(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 553 430 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
14.05.2025 Bulletin 2025/20

(21) Application number: **24207546.3**

(22) Date of filing: **18.10.2024**

(51) International Patent Classification (IPC):
F25D 17/08 *(2006.01)* ***F25D 17/06*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F25D 17/08; F25D 17/065; F25D 2317/0666; F25D 2317/067; F25D 2317/0683; F25D 2400/06

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
GE KH MA MD TN

(30) Priority: **07.11.2023 CN 202323007506 U**

(71) Applicant: **BSH Hausgeräte GmbH**
81739 München (DE)

(72) Inventors:
- **Wu, Hao**
  Nanjing, 210046 (CN)
- **Chen, Xiupeng**
  Nanjing, 210046 (CN)
- **Liu, Yuhui**
  Nanjing, 210046 (CN)

(54) **REFRIGERATOR**

(57) An embodiment of the present application relates to a refrigerator. The refrigerator includes a heat-insulated main body (101) with a first chamber (102), an first evaporator (2), a first air duct unit (3) configured to define an air channel (4), and a fan (5) located in the air channel (4). The air channel (4) includes a first channel (41) for supplying air cooled by the first evaporator (2) to the fan, a second channel (42) for supplying air flowing out of the fan upward, and a third channel (43) for supplying the air flowing out of the fan downward. The first air duct unit (3) includes a front cover (33), a first rear cover (34) and a second rear cover (35) located below the first rear cover (34). The fan is located between the first rear cover (34) and the front cover (33), at least a portion of the third channel (43) is located between the second rear cover (35) and the front cover (33), and the first air duct unit (3) has at least one first air outlet (312) communicated with the third channel (43) in a region corresponding to the second rear cover (35) to supply the cooled air to a storage space (104).

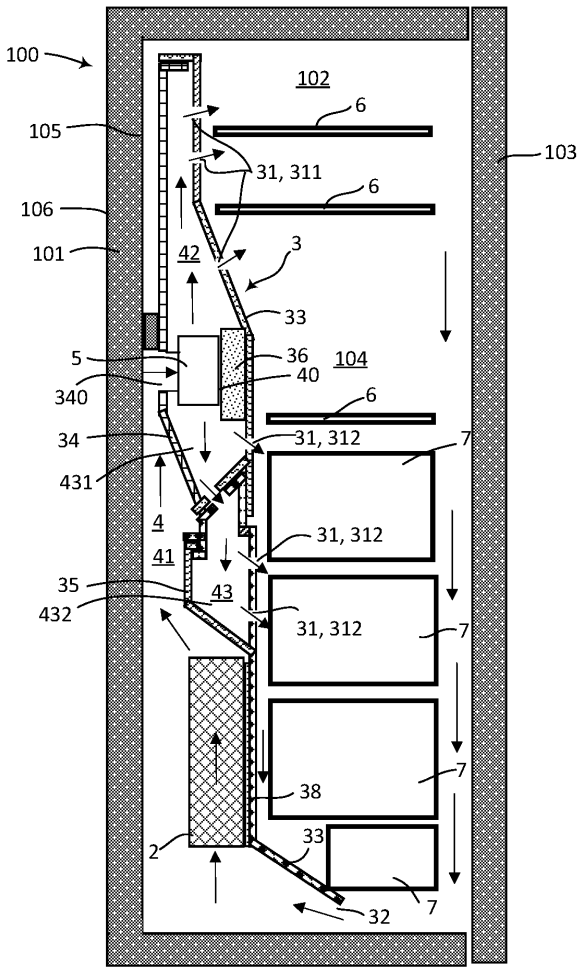

FIG. 2

EP 4 553 430 A1

Description

TECHNICAL FIELD

[0001] An embodiment of the present application relates to a refrigerator, and in particular to, a refrigerator with an air duct unit.

BACKGROUND

[0002] A refrigerator may be provided with an air duct unit to form a forced air circulation in a storage chamber and a channel suitable for supplying cold air to the storage chamber. Usually, the air duct unit is internally provided with a fan to suck the air from the storage chamber into the cold air channel, and the air is cooled by an evaporator and then flows back to the storage chamber. How to design the air duct unit to effectively and evenly cool different regions of the storage chamber is a technical problem faced by designers.

SUMMARY

[0003] One objective of an embodiment of the present application is to provide an improved refrigerator.

[0004] An aspect of an embodiment of the present application relates to a refrigerator. The refrigerator includes: a heat-insulated main body with a first chamber, a first evaporator, a first air duct unit located in the first chamber and configured to define an air channel for conveying air cooled by the first evaporator to a storage space located in front of the first air duct unit, and a fan located in the air channel, where the air channel includes a first channel for supplying the air cooled by the first evaporator to the fan, a second channel for supplying air flowing out of the fan upward, and a third channel for supplying the air flowing out of the fan downward; and the first air duct unit includes a front cover, a first rear cover and a second rear cover located below the first rear cover, the fan is located between the first rear cover and the front cover, at least a portion of the third channel is located between the second rear cover and the front cover, and the first air duct unit has at least one first air outlet communicated with the third channel in a region corresponding to the second rear cover to supply the cooled air to the storage space.

[0005] In this way, the uniformity of cold air distribution in the storage space can be improved. Furthermore, the first rear cover is configured to form an air pressure room with a larger pressure, and a space below the fan is configured to form at least a portion of the third channel for supplying air downward, which is beneficial for improving the space utilization of the air duct unit.

[0006] In a possible embodiment, the second channel is configured to supply cold air to a region above the fan in the storage space.

[0007] In a possible embodiment, the third channel is configured to supply cold air to a region below the fan in the storage space.

[0008] In a possible embodiment, the front cover has at least one second air outlet in the region above the fan to allow the cold air of the second channel to be supplied to the storage space from the second air outlet.

[0009] In a possible embodiment, the front cover has at least one second air outlet communicated with the third channel in the region corresponding to the second rear cover to supply cold air to the region below the fan in the storage space.

[0010] In a possible embodiment, the air channel includes a fourth channel, and the fourth channel is configured to transversely discharge the air flowing out of the fan to supply the air to a second chamber arranged side by side with the first chamber.

[0011] In a possible embodiment, the refrigerator includes a plurality of shelves distributed up and down at intervals in an upper region of the storage space and a plurality of drawers distributed up and down in a lower region of the storage space, where the second channel is configured to convey cold air to the region where the plurality of shelves are located, and the third channel is configured to convey cold air to the region where the plurality of drawers are located.

[0012] In a possible embodiment, the front cover is flush on a front surface corresponding to at least three drawers.

[0013] In a possible embodiment, the first evaporator is located in the air channel and located behind the front cover, and the front cover is flush on a front surface corresponding to a section between an upper end of the fan and a lower end of the first evaporator.

[0014] In a possible embodiment, a portion of the third channel is defined between the first rear cover and the front cover, and the portion of the third channel located between the first rear cover and the front cover is upstream of the portion of the third channel located between the second rear cover and the front cover.

[0015] In a possible embodiment, the first channel includes a portion located behind the second channel and the third channel, so that cold air sequentially flows through rear surfaces of the second rear cover and the first rear cover, and then, the coldest air is separated by the second channel and the third channel.

[0016] In a possible embodiment, the first rear cover has a through hole, the through hole connects the first channel and an inlet of an air pressure cavity where the fan is located, and the air enters the fan from the through hole.

[0017] In a possible embodiment, the first evaporator is located in the first chamber, and in a height direction of the first chamber, the second rear cover is located above the first evaporator and has a distance from a top of the first evaporator, which is more convenient for water to flow onto the first evaporator.

[0018] In a possible embodiment, the second rear cover and the first rear cover are arranged in a contactless manner; and/or the second rear cover is fixed to a

rear side of the front cover; and/or a part of the first channel is bounded by the second rear cover.

[0019] In a possible embodiment, the first rear cover has a first drainage port; and/or the second rear cover has a second drainage port.

[0020] In a possible embodiment, the first drainage port and the second drainage port are located in a third channel.

[0021] In a possible embodiment, a lower end of the second rear cover has an oblique wall inclined towards the front cover, and the second drainage port is located on the oblique wall and is located above a bottom wall of the third channel with a distance from the bottom wall of the third channel.

[0022] In a possible embodiment, the second rear cover has a water blocking rib protruding from an outer surface facing away from the third channel, and the water blocking rib obliquely extends rearward towards a first evaporator.

[0023] In a possible embodiment, the first drainage port and the second drainage port are both located above the first evaporator, and along a height direction of the first chamber, both the first drainage port and the second drainage port are overlapped with the first evaporator.

[0024] In a possible embodiment, the first drainage port extends rearward beyond the rear surface of the second rear cover. In this way, it is avoided that condensate water accumulates in the second channel and the third channel.

[0025] In a possible embodiment, the front cover includes an upper cover and a lower cover connected to a lower end of the upper cover, where the fan is located between the upper cover and the first rear cover, and the third channel is at least partially located between the lower cover and the second rear cover.

[0026] In a possible embodiment, the air duct unit includes a first assembly unit and a second assembly unit, the first assembly unit includes the upper cover, the first rear cover and the fan, the second assembly unit includes the lower cover and the second rear cover, and the first assembly unit and the second assembly unit are sequentially assembled to the main body.

[0027] In a possible embodiment, the first assembly unit is assembled to the main body before the second assembly unit.

[0028] In a possible embodiment, the second assembly unit covers a lower end of the first assembly unit. In a possible embodiment, a gap is reserved between the second rear cover and the first assembly unit in a height direction and/or a depth direction of the first chamber.

[0029] In a possible embodiment, an upper end of the second rear cover is located in front of the lower end of the upper cover.

[0030] In a possible embodiment, the second rear cover at least partially covers a fixing structure for fixing the first assembly unit to the main body.

[0031] In a possible embodiment, the upper cover and the lower cover are flush on a front surface at least at a part corresponding to the third channel.

[0032] In a possible embodiment, the first evaporator is located behind the lower cover, and the lower cover has a front surface exposed to the storage space, the front surfaceis planar on the section from an upper end of the lower cover to a lower end, that is corresponding first evaporator, of the lower cover.

[0033] In a possible embodiment, the third channel includes an introduction channel integrally formed at a top of the lower cover and located behind the front surface of the lower cover.

[0034] In a possible embodiment, the lower cover includes a connection groove opened rearward, and the second rear cover includes a connection flange inserted into the connection groove.

[0035] In a possible embodiment, the upper cover comprises at least one second air outlet and the lower cover comprises at least one first air outlet for supplying cold air from the third channel to the storage space.

[0036] In a possible embodiment, the lower end of the upper cover is located behind the introduction channel.

[0037] In a possible embodiment, the upper cover is located below an inlet of the introduction channel.

[0038] In a possible embodiment, the third channel includes an air supply cavity that is downstream of the introduction channel and located between the second rear cover and the lower cover, and the lower cover has at least one air outlet at a position corresponding to the air supply cavity.

[0039] In a possible embodiment, along a width direction of the first chamber, the air supply cavity has a larger width than the introduction channel; and/or along a depth direction of the first chamber, the air supply cavity has a larger depth than the introduction channel.

[0040] In a possible embodiment, the front cover includes an upper cover and a lower cover located below the upper cover, where the fan is located between the upper cover and the first rear cover, and the third channel is at least partially located between the lower cover and the second rear cover.

[0041] In a possible embodiment, the front cover includes a main board body made of plastic and a decorative panel covering at least a portion of a front side of the main board body.

[0042] In a possible embodiment, the first air duct unit includes a first assembly unit and a second assembly unit, and the first assembly unit and the second assembly unit are first assembled in a modular manner before being assembled onto the main body. In a possible embodiment, the fan is located in the air pressure cavity formed by the first assembly unit.

[0043] In a possible embodiment, the second assembly unit is connected below the first assembly unit and covers the first evaporator. The first assembly unit and the second assembly unit are sequentially assembled onto the main body.

[0044] In a possible embodiment, the first assembly unit includes the upper cover, a first heat insulation ele-

ment, the fan and the first rear cover, and these components are pre-assembled together and form the air pressure cavity.

[0045] In a possible embodiment, the second assembly unit includes the lower cover, the second rear cover and a second heat insulation element, and these components are pre-assembled together.

[0046] In a possible embodiment, the first assembly unit is assembled in the first chamber before the second assembly unit. The second assembly unit covers a lower end of the first assembly unit. Especially, the upper cover of the first assembly unit includes an installation portion located at the lower end thereof and extending to the rear of the second assembly unit. In a possible embodiment, the installation portion has at least one fixing portion for fixing the first assembly unit to the main body. The upper end of the second rear cover is located at the lower end of the upper cover, especially in front of the installation portion, and covers the fixing portion and at least a portion of the installation portion.

[0047] In a possible embodiment, a gap is reserved between the second rear cover and the first assembly unit in a height direction and/or a depth direction of the first chamber. The gap is reserved between the second rear cover and the installation portion. After the second assembly unit is assembled in the first chamber, this gap can prevent the first assembly unit and the second assembly unit from being unable to assemble due to manufacturing tolerances, thus improving the assembly fault tolerance.

[0048] In a possible embodiment, the installation portion and the second assembly unit are each have at least one step to form a maze shape on the gap among the outside of the third channel, the first assembly unit and the second assembly unit. The possibility of leakage of air in the third channel at assembly positions of the first assembly unit and the second assembly unit, especially leakage of the air in the third channel to the first channel is reduced.

[0049] In a possible embodiment, the third channel includes an introduction channel located at an upper portion of the second assembly unit. The introduction channel forms a portion of the second portion of the third channel. Downstream of the introduction channel, the third channel has an air supply cavity with a sectional area larger than that of the introduction channel. The lower cover may have at least one first air outlet at a position corresponding to the air supply cavity.

[0050] In a possible embodiment, sizes of the air supply cavity in the width direction and/or the depth direction of the first chamber may be respectively larger than corresponding sizes of the introduction channel. In other words, along the width direction of the first chamber, the air supply cavity has a larger width than that of the introduction channel; and/or along the depth direction of the first chamber, the air supply cavity has a larger depth than that of the introduction channel. Along the depth direction of the first chamber, the second rear cover may be further back than a rear wall of the introduction channel to increase a volume of the air supply cavity.

[0051] In a possible embodiment, after passing through the introduction channel, air enters the air supply cavity with a larger sectional area, and first air outlets located at different heights may obtain more balanced cold air.

[0052] In a possible embodiment, the first assembly unit is provided with a first portion of the third channel and the second assembly unit is provided with a second portion of the third channel. The first portion and the second portion are butted behind the front surface of the front cover through the upper cover and the lower cover to achieve butting of the first portion and the second portion. The upper cover and the lower cover may have a pair of connection walls which are superposed and abut face to face, and the third channel sequentially passes through the connection walls of the upper cover and the lower cover to achieve anti-leakage connection between the first portion and the second portion.

[0053] In a possible embodiment, the introduction channel is located at a top of the lower cover and located behind the front surface of the lower cover. The air supply cavity may be formed by a space between the second rear cover and the lower cover. The connection walls of the introduction channel and the lower cover are formed by a single component of the lower cover, so that a complex structure is located in the single component, which is beneficial for reducing an air volume loss caused by assembly errors.

[0054] In a possible embodiment, the lower end of the upper cover is located behind the introduction channel. The lower end of the upper cover extends below an inlet of the introduction channel.

[0055] In a possible embodiment, the lower cover includes a connection groove extending rearward and opened rearward, and the second rear cover includes a connection flange inserted into the connection groove, thus further forming a maze structure.

[0056] In a possible embodiment, The first air outlets at different heights are arranged in a stepped shape at the side facing the air supply cavity. That is, the first air outlet located at a far end (lower end) of the third channel is further back than the first air outlet located above, so that the first air outlet at the far end can obtain sufficient air output volume, and the distribution of air output volume of the first air outlets at different heights can be more uniform.

[0057] In a possible embodiment, the second channel, the third channel and the fourth channel are all derived from the air pressure cavity between the first heat insulation element and the first rear cover. The air pressure cavity includes outlets leading to the second channel, the third channel and the fourth channel respectively. Air discharged from the air pressure cavity flows upward along the second channel, or flows downward along the third channel, or flows basically transversely along the fourth channel to further flow to the second chamber.

[0058] The construction of the embodiments of the present application and other inventive objectives and beneficial effects thereof will be more clearly understood through the description of preferred embodiments with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0059] As portion of the specification and to provide a further understanding of the present application, the following accompanying drawings illustrate the detailed description of the present application and, together with the specification, serve to explain the principles of the present application, where

FIG. 1 shows a schematic front view of a refrigerator according to an embodiment of the present application, where doors of the refrigerator are not shown;
FIG. 2 is a schematic sectional view taken along a plane A-A in FIG. 1, and schematically shows a door;
FIG. 3a shows a three-dimensional view of an air duct unit according to an embodiment of the present application;
FIG. 3b is a partial exploded view of the air duct unit in FIG. 3a;
FIG. 3c is a partial enlarged view of a portion B in FIG. 3b; and
FIG. 4 is a partial sectional view along a direction C-C in FIG. 3a.
FIG. 5 is a schematic exploded view of a second assembly unit according to an embodiment of the present application;
FIG. 6 is a schematic three-dimensional view of a second assembly unit according to an embodiment of the present application;
FIG. 7 is a schematic three-dimensional view of a second rear cover according to an embodiment of the present application;
FIG. 8 is a schematic exploded view of a first assembly unit according to an embodiment of the present application.

DETAILED DESCRIPTION

[0060] FIG. 1 shows a schematic front view of a refrigerator 100 according to an embodiment of the present application, where doors of the refrigerator are not shown. FIG. 2 is a schematic sectional view taken along a plane A-A in FIG. 1, and schematically shows a door 103.

[0061] As shown in FIG. 1, the refrigerator 100 includes a heat-insulated main body 101 and chambers 102, 107 and 108 located in the main body 101. These chambers 102, 107 and 108 may be defined by corresponding heat-insulated partitions and closed by the door 103.

[0062] In the embodiment shown in the figure, the chambers 102, 107 and 108 include a first chamber 102, a second chamber 107 and a third chamber 108 which are separated from each other in a heat-insulated manner. The second chamber 107 and the third chamber 108 are respectively arranged side by side with the first chamber 102 along a width direction, and the second chamber 107 is located above the third chamber 108.

[0063] The refrigerator 100 includes a first evaporator 2 for cooling the first chamber 102 and the second chamber 107. The first evaporator 2 is arranged in the first chamber 102. A supply channel 44 communicates the first chamber 102 with the second chamber 107 to supply air cooled by the first evaporator 2 to the second chamber 107.

[0064] The refrigerator 100 may include a return channel 7 which communicates the first chamber 102 to the second chamber 107, so as to guide air in the second chamber 107 to flow back to the space where the first evaporator 2 is located.

[0065] The third chamber 108 may be cooled by a second evaporator 51 located in the third chamber 108.

[0066] The first chamber 102, the second chamber 107 and the third chamber 108 may be internally provided with respective air duct units 3, 21 and 22, so as to enable cold air to enter the corresponding chambers along a predetermined path in the corresponding chambers. The air duct unit 3 in the first chamber 102 is in fluid communication with the air duct unit 21 in the second chamber 107.

[0067] The first chamber 102 is preferably a freezing chamber. The second chamber 107 is preferably a refrigerating chamber. The third chamber 108 is preferably a storage chamber with a larger set temperature range and/or more accurate temperature control, such as a chill chamber or a temperature-variable chamber.

[0068] As shown in FIG. 2, the main body 101 may include a cabinet liner 105 defining the first chamber 102, a shell 106 arranged at an interval from the liner 105, and a heat insulation material located between the liner 105 and the shell 106.

[0069] The air duct unit 3 is located at a rear portion of the chamber 102. Relative to the air duct unit 3, the first chamber 102 includes a storage space 104 located in front of the air duct unit 3 and an air channel 4 for conveying air cooled by the evaporator 2 to the storage space 104. At least a portion of boundary of the air channel 4 is defined by the air duct unit 3. In some implementations, a rear wall of the liner 105 may form a portion of a rear boundary of the air channel 4.

[0070] The air channel 4 includes a plurality of air outlets 31 for conveying cold air to the storage space 104. Air in the storage space 104 returns to the region where the first evaporator 2 is located through an air return opening 32. The refrigerator 100 includes a fan 5 located in the air channel 4 to form a forced air circulation between the storage space 104 and the air channel 4.

[0071] The air return opening 32 is arranged in a bottom region of the first chamber 102.

[0072] The first evaporator 2 is located in the air channel 4. The air in the storage space 104 returns to the air

channel 4 through the air return opening 32 and is cooled by the evaporator 2 before being conveyed into the storage space 104.

[0073] The fan 5 is located above the first evaporator 2. The air channel 4 includes a first channel 41 located between the first evaporator 2 and the fan 5, a second channel 42 for supplying air flowing out of the fan 5 upward, and a third channel 43 for supplying the air flowing out of the fan 5 downward.

[0074] The air channel 4 may also include a fourth channel 45 for transversely conveying the air flowing out of the fan 5 to the adjacent second chamber 107. The fourth channel 45 is communicated with the supply channel 44 located in a partition 8 to supply cold air into the air duct unit 21.

[0075] The fourth channel 45 and the supply channel 44 are arranged corresponding to a lower portion of the second chamber 107, so that the cold air from the first chamber 3 enters the air duct unit 21 from the lower portion of the second chamber 107. A lower portion of the air duct unit 21 is obliquely arranged to enable cold air to obliquely flow upward to a cold air distribution region that is substantially symmetrically arranged of the air duct unit 21. The supply channel 44 has a damper 9 for opening or closing the supply channel 44 in the partition 8, and the damper 9 controls whether the first chamber 102 supplies cold air to the second chamber 107.

[0076] Straight lines with arrows in FIG. 1 and FIG. 2 schematically represent the air circulation in the first chamber 102.

[0077] The second channel 42 is configured to supply cold air to a region above the fan 5 in the storage space 104, and cold air flowing to the second channel 42 may be discharged to the storage space 104 through a first air outlet 311 arranged above the fan 5.

[0078] The third channel 43 is configured to supply cold air to a region below the fan 5 in the storage space 104, and cold air flowing to the third channel 43 may be discharged to the storage space 104 through a first air outlet 312 arranged below the fan 5. A plurality of first air outlets 312 may be provided and may be distributed at different heights of the third channel 43.

[0079] The air duct unit 3 may include an air pressure cavity 40 for accommodating the fan 5. Air flowing into the air pressure cavity 40 from the first channel 41 is distributed by the fan 5 to the second channel 42 and the third channel 43 to flow upward and downward respectively so as to be discharged into a corresponding region of the storage space 104.

[0080] The refrigerator 100 includes a plurality of shelves 6 and a plurality of drawers 7 located in the storage space 104. The shelves 6 are located in an upper region of the storage space 104. Relative to the shelves 6, the drawers 7 are located in a lower region of the storage space 104.

[0081] The second air outlet 311 is arranged near a corresponding shelf 6 to cool the region where the shelf 6 is located. The first air outlet 312 is arranged near a corresponding drawer to cool the region inside the corresponding drawer 7 and the region where the drawer 7 is located. In addition to supplying cold air to the upper portion of the storage space 104 through the second channel 42, the lower region of the storage space 104, especially the region where the drawer 7 is located, may be cooled by the cold air conveyed through the third channel 43 located below the fan 5.

[0082] By reasonably distributing the air volume of the second channel 42 and the third channel 43, the drawer 7 in the storage space 104 can be effectively cooled, and the temperature distribution in the storage space 104 can be more balanced.

[0083] The air duct unit 3 includes a front cover 33 facing the storage space 104 and a first rear cover 34. The air pressure cavity 40 is formed between the first rear cover 34 and the front cover 33, and the fan 5 is located between the first rear cover 34 and the front cover 33.

[0084] The air duct unit 3 may include a first heat insulation element 36 arranged along at least a portion of section on an inner side of the front cover 33. The first heat insulation element 36 may define a boundary of at least a portion of section of the second channel 42 and/or the third channel 43. The first heat insulation element 36 is arranged at least on a front side of the corresponding air pressure room 40 and defines a front boundary of the air pressure room 40 to achieve shock absorption for the fan 5 and heat insulation for cooling capacity in the air pressure room 40. The first heat insulation element 36 may be, for example, an EPS element.

[0085] The air duct unit 3 includes a second rear cover 35 located below the first rear cover 34. The first rear cover 34 and the second rear cover 35 are separately provided components. At least a portion of the third channel 43 is located between the second rear cover 35 and the front cover 33, and at least one first air outlet 312 is arranged in the region, corresponding to the second rear cover 35, of the air duct unit 3 to supply the cooled air to the storage space 104 in the region corresponding to the second rear cover 35.

[0086] The first rear cover 34 has a through hole 340, the through hole 340 connects the first channel 41 and the air pressure cavity 40 where the fan 5 is located, and air enters the air pressure cavity 40 through the through hole 340 and is distributed to the second channel 42 and the third channel 43.

[0087] At least a portion of the third channel 43 is arranged between a rear side of the front cover 33 and a front side of the second rear cover 35 to further increase a length of downward extension of the third channel 43, so that the temperature uniformity in the storage space 104, especially the temperature distribution in the region where the drawer 7 is located, can be effectively improved.

[0088] Further, in a height direction of the chamber 102, the second rear cover 35 is located between the fan 5 and the first evaporator 2. A space between the first evaporator 2 and the fan 5 in the height direction is used

for forming an air supply cavity 434 located below the fan 5. Meanwhile, a space between the second rear cover 35 and the front cover 33 is used for heat insulation buffering. Less cooling capacity of the region where the first evaporator 2 is located may be directly transferred to the storage space 104, and it is to be expected that no additional heat insulation element is arranged on a rear side of the second rear cover 35 corresponding to the front cover 33.

[0089] At a position corresponding to the first evaporator 2, a second heat insulation element 38 for separating the front cover 33 from the first evaporator 2 may be arranged on the rear side of the front cover 33.

[0090] The upstream first channel 41 is at least partially located behind the second channel 42 and the third channel 43. A portion of section of the first channel 41 is bounded by the second rear cover 34. Air returning from the storage space 104 to the air channel 4 flows upward after flowing through the first evaporator 2 at a bottom of the air channel 4, and flows to the air pressure cavity 40 behind the second channel 42 and the third channel 43. The coldest air is separated from the storage space 104 at least in a portion of section by the second rear cover and the third channel 43, and sequentially flows through rear surfaces of the second rear cover 35 and the first rear cover 34, which is beneficial for preventing condensate water/frost from occurring in this region of the front cover 33, and is also beneficial for the design of component distribution from the air pressure cavity 40 to the second channel 42, the third channel 43 and the fourth channel 45.

[0091] The second air outlet 311 may be arranged in a region above the fan 5 corresponding to the front cover 33, so that cold air may pass through the front cover 33 to enter the storage space 104. Similarly, the first air outlet 312 may be arranged in a region below the fan 5 corresponding to the front cover 33.

[0092] As shown in FIG. 2, in a height direction of the chamber 102, the second rear cover 35 is located above the first evaporator 2 and has a distance from a top of the first evaporator.

[0093] The second rear cover 35 is fixed to the front cover 33, and at least one of the second rear cover 35 and the front cover 33 may be provided with a clamping hook for buckling connection. The second rear cover 35 and the first rear cover 34 are arranged in a contactless manner.

[0094] FIG. 3a to FIG. 4 show an air duct unit 3 according to an embodiment of the present application, where FIG. 3a shows a three-dimensional view of the air duct unit 3, FIG. 3b is a partial exploded view of the air duct unit 3 shown in FIG. 3a, FIG. 3c is a partial enlarged view of a portion B in FIG. 3b, and FIG. 4 is a partial sectional view along a direction C-C in FIG. 3a. In FIG. 3a, the air duct unit 3 and a pipe body 441 for defining the supply channel 44 are fixed together.

[0095] The pipe body 441 may be embedded in the partition 8, especially may be combined together with a heat insulation material of the main body 101 in a foaming process of the main body 101.

[0096] Referring to FIG. 3a to FIG. 4 in conjunction with FIG. 2, the front cover 33 may include a main board body 338 made of plastic and a decorative panel 339 covering at least a portion of a front side of the main board body 338.

[0097] The front cover 33 may include an upper cover 331 and a lower cover 332 connected to a lower portion of the upper cover 331. The fan 5 is located between the upper cover 331 and the first rear cover 34, and the third channel 43 is at least partially located between the lower cover 332 and the second rear cover 35.

[0098] Because the second rear cover 35 is arranged behind the lower cover 332 to form a channel for supplying cold air downward, the upper cover 331 and the lower cover 332 may be flush at least on a front surface corresponding to a section of the third channel 43 and the fan 5. In addition, the first evaporator 2 is covered by the lower cover 332, and a front surface of the lower cover 332 exposed to the storage space 104 may be a plane in a section from an upper end thereof to a lower end of the corresponding first evaporator 2. Thus, the upper cover 331 and the lower cover 332 may be flush at least in a region behind the plurality of drawers 7. As a result, the universality of the drawer 7 can be improved.

[0099] As shown in FIG. 4 and FIG. 8, a first portion 431 of the third channel 43 is arranged between the first rear cover 34 and the front cover 33, a second portion 432 of the third channel 43 is arranged between the second rear cover 35 and the front cover 33, and the first portion 431 is upstream of the second portion 432. The first rear cover 34 is used for forming a portion of the third channel 43, and the air pressure cavity 40 and a back side of an upstream region of the third channel 43 may be formed by a same component, which is beneficial for reducing the probability of unwanted significant air leakage near the air pressure cavity 40.

[0100] The upper cover 331 and the lower cover 332 each include at least one first air outlet 312 for supplying cold air from the third channel 43 to the storage space 104.

[0101] As shown in FIG. 4 and FIG. 8, to avoid condensate water from accumulating in the second channel 42 and the third channel 43, the air duct unit 3 includes a first drainage port 345 arranged on the first rear cover 34 and a second drainage port 355 arranged on the second rear cover 35. The first drainage port 345 is located above the second drainage port 355.

[0102] The first drainage port 345 and the second drainage port 355 are both located at a rear boundary of the third channel 43. The first drainage port 345 is located at a lower portion of the first rear cover 34, and the first drainage port 345 is located further back than the second rear cover 35 to prevent water discharged from the first drainage port 345 from falling onto the second rear cover 35.

[0103] The second rear cover 35 is located above the

first evaporator 2 and has a distance from a top of the first evaporator 2 in a height direction. The second drainage port 355 is arranged on a wall opposite to the front cover 33. A projection of the second drainage port in a horizontal direction falls into in the first evaporator 2, i.e. along the height direction of the storage chamber 104, the second drainage port is overlapped with the first evaporator 2. Condensed water may be discharged onto the first evaporator 2 and may frost on the first evaporator 2. A lower end of the second rear cover 35 has an oblique wall 351 inclined towards the front cover 33, and the second drainage port 355 is arranged on the oblique wall 351 and is located above a bottom wall 438 of the third channel 43 with a distance from the bottom wall 438 of the third channel 43. The condensed water may flow to the first evaporator 2 instead of the front or rear of the first evaporator 2, thus preventing the condensed water from flowing into the storage space 104.

[0104] Below the second drainage port 355, the second rear cover 35 may be provided with a water blocking rib 356 protruding from an outer surface facing away from the third channel 43, and the water blocking rib 356 obliquely extends rearward towards the first evaporator 2, so that water falling on the water blocking rib 356 may be guided to the first evaporator 2.

[0105] Referring to FIG. 3a to FIG. 8, the air duct unit 3 includes a first assembly unit 200 and a second assembly unit 300, and the first assembly unit 200 and the second assembly unit 300 are first assembled in a modular manner on the main body 101 before being assembled onto the main body 101. The fan 5 is located in the air pressure cavity 40 formed by the first assembly unit 200.

[0106] The second assembly unit 300 is connected below the first assembly unit 200 and covers the first evaporator 2. The first assembly unit 200 and the second assembly unit 300 are sequentially assembled in the main body 101.

[0107] In one embodiment, the first assembly unit 200 may include the upper cover 331, the first heat insulation element 36, the fan 5 and the first rear cover 34, and these components are pre-assembled together and form the air pressure cavity 40.

[0108] Similarly, the second assembly unit 300 includes the lower cover 332, the second rear cover 35 and the second heat insulation element 38, and these components are pre-assembled together.

[0109] The first assembly unit 200 is assembled in the chamber 102 before the second assembly unit 300. The second assembly unit 300 covers a lower end of the first assembly unit 200. Especially, the upper cover 331 of the first assembly unit 200 includes an installation portion 3311 located at the lower end thereof and extending to the rear of the second assembly unit 300. The installation portion 3311 has at least one fixing portion 3312 for fixing the first assembly unit 200 to the main body 101. The upper end of the second rear cover 35 is located at the lower end of the upper cover 331, especially in front of the installation portion 3311, and covers the fixing portion 3312 and at least a portion of the installation portion 3311.

[0110] As shown in FIG. 4, a gap is reserved between the second rear cover 35 and the first assembly unit 200 in a height direction H and/or a depth direction D of the chamber 102. A gap is reserved between the second rear cover 35 and the installation portion 3311. After the second assembly unit 300 is assembled in the chamber 102, this gap can prevent the first assembly unit 200 and the second assembly unit 300 from being unable to assemble due to manufacturing tolerances, thus improving the assembly fault tolerance.

[0111] The installation portion 3311 and the second assembly unit 300 may each have at least one step to form a maze shape on the gap among the outside of the third channel 43, the first assembly unit 200 and the second assembly unit 300. The possibility of leakage of air in the third channel 43 at assembly positions of the first assembly unit 200 and the second assembly unit 300, especially leakage of the air in the third channel 43 to the first channel 41 is reduced.

[0112] As shown in FIG. 4 and FIG. 6, the third channel 43 includes an introduction channel 433 located at an upper portion of the second assembly unit 300. The introduction channel 433 forms a portion of the second portion 432 of the third channel 43. Downstream of the introduction channel 433, the third channel 43 has an air supply cavity 434 with a sectional area larger than that of the introduction channel 433. The lower cover 322 may have at least one first air outlet 312 at a position corresponding to the air supply cavity 434.

[0113] Sizes of the air supply cavity 434 in the width direction W and/or the depth direction D of the chamber 102 may be respectively larger than corresponding sizes of the introduction channel 433. In other words, along the width direction W of the chamber 102, the air supply cavity 434 has a larger width than that of the introduction channel 433; and/or along the depth direction D of the chamber 102, the air supply cavity 434 has a larger depth than that of the introduction channel 433. Along the depth direction D of the chamber 102, the second rear cover 35 may be further back than a rear wall of the introduction channel 433 to increase a volume of the air supply cavity 434.

[0114] After passing through the introduction channel 433, air enters the air supply cavity 434 with a larger sectional area, and first air outlets 312 located at different heights may obtain more balanced cold air.

[0115] The first assembly unit 200 is provided with a first portion 431 of the third channel 43, and the second assembly unit 300 is provided with a second portion 432 of the third channel 43. The first portion 431 and the second portion 432 are coupled behind the front surface of the front cover 33, such that the first portion 431 and the second portion 432 is coupled. The upper cover 331 and the lower cover 332 may have a pair of connection walls 315 which are overlapped with each other and are in face-to-face contact. The third channel 43 sequentially passes through the connection walls 315 of the upper cover 331

and the lower cover 332 to achieve anti-leakage connection between the first portion 431 and the second portion 432.

[0116] The introduction channel 433 may be located at a top of the lower cover 332 and located behind the front surface of the lower cover 332. The air supply cavity 434 is formed by a space between the second rear cover 35 and the lower cover 332. The connection walls 315 of the introduction channel 433 and the lower cover 332 are formed by a single component of the lower cover 332, so that a complex structure is located in the single component, which is beneficial for reducing an air volume loss caused by assembly errors.

[0117] The lower end of the upper cover 331 is located behind the introduction channel 433. The lower end of the upper cover 331 extends below an inlet of the introduction channel 433.

[0118] The lower cover 332 may include a connection groove 316 extending rearward and opened rearward, and the second rear cover 35 includes a connection flange 357 inserted into the connection groove 316, thus further forming a maze structure.

[0119] The first air outlets 312 at different heightsmay be arranged in a stepped shape at the side facing to the air supply cavity 434. That is, the first air outlet 312 located at a far end (lower end) of the third channel 43 is further back than the first air outlet 312 located above (as shown in FIG. 4), so that the first air outlet 312 at the far end can obtain sufficient air output volume, and the distribution of air output volume of the first air outlets at different heights can be more uniform.

[0120] As shown in FIG. 8, the second channel 42, the third channel 43 and the fourth channel 45 are all derived from the air pressure cavity 40 between the first heat insulation element 36 and the first rear cover 34. The air pressure cavity 40 includes outlets leading to the second channel 42, the third channel 43 and the fourth channel 45 respectively. Air discharged from the air pressure cavity 40 flows upward along the second channel 42, or flows downward along the third channel 43, or flows basically transversely along the fourth channel 45 to further flow to the second chamber 107.

[0121] Various embodiments of single parts described with reference to FIG. 1 to FIG. 8 may be combined with each other in any given way to achieve the advantages of the present application. In addition, the present application is not limited to the shown embodiments. In general, other methods other than the shown methods may also be used, as long as these methods can achieve the same effects.

Claims

1. A refrigerator (100), **characterized by** comprising:

   a heat-insulated main body (101) with a first chamber (102),

   a first evaporator (2),

   a first air duct unit (3) located in the first chamber (102) and configured to define an air channel (4) for conveying air cooled by the first evaporator (2) to a storage space (104) located in the first chamber (102), and

   a fan (5) located in the air channel (4),

   wherein the air channel (4) comprises a first channel (41) for supplying the air cooled by the first evaporator (2) to the fan (5), a second channel (42) for supplying air flowing out of the fan (5) upward, and a third channel (43) for supplying the air flowing out of the fan (5) downward; and

   the first air duct unit (3) comprises a front cover (33), a first rear cover (34) and a second rear cover (35) located below the first rear cover (34), the fan (5) is located between the first rear cover (34) and the front cover (33), at least a portion of the third channel (43) is located between the second rear cover (35) and the front cover (33), and the first air duct unit (3) has at least one first air outlet (312) communicated with the third channel (43) in a region corresponding to the second rear cover (35) to supply the cooled air to the storage space (104).

2. The refrigerator (100) according to claim 1, **characterized in that**

   the second channel (42) is configured to supply cold air to a region above the fan (5) in the storage space (104); and/or

   the third channel (43) is configured to supply cold air to a region below the fan (5) in the storage space (104); and/or

   the front cover (33) has at least one second air outlet (311) in the region above the fan (5) to allow the cold air of the second channel (42) to be supplied to the storage space (104) from the second air outlet (311); and/or

   the front cover has at least one first air outlet (312) communicated with the third channel in the region corresponding to the second rear cover to supply cold air to the region below the fan (5) in the first storage space (104); and/or

   the air channel (4) comprises a fourth channel (45), and the fourth channel (45) is configured to transversely discharge the air flowing out of the fan (5) to supply the air to a second chamber (107) arranged side by side with the first chamber (102).

3. The refrigerator (100) according to anyone of the preceding claims, **characterized by** comprising: a plurality of shelves (6) distributed up and down at intervals in an upper region of the storage space (104) and a plurality of drawers (7) distributed up and

down in a lower region of the storage space (104), wherein the second channel (42) is configured to convey cold air to the region where the plurality of shelves (6) are located, and the third channel (43) is configured to convey cold air to the region where the plurality of drawers (7) are located.

4. The refrigerator (100) according to claim 3, **characterized in that**

the front cover (33) is flush on a front surface corresponding to at least three drawers (7); and/or
the first evaporator (2) is located in the air channel (4) and located behind the front cover (33), and the front cover (33) is flush on a front surface corresponding to a section between an upper end of the fan (5) and a lower end of the first evaporator (2).

5. The refrigerator (100) according to anyone of the preceding claims, **characterized in that**

a portion of the third channel (43) is defined between the first rear cover (34) and the front cover (33), and the portion of the third channel (43) located between the first rear cover (34) and the front cover (33) is upstream of the portion of the third channel (43) located between the second rear cover (35) and the front cover (33); and/or
the first channel (41) comprises a portion located behind the second channel (42) and the third channel (43), so that cold air sequentially flows through rear surfaces of the second rear cover (35) and the first rear cover (34); and/or
the first rear cover (34) has a through hole (340), the through hole (340) connects the first channel (41) and an inlet of an air pressure cavity (40) where the fan (5) is located, and air enters the fan (5) from the through hole (340); and/or
the first evaporator (2) is located in the first chamber (102), and in a height direction of the first chamber (102), the second rear cover (35) is located above the first evaporator (2) and has a distance from a top of the first evaporator (2).

6. The refrigerator (100) according to anyone of the preceding claims, **characterized in that**

the second rear cover (35) and the first rear cover (34) are arranged in a contactless manner; and/or
the second rear cover (35) is fixed to a rear side of the front cover (33); and/or
a part of the first channel (41)is bounded by the second rear cover (35).

7. The refrigerator (100) according to anyone of the preceding claims, **characterized in that**

the first rear cover (34) has a first drainage port (345); and/or
the second rear cover (35) has a second drainage port (355).

8. The refrigerator (100) according to claim 7, **characterized in that**

the first drainage port (345) and the second drainage port (355) are located in the third channel (43); and/or
a lower end of the second rear cover (35) has an oblique wall (351) inclined towards the front cover (33), and the second drainage port (355) is located on the oblique wall (351) and is located above a bottom wall (438) of the third channel (43) with a distance from the bottom wall (438) of the third channel (43); and/or
the second rear cover (35) has a water blocking rib (356) protruding from an outer surface facing away from the third channel (43), and the water blocking rib (356) obliquely extends rearward towards the first evaporator (2); and/or
the first drainage port (345) and the second drainage port (355) are both located above the first evaporator (2), and along a height direction of the first chamber (104), both the first drainage port (345) and the second drainage port (355) are overlapped with the first evaporator (2); and/or
the first drainage port (35) extends rearward beyond a rear surface of the second rear cover (35).

9. The refrigerator (100) according to anyone of the preceding claims, **characterized in that** the front cover (33) comprises an upper cover (331) and a lower cover (332) connected to a lower end of the upper cover (331), wherein the fan (5) is located between the upper cover (331) and the first rear cover (34), and the third channel (43) is at least partially located between the lower cover (332) and the second rear cover (35).

10. The refrigerator (100) according to claim 9, **characterized in that** the first air duct unit (3) comprises a first assembly unit (200) and a second assembly unit (300), the first assembly unit (200) comprises the upper cover (331), the first rear cover (34) and the fan (5), the second assembly unit (300) comprises the lower cover (332) and the second rear cover (35), and the first assembly unit (200) and the second assembly unit (300) are sequentially assembled to the main body (101).

11. The refrigerator (100) according to claim 10, **characterized in that**

the first assembly unit (200) is assembled to the main body (101) before the second assembly unit (300); and/or
the second assembly unit (300) covers a lower end of the first assembly unit (200); and/or a gap is reserved between the second rear cover (35) and the first assembly unit (200) in a height direction and/or a depth direction of the first chamber (102); and/or
an upper end of the second rear cover (35) is located in front of the lower end of the upper cover (331); and/or
the second rear cover (35) at least partially covers a fixing structure for fixing the first assembly unit (200) to the main body; and/or
the first assembly unit (200) is provided with a first portion (431) of the third channel (43), the second assembly unit (300) is provided with a second portion (432) of the third channel (43), and the upper cover (331) is attached to the lower cover (332) behind a front surface of the front cover (33) such that the first portion and the second portion are attached.

12. The refrigerator (100) according to anyone of the preceding claims 9 to 11, **characterized in that** the upper cover (331) and the lower cover (332) have a pair of connection walls (315) which are overlapped to each other and are in face-to-face contact, and the third channel (43) sequentially passes through the connection walls (315) of the upper cover (331) and the lower cover (332).

13. The refrigerator (100) according to anyone of the preceding claims 9 to 12, **characterized in that**

the upper cover (331) and the lower cover (332) are flush on a front surface at least at a part corresponding to the third channel (43); and/or
the first evaporator (2) is located behind the lower cover (332), and the lower cover (332) has a front surface exposed to the storage space (104), the front surface is planar on the section from an upper end of the lower cover to a lower portion, e corresponding to first evaporator (2), of the lower cover.

14. The refrigerator (100) according to anyone of the preceding claims 9 to 12, **characterized in that**

the third channel(43) comprises an introduction channel (433) integrally formed at a top of the lower cover (332) and disposed behind the front surface of the lower cover (332); and/or
the lower cover (332) comprises a connection groove (316) opened rearward, and the second rear cover (35) comprises a connection flange (357) inserted into the connection groove (316); and/or
the upper cover (331) comprises at least one second air outlet (311) and the lower cover (332) comprises at least one first air outlet (312) for supplying cold air from the first air duct unit (3) to the storage space (104).

15. The refrigerator (100) according to claim 14, **characterized in that**

the lower end of the upper cover (331) is located behind the introduction channel (433); and/or
the lower end of the upper cover (331) is located below an inlet of the introduction channel (433); and/or
the first air duct unit (3) comprises an air supply cavity (434) that is downstream of the introduction channel (433) and located between the second rear cover (35) and the lower cover (332), and the lower cover (332) has at least one first air outlet (312) at a position corresponding to the air supply cavity (434).

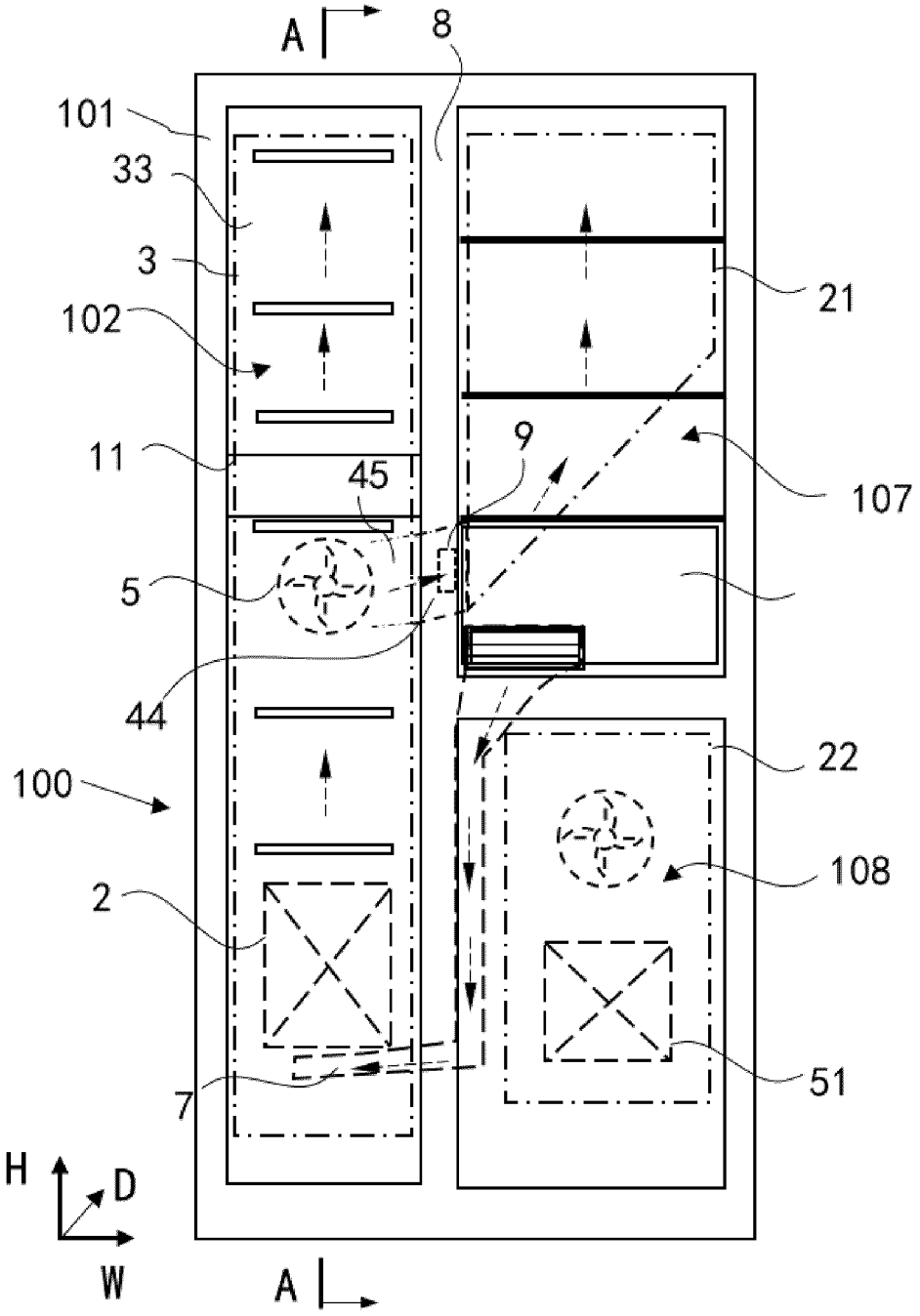

FIG. 1

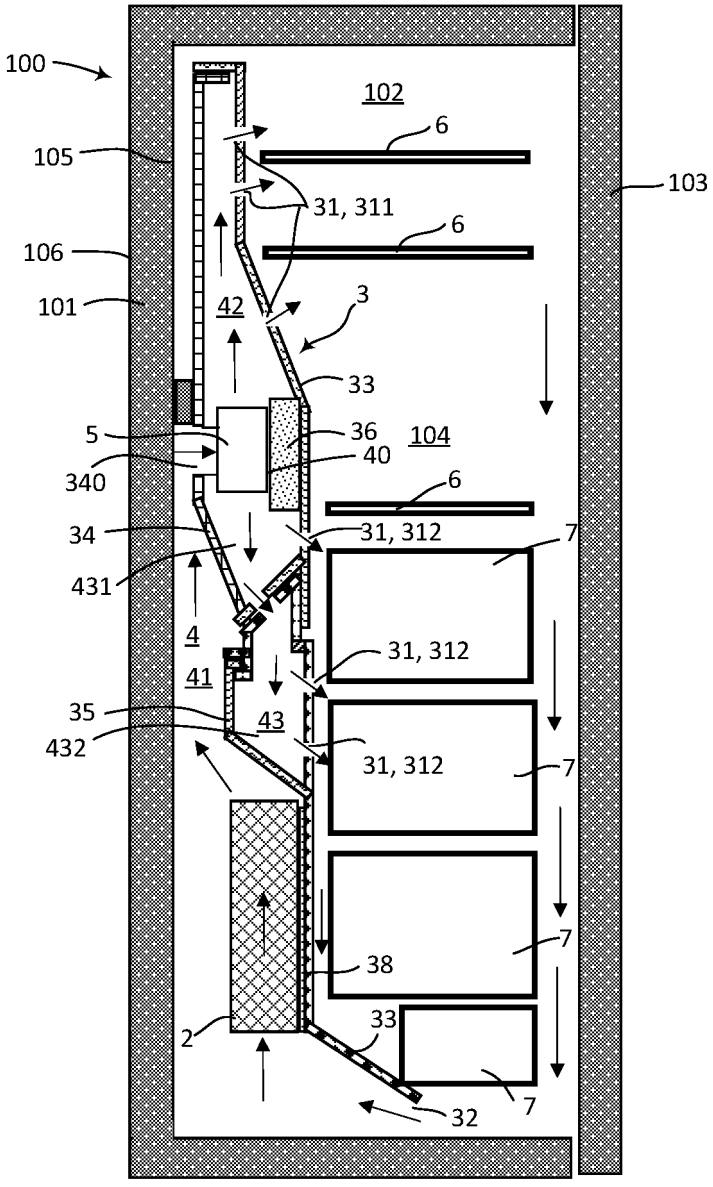
100
102
6
105
103
31, 311
6
106
101
42
3
33
5
36
104
40
340
6
34
31, 312
7
431
4
31, 312
41
35
43
432
31, 312
7
7
38
2
33
32
7

FIG. 2

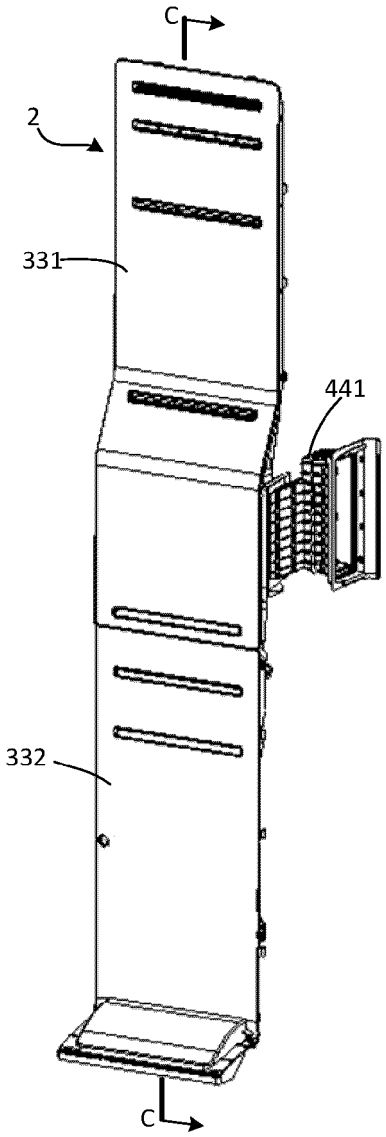

FIG. 3a

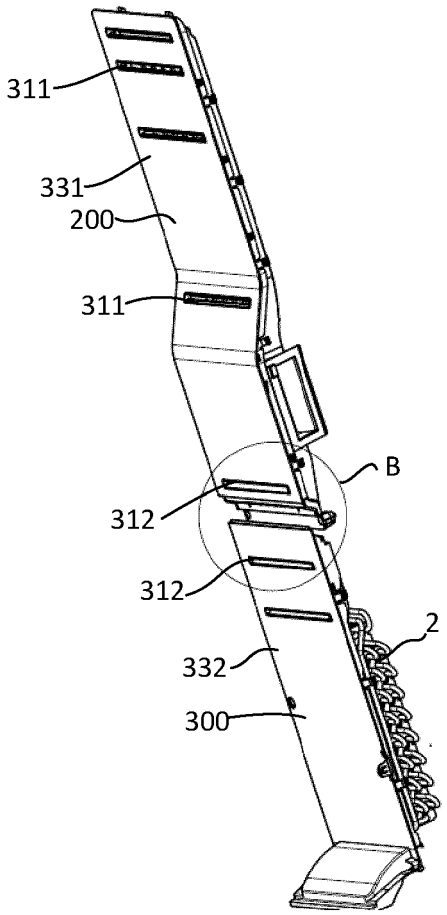

FIG. 3b

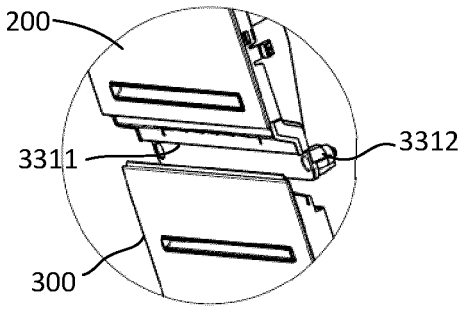

FIG. 3c

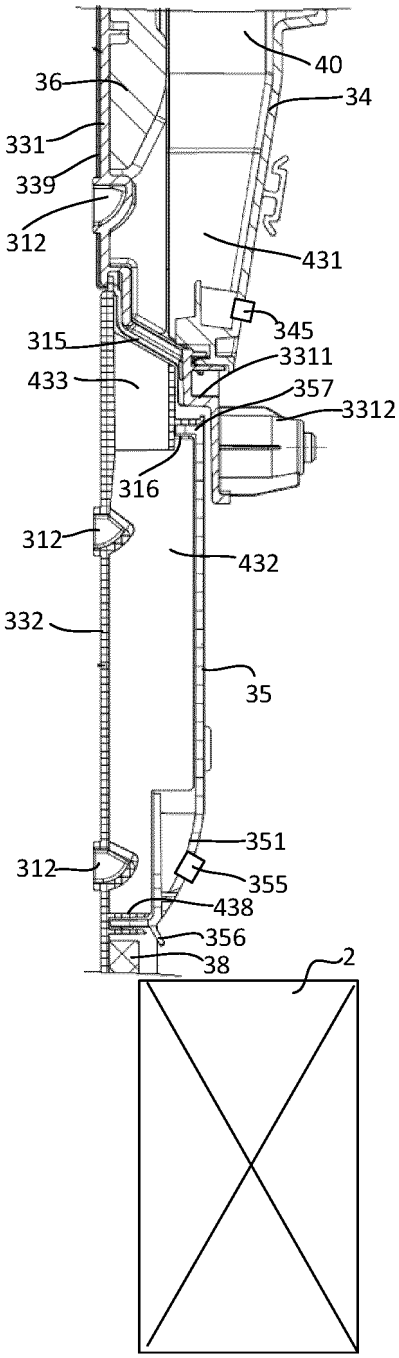
40
36
34
331
339
312
431
345
315
3311
433
357
3312
316
312
432
332
35
351
312
355
438
356
38
2

FIG. 4

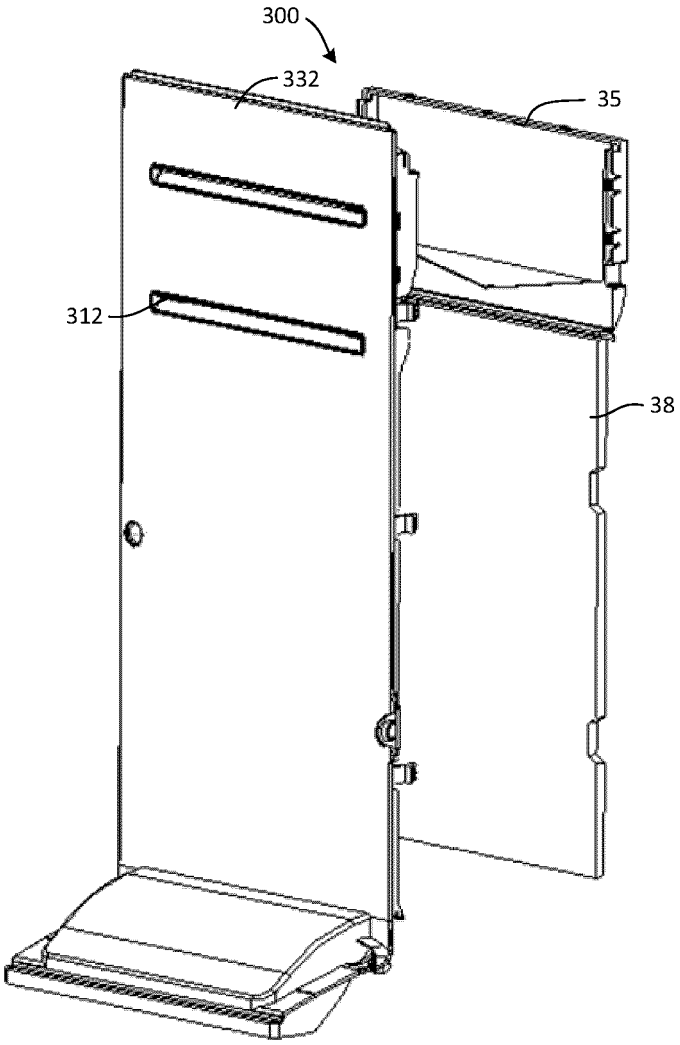

FIG. 5

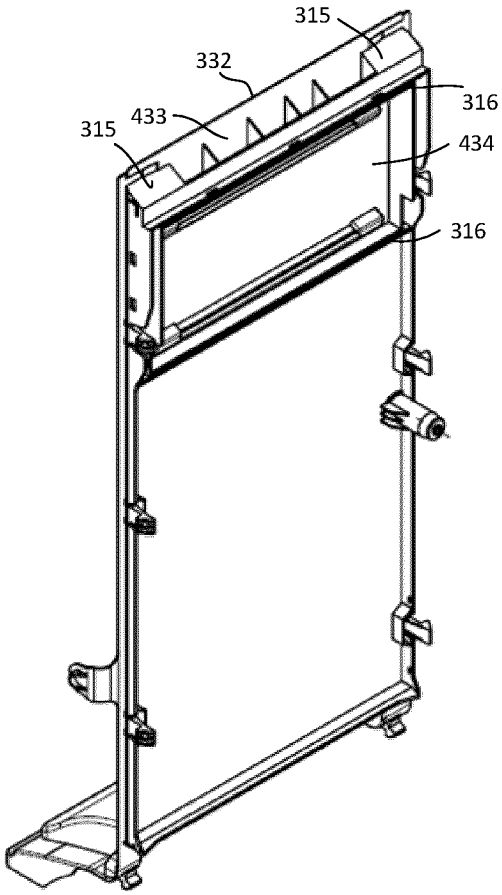

FIG. 6

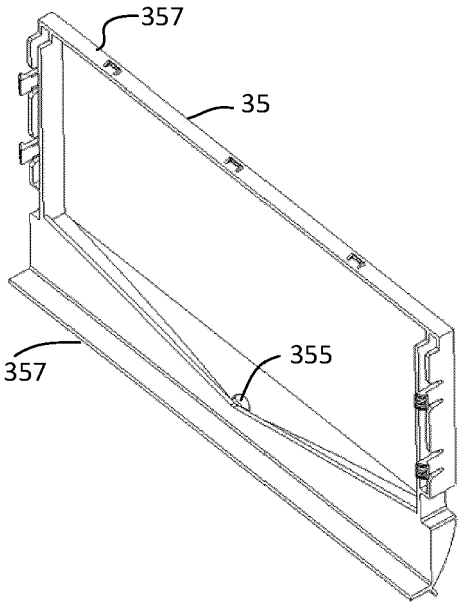

FIG. 7

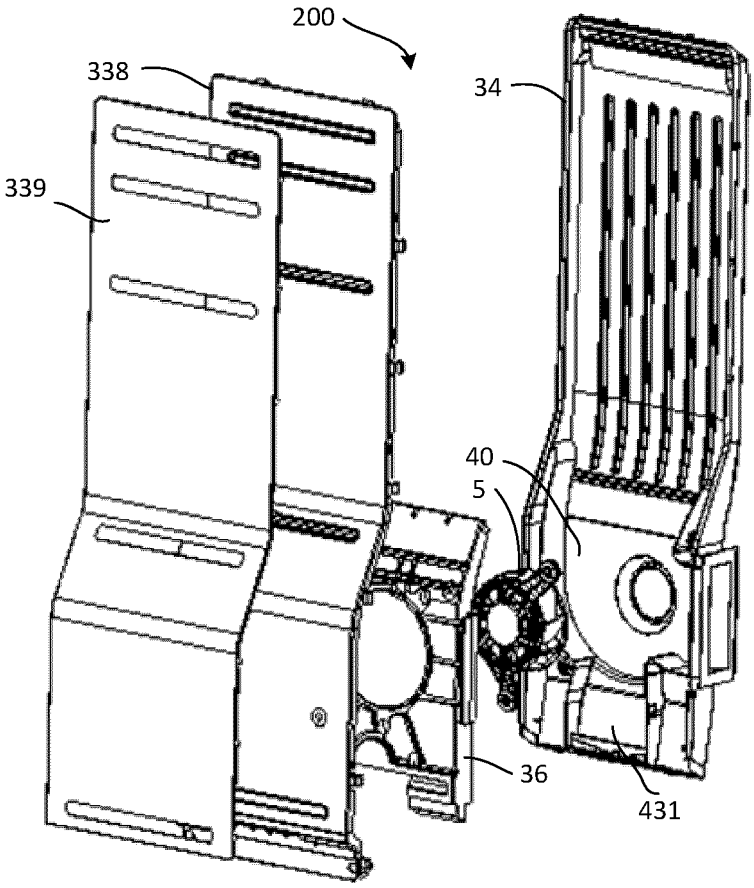

FIG. 8

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 24 20 7546

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	US 2020/386468 A1 (MATSUNO TOMOHIKO [JP] ET AL) 10 December 2020 (2020-12-10) * abstract; figures 1-6 *	1-6,9-15 7,8	INV. F25D17/08 F25D17/06
X	CN 216 868 922 U (LONG RAINBOW MEIZHI CO LTD) 1 July 2022 (2022-07-01) * abstract; figures 1-8 *	1-6,9-15	
Y A	US 2022/011038 A1 (YOON HAN BYEOL [KR]) 13 January 2022 (2022-01-13) * abstract; figure 12 *	7,8 1	
A	US 10 288 338 B2 (SAMSUNG ELECTRONICS CO LTD [KR]) 14 May 2019 (2019-05-14) * the whole document *	1-15	
A	US 2023/304722 A1 (KIM DONG HWI [KR] ET AL) 28 September 2023 (2023-09-28) * the whole document *	1-15	
A	EP 3 705 818 B1 (SAMSUNG ELECTRONICS CO LTD [KR]) 27 April 2022 (2022-04-27) * the whole document *	1-15	TECHNICAL FIELDS SEARCHED (IPC) F25D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	26 February 2025	Bejaoui, Amin

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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 24 20 7546

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

26-02-2025

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2020386468 A1	10-12-2020	EP 3963272 A1	09-03-2022
		US 2020386468 A1	10-12-2020
		WO 2020246829 A1	10-12-2020
CN 216868922 U	01-07-2022	NONE	
US 2022011038 A1	13-01-2022	AU 2021204088 A1	27-01-2022
		AU 2023203154 A1	15-06-2023
		EP 3936797 A1	12-01-2022
		KR 20220007292 A	18-01-2022
		US 2022011038 A1	13-01-2022
US 10288338 B2	14-05-2019	US 2017059224 A1	02-03-2017
		US 2019226746 A1	25-07-2019
		WO 2017039234 A1	09-03-2017
US 2023304722 A1	28-09-2023	AU 2023201033 A1	14-09-2023
		CN 116659156 A	29-08-2023
		EP 4235065 A1	30-08-2023
		KR 20230127781 A	01-09-2023
		KR 20240027658 A	04-03-2024
		US 2023304722 A1	28-09-2023
EP 3705818 B1	27-04-2022	CN 113544448 A	22-10-2021
		EP 3705818 A1	09-09-2020
		EP 4015949 A1	22-06-2022
		KR 20200107390 A	16-09-2020
		US 2020284493 A1	10-09-2020
		WO 2020180040 A1	10-09-2020

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82