which are given for illustrative and not-limiting purposes.

Brief description of the drawings

[0018] Reference will be made to the figures of the accompanying drawings, in which:

- figure 1 is a perspective view showing a refrigerating appliance according to the present invention;
- figure 2 shows a detail II of figure 1;
- figure 3 shows a longitudinal section of the refrigerator appliance of figure 1 taken along a plane passing through line III-III;
- figure 4 shows a detail IV of the longitudinal section of figure 3.

Detailed description of preferred embodiments

[0019] With reference to figure 1, a built-in refrigerating appliance according to the invention is generally indicated by reference number 100.

[0020] The refrigerating appliance 100 is shown with reference to a three-dimensional coordinate system. A first axis X and a second axis Y that are mutually perpendicular define a horizontal plane, while a third axis Z, perpendicular to said horizontal plane, defines a vertical axis corresponding to the direction along which the force of gravity acts.

[0021] It will be appreciated that neither the type of refrigerating appliance, nor the configuration of the evaporator are limiting features of the invention.

[0022] The refrigerating appliance 100, hereinafter also referred to as refrigerator only, comprises a cabinet 110 whose cavity is configured to store food items. The appliance shown in the drawings is e.g. a "bottom mount" refrigerating appliance, where a refrigerator compartment 111 is formed above a freezer compartment 112 in a vertical direction and are separated from each other by an insulating wall 113, also known as "mullion" to those skilled in the art.

[0023] The cabinet 110 comprises an inner casing or liner 114 that is made e.g. of a polymeric material, where the refrigerator compartment 111 and the freezer compartment 112 are formed, and an outer casing 115. The outer casing 115 is spaced apart from the inner casing 114 so as to define a cavity that is typically filled with a thermally insulating material such as e.g. polyurethane foam.

[0024] The outer casing 115 has a parallelepiped shape and comprises a pair of spaced apart side walls, a top wall, a bottom wall and a back wall. These walls may e.g. be made of sheet metal or a plastic material.

[0025] The refrigerator compartment 111 and the freezer compartment 112 are selectively accessible through respective doors that are not shown in the drawings.

[0026] Now considering figures 3 and 4, the refrigerator appliance 100 comprises a refrigerating chamber 130 that is arranged e.g. below the mullion 113. The refrigerating chamber 130 accommodates an evaporator 131 allowing to cool air and a fan 132, which allows to supply cooled air to the refrigerator compartment 111 and the freezer compartment 112, respectively, through an air duct 140 that stretches out in the vertical direction Z and has a plurality of outlet ports 141 fluidly communicating with the refrigerator compartment 111 and the freezer compartment 112. A gate valve 133, also known as "damper" in the field of refrigerating appliances, allows to adjust the flow of cooling air to the refrigerator compartment 111.

[0027] The evaporator 131 is part of a closed cooling circuit of the refrigerator appliance 100 that also comprises a condenser (not shown), wherein a refrigerant fluid is made to circulate by a compressor (not shown). The refrigerant fluid fills the closed cooling circuit. The compressor is operated by a control unit (not shown) of the refrigerator appliance 100, and makes the refrigerant fluid to circulate through the condenser and then through the evaporator 131. When flowing through the condenser, the refrigerant fluid is cooled down and changes phase from gas to liquid while releasing heat that is dissipated by the condenser. When flowing through the evaporator 131 the refrigerant fluid evaporates, thus subtracting heat from surrounding air, which is cooled and can be supplied to the refrigerator and freezer compartments. Cooling

temperatures are typically comprised between 1°C and 10°C in the refrigerator compartment 111, and between -15°C and -30°C in the freezer compartment 112.

[0028] As shown in the drawings, the evaporator 131 can advantageously be arranged in a substantially horizontal position, which prevents refrigerant fluid from flowing away due to gravity during the compressor off phase. Despite its static condition, the refrigerant fluid confers thermal inertia to the evaporator, which minimizes temperature rise and allows to save energy when the compressor is restarted.

[0029] As schematically shown by the arrows in figure 3, cool air supplied from the outlet ports 141 of the air duct 140 to the refrigerator compartment 111 and the freezer compartment 112 subtracts heat from food items stored therein (not shown) and warms up. Warm air is made to circulate back to the refrigerating chamber 130 through inlet ducts fluidly communicating with the refrigerator compartment 111 and the freezer compartment 112, respectively. This allows to cool down and dehumidify such air before it is made to recirculate to these compartments.

[0030] According to the invention, at least one inlet duct 150 is provided at a bottom wall 116 of the refrigerator compartment 111. The inlet duct 150 crosses the mullion 113 in order to allow suction of warm air from the refrigerator compartment 111 into the refrigerating chamber 131.

[0031] In the embodiment shown in the drawings the refrigerator appliance 100 features a single inlet duct 150.

[0032] The inlet duct 150 includes a channel 151 one end of which faces the refrigerator compartment 111, while the opposite end fluidly communicates with the refrigerating chamber 130.

[0033] Now particularly referring to figure 4, the end of the channel 151 facing the refrigerator compartment 111 is preferably arranged in a recessed portion 116a formed in the bottom wall 116 thereof. This configuration allows to have a clearance under the crisper drawer or drawers (not shown) that is or are typically arranged on the bottom wall 116, thereby facilitating suction of warm air into evaporator compartment.

[0034] It will be appreciated that possible liquids pooling on the recessed portion 116a of the bottom wall 116 can be dried out by the air flow sucked into the channel 151. This is beneficial in that cleaning operations are facilitated, while minimizing generation of bad smells associated with such liquids.

[0035] This configuration also allows to completely hide the inlet duct 150 from the users' view, thus not penalizing the overall aesthetic appearance of the refrigerating appliance 100.

[0036] Still referring to the detail view of figure 4, the end of the channel 151 facing the refrigerator compartment 111 protrudes from the bottom wall 116, more particularly from its recessed portion 116a, thus allowing to prevent suction into the refrigerating chamber 130 of possible fluids collected on the latter.

[0037] Still according to the invention, the inlet duct 150 comprises at least one septum 152. The septum 152, which can be configured e.g. as a mesh or grid element, acts as a separation element preventing objects, such as e.g. parts of fruits or vegetables, from falling into the inlet duct 150 thereby reaching the refrigerating chamber 130 and clogging the evaporator 131. The septum 152 can be formed integrally with the channel 151 or mounted thereto. In the latter case, the septum can be removably mounted in the channel 151, so as to ease cleaning and removal of possible solid items.

[0038] A cover member 153 may advantageously be arranged at the end of the channel 151 facing the refrigerator compartment 111 to protect it and to contribute to prevent suction of fluids and solid items in the inlet duct 150.

[0039] The cover member 153, features a plurality of apertures allowing suction of warm air into the channel 151 of the inlet duct 150.

[0040] The cover member 153 may advantageously have a convex profile, e.g. a mushroom-like shape, in cross section, which allows to divert away from the inlet duct 150 possible fluids and/or solid items falling on the bottom wall 116.

[0041] The cover member 153 is preferably removably mounted at the end of the channel 151, so as to allow access to the interior thereof for cleaning purposes, e.g. to remove possible objects obstructing the septum 152.

[0042] Ribs 154 can advantageously formed on the outer surface of the duct 150 to facilitate its assembly inside the mullion 113 and stiffen its structure during foaming.

[0043] The present invention has been disclosed with reference to preferred embodiments thereof. It will be appreciated that there may be other embodiments relating to the same inventive idea, all of which are included in the scope of protection defined by the claims set out below.

Claims

1. A refrigerator appliance (100) comprising:

- a refrigerator compartment (111) and a freezer compartment (112) separated from each other by an insulating wall (113);
- a refrigerating chamber (130) accommodating an evaporator (131) and a fan (132);
- an air duct (140) in fluid communication with said refrigerating chamber (130), said air duct (140) stretching out in a vertical direction (Z) and having a plurality of outlet ports (141) fluidly communicating with the refrigerator compartment (111) and the freezer compartment (112),

the refrigerator appliance further comprising at least one inlet duct (150) crossing said insulating wall

(113), said inlet duct (150) including a channel (151) one end of which faces the refrigerator compartment (111), while the opposite end fluidly communicates with the refrigerating chamber (130).

2. The refrigerator appliance (100) of claim 1, wherein the refrigerator compartment (111) is arranged above the freezer compartment (112) in the vertical direction (Z) and wherein an end of the channel (151) facing the refrigerator compartment (111) is arranged in a recessed portion (116a) formed in a bottom wall (116) thereof.

3. The refrigerator appliance (100) of claim 2, wherein the end of the channel (151) facing the refrigerator compartment (111) protrudes from the recessed portion (116a) formed in the bottom wall (116).

4. The refrigerator appliance (100) of claim 2 or 3, wherein the inlet duct (150) comprises at least one septum (152) configured to prevent objects from falling into the inlet duct (150).

5. The refrigerator appliance (100) of claim 4, wherein said septum (152) is a mesh or grid element.

6. The refrigerator appliance (100) of claim 4 or 5, wherein the septum (152) is formed integrally with the channel (151) or is removably mounted thereto.

7. The refrigerator appliance (100) of any one of the preceding claims, wherein a cover member (153) is advantageously arranged at the end of the channel (151) facing the refrigerator compartment (111).

8. The refrigerator appliance (100) of claim 7, wherein the cover member (153) features a plurality of apertures allowing suction of warm air into the channel (151) of the inlet duct (150).

9. The refrigerator appliance (100) of claim 7 or 8, wherein the cover member (153) has a convex profile in cross section.

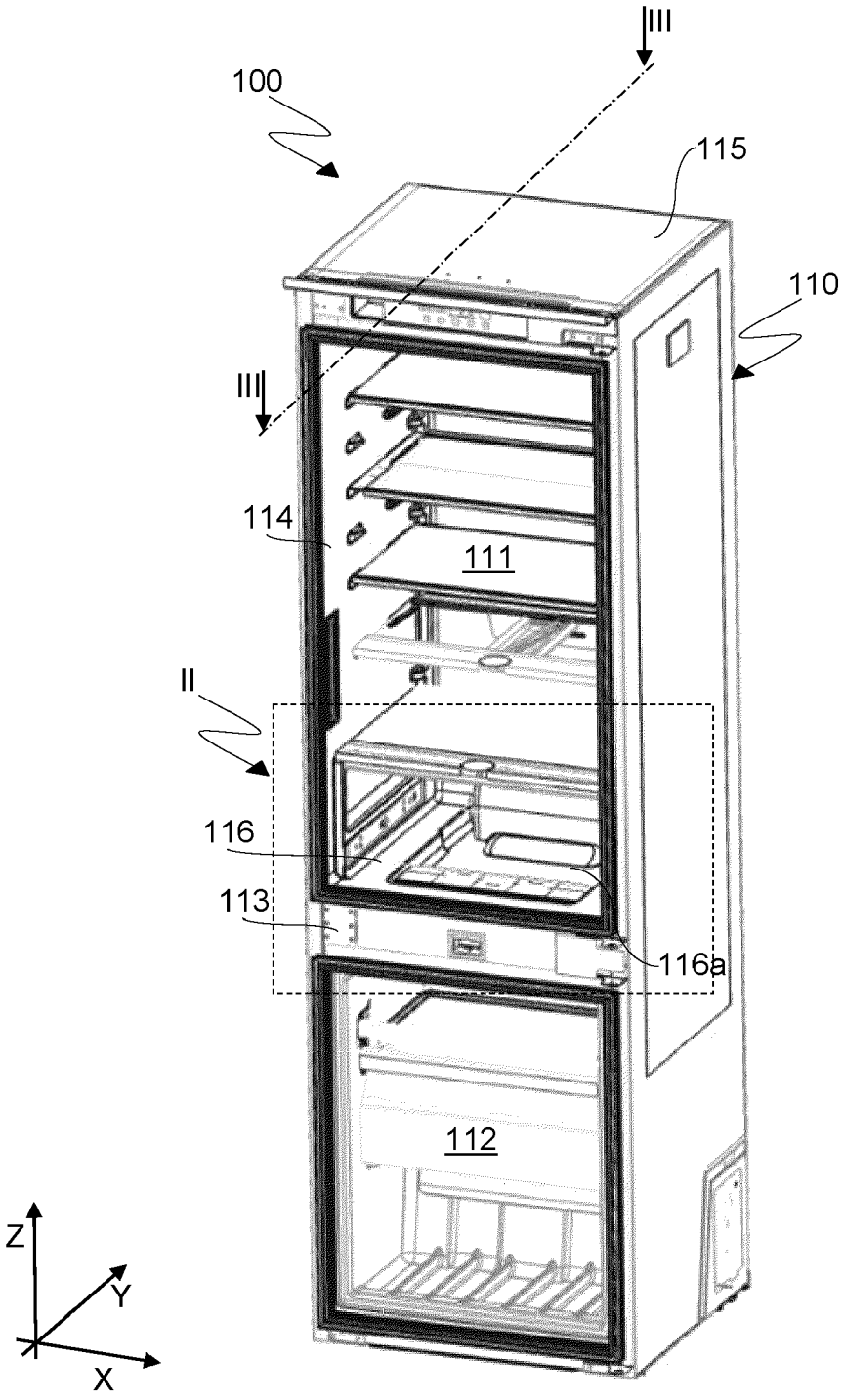
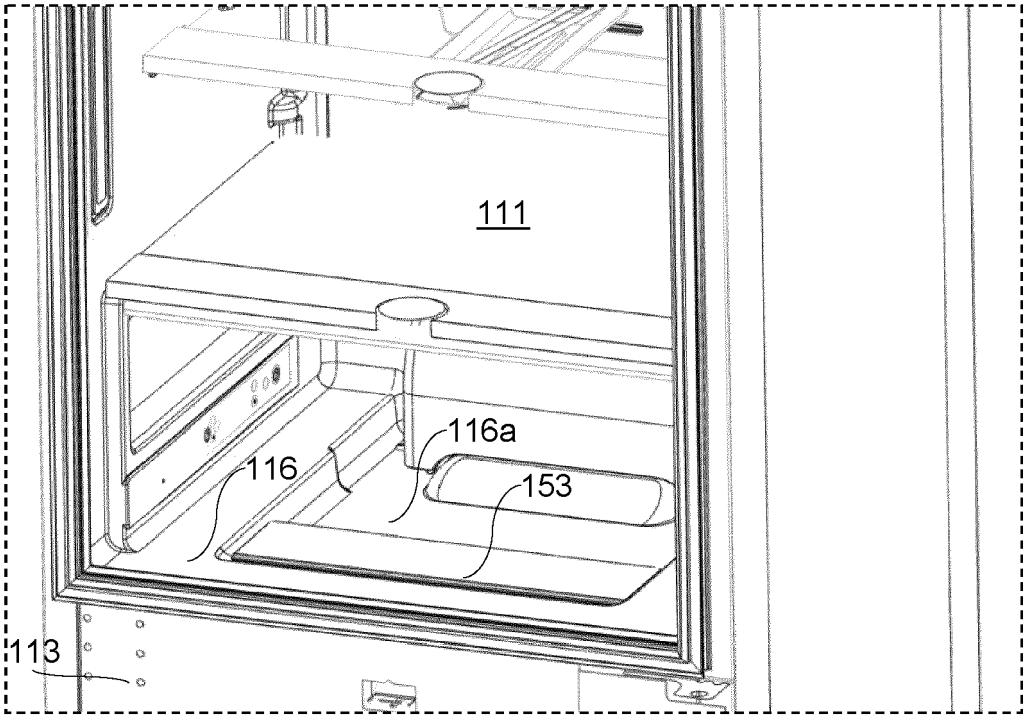


Fig.1



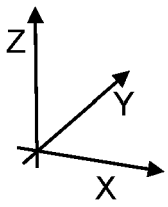


Fig.2

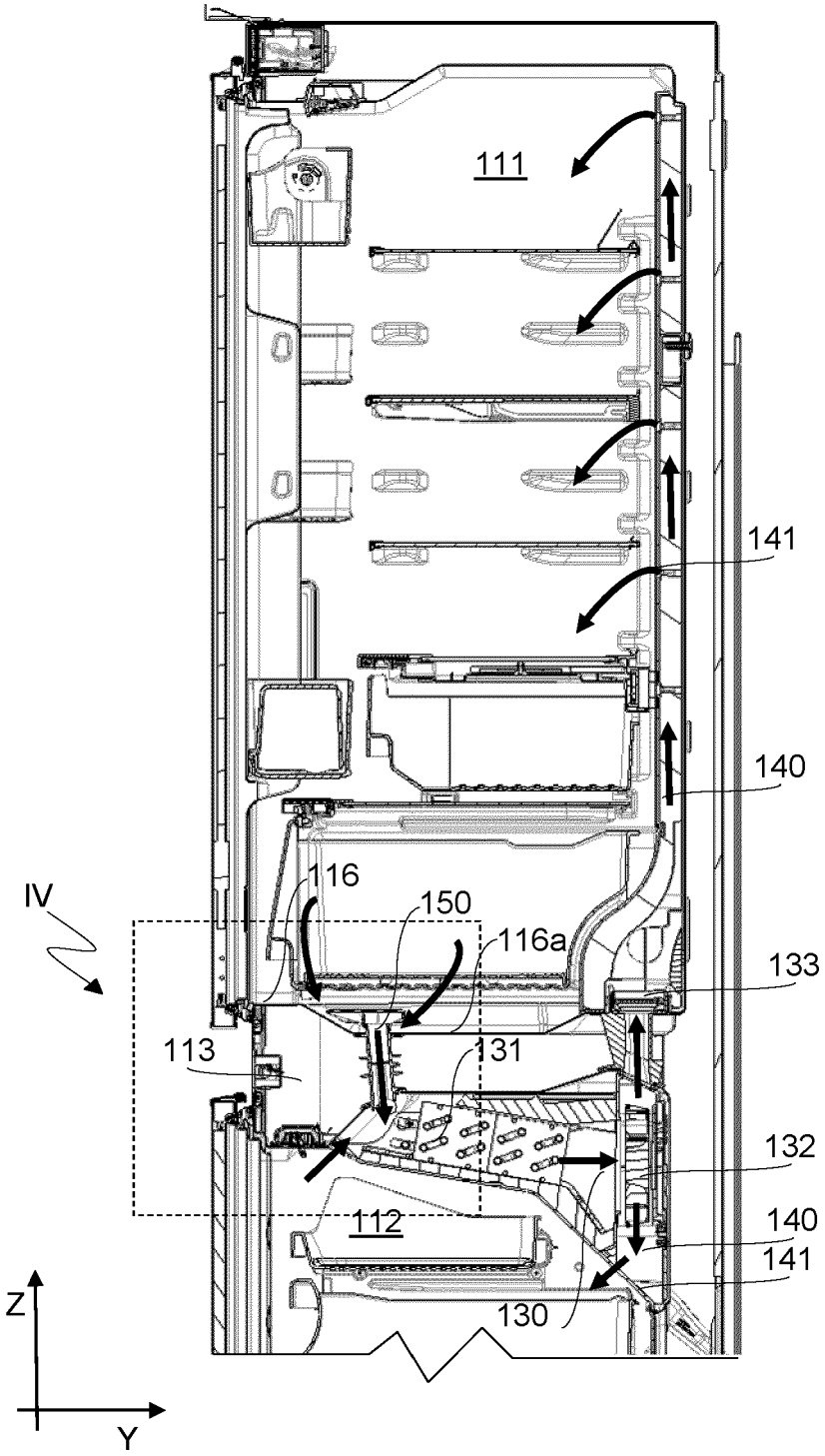


Fig.3

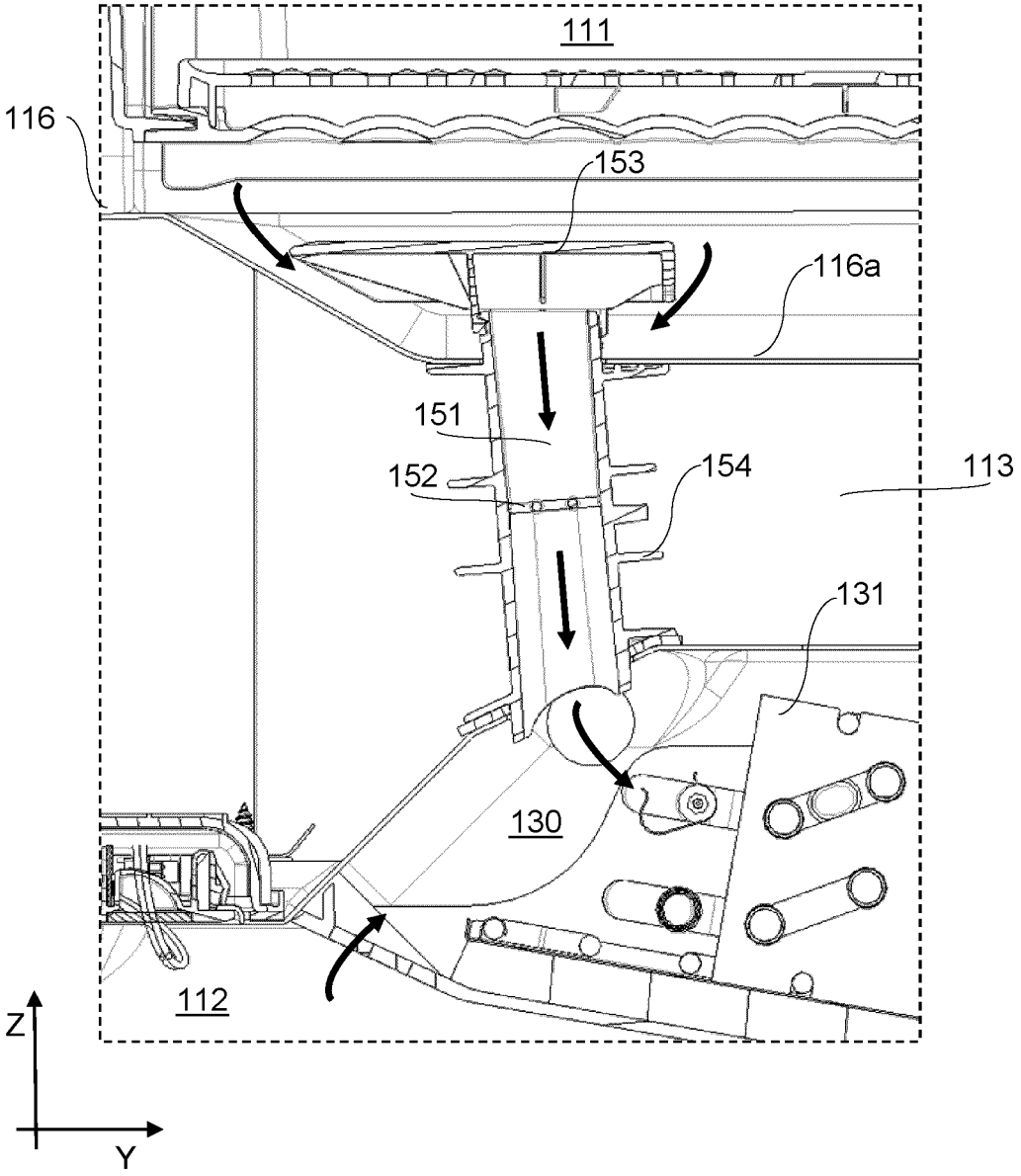


Fig.4

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EUROPEAN SEARCH REPORT

Application Number
EP 20 18 8918

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	15 December 2020	Bejaoui, Amin

CATEGORY OF CITED DOCUMENTS

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