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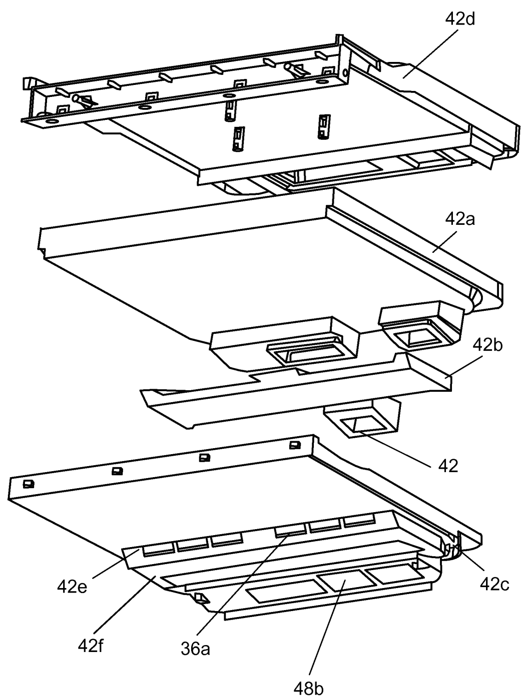
(54) **REFRIGERATOR**

(57) A refrigerator of the present invention includes a refrigerating room, a freezing room, a switching room, a cooler, a fan placed above the cooler, a duct system including a refrigerating room flow duct for allowing cooled air to flow into the refrigerating room, a switching room flow duct for allowing the cooled air to flow into the switching room, and a refrigerating room feedback duct for returning the cooled air discharged into the refrigerating room to the cooler; and a dividing wall for vertically separating between the refrigerating room and the switching room. A discharge duct portion for discharging the cooled air into the switching room is provided on a lower surface of the dividing wall, and connected to the switching room flow duct of the duct system which is installed on a rear surface of the switching room.

FIG. 5



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Description

TECHNICAL FIELD

[0001] The present invention relates to a refrigerator for cooling storage rooms having different temperature ranges by forcibly circulating cooled air generated by a cooler.

BACKGROUND ART

[0002] A conventional refrigerator is described with reference to Fig. 14. Fig. 14 is a longitudinal sectional view of a conventional refrigerator.

[0003] As shown in Fig. 14, refrigerator 1 includes heat insulation box 5 made by filling heat-insulating material 4 between inner box 2 and outer box 3. The refrigerator is sectioned into a plurality of storage rooms, which includes refrigerating room 6, switching room 7, and freezing room 8 from the top. Front opening portions of the storage rooms are closed by refrigerating room door 9, switching room door 10 and freezing room door 11, respectively.

[0004] Partition board 12 having a heat insulation effect partitions refrigerating room 6 and switching room 7 from each other. Similarly, partition board 13 having a heat insulation effect partitions switching room 7 and freezing room 8 from each other. In a deep part of partition board 13 (a rear surface side of inner box 2 of refrigerating room 6), duct 14 linked to freezing room 8 is installed.

[0005] Refrigerating room shelf 20 and refrigerating room case 21 for storing food are placed in refrigerating room 6. Furthermore, tube-on-sheet 15 (evaporator) is placed such that it is brought into contact with a wall surface on a rear surface of inner box 2 of refrigerating room 6, thereby cooling the inside of refrigerating room 6. Furthermore, cooler 16 is placed on a rear surface of freezing room 8, and fan 17 is placed above cooler 16.

[0006] Furthermore, switching room case 22 for storing food is placed in switching room 7, and duct 18 having damper 19 inside thereof is placed on a rear surface of switching room 7.

[0007] An operation of a conventional refrigerator having the above-mentioned configuration is described.

[0008] Firstly, in refrigerating room 6, tube-on-sheet 15 is provided such that it is brought into contact with a rear surface of inner box 2 of refrigerating room 6, and thereby the rear surface of inner box 2 of refrigerating room 6 becomes a cooling wall surface. Therefore, refrigerating room shelf 20 and refrigerating room case 21 inside refrigerating room 6 are naturally cooled.

[0009] On the other hand, freezing room 8 is forcibly cooled by forcibly circulating cooled air of cooler 16 provided in a cooling room by fan 17. The cooled air that has circulated in freezing room 8 is returned to cooler 16.

[0010] Similarly, switching room 7 is forcibly cooled by allowing a part of the cooled air to flow into duct 14 and circulating the cooled air into duct 18 provided at the rear surface of switching room 7 by fan17. The cooled air flowing into duct 18 passes through damper 19, is discharged into switching room case 22, and is subjected to heat exchange with the air in switching room case 22. Thereafter, the air is drawn into return duct 18 to cooler 16 provided at the rear surface, and then returned to cooler 16.

[0011] That is to say, in a conventional refrigerator, refrigerating room 6 and switching room 7 are divided from each other into up and down parts by partition board 12, so that a passage through which the cooled air is circulated is not formed. Therefore, refrigerating room 6 is cooled by tube-on-sheet 15 at a predetermined temperature. On the other hand, in switching room 7, a temperature in switching room 7 is kept at a predetermined temperature by circulating the cooled air cooled by cooler 16 in switching room 7 by fan 17 and by controlling the amount of the circulated cooled air by damper 19. Thus, food in switching room case 22 can be kept at a predetermined temperature, and thereby freshness of the food can be kept (see, for example, Patent Literature 1).

[0012] However, with the above-mentioned conventional configuration, since an air-flow path for forcibly circulating cooled air is not made in refrigerating room 6, a temperature difference tends to be increased between a near place and a distant place with respect to tube-on-sheet 15 in refrigerating room 6. Furthermore, in order to uniformly cool the inside switching room 7, a plurality of passages are provided inside duct 18 such that the air is divided into many branches. That is to say, duct 18 must be provided with a plurality of discharge ports communicating with discharge ports provided on a top plate of switching room 7 for discharging the cooled air, thus making the structure of duct 18 complicated. As a result, since air-flow path resistance in duct 18 of the cooled air introduced from cooler 16 by fan 17 is increased, a predetermined amount of cooled air cannot be discharged to switching room 7, and therefore the temperature of switching room 7 cannot be kept at a predetermined temperature. Therefore, in order to reduce the air-flow path resistance of duct 18, an area of the air-flow path needs to be increased. However, when the area of the air-flow path is increased, a depth dimension of switching room 7 is reduced, and an inner volume of refrigerator 1 is accordingly reduced.

Patent Literature

[0013]

PTL 1: Japanese Patent Application Unexamined Publication 2005-195293

SUMMARY OF THE INVENTION

[0014] A refrigerator of the present invention includes a refrigerating room provided in an upper part; a freezing room provided in a lower part; a switching room which is provided between the refrigerating room and the freezing room and configured such that temperature ranges are changed; a cooler provided in a rearward part of the freezing room for generating cooled air; a fan which is placed above the cooler for delivering the cooled air generated by the cooler into the refrigerating room, the freezing room and the switching room; a duct system including a refrigerating room flow duct for allowing the cooled air to flow into the refrigerating room, a switching room flow duct for allowing the cooled air to flow into the switching room, and a refrigerating room feedback duct for returning the cooled air discharged into the refrigerating room to the cooler; and a dividing wall for vertically separating between the refrigerating room and the switching room. A discharge duct portion for discharging the cooled air into the switching room is provided on a lower surface of the dividing wall, and connected to the switching room flow duct of the duct system which is installed on a rear surface of the switching room.

[0015] Thus, an air-flow path structure in the duct system on the rear surface of the switching room is simplified, and the cooled air can be dispersed uniformly, thus enabling the inside of each storage room linked to the air-flow path to be cooled at a predetermined temperature more reliably.

BRIEF DESCRIPTION OF DRAWINGS

[0016]

Fig. 1 is a longitudinal sectional view of a refrigerator in accordance with an exemplary embodiment of the present invention.
Fig. 2 is a front view of the refrigerator in accordance with the exemplary embodiment of the present invention.
Fig. 3 is a schematic view for illustrating an air-flow path in the refrigerator in accordance with the exemplary embodiment of the present invention.
Fig. 4 is a perspective view of a dividing wall of the refrigerator in accordance with the exemplary embodiment of the present invention.
Fig. 5 is an exploded perspective view of the dividing wall of the refrigerator in accordance with the exemplary embodiment of the present invention.
Fig. 6 is a perspective view of a duct system of the refrigerator in accordance with the exemplary embodiment of the present invention.
Fig. 7 is an exploded perspective view of a duct system of the refrigerator in accordance with the exemplary embodiment of the present invention.
Fig. 8 is an exploded perspective view of a duct system of the refrigerator in accordance with the exemplary embodiment of the present invention.
Fig. 9 is an exploded perspective view of a duct system of the refrigerator in accordance with the exemplary embodiment of the present invention.
Fig. 10 is a schematic view of a duct system of the refrigerator in accordance with the exemplary embodiment of the present invention.
Fig. 11 is a schematic perspective view showing a first dividing wall and a first cover of the refrigerator in accordance with the exemplary embodiment of the present invention.
Fig. 12 is a perspective view showing a main part of the first cover of the refrigerator in accordance with the exemplary embodiment of the present invention.
Fig. 13 is a view for illustrating a main part of a vicinity of a cooling room of the refrigerator in accordance with the exemplary embodiment of the present invention.
Fig. 14 is a sectional view of a conventional refrigerator.

DESCRIPTION OF EMBODIMENTS

[0017] Hereinafter, exemplary embodiments of the present invention are described with reference to drawings, and the same reference numerals are given to the same configurations as to those of a conventional example or previously described exemplary embodiments, and the detailed description thereof is omitted. Note here that the present invention is not limited by the exemplary embodiments. Furthermore, in the exemplary embodiments, a door side of a refrigerator is referred to as a forward part, a front side and a front surface, and an opposite side to the door side is referred to as a rearward part, a rear side, a back surface, and a rear surface.

(EXEMPLARY EMBODIMENT)

[0018] Hereinafter, an entire configuration of refrigerator 30 is described with reference to Figs. 1 and 2.

[0019] Fig. 1 is a longitudinal sectional view of a refrigerator in accordance with an exemplary embodiment of the present invention. Fig. 2 is a front view of the refrigerator in accordance with the exemplary embodiment of the present invention.

[0020] As shown in Fig. 1, heat insulation box 31 of refrigerator 30 includes outer box 32 mainly made of a steel plate and inner box 33 formed by molding resin such as ABS, and foaming heat-insulating material 34 such as hard urethane foam is filled between outer box 32 and inner box 33, thereby giving heat insulation from the surrounding.

[0021] Heat insulation box 31 is sectioned into a plurality of storage rooms. For example, refrigerating room 35 is placed in a top portion of heat insulation box 31, switching room 36 is placed below refrigerating room 35, and freezing room 37 is placed in a bottom portion. Switching room 36 and freezing room 37 are divided from each other into up and down parts by first dividing wall 41. Refrigerating room 35 and switching room 36 are divided from each other into up and down parts by dividing wall 42. At a front end (switching room door 39 side) of dividing wall 42, partition plate 80 is provided. Partition plate 80 is formed of a member other than dividing wall 42 and includes a synthetic resin member, for example, a heat insulating member such as foam polystyrene inside thereof. In partition plate 80, a dew-prevention pipe (not shown) is embedded such that dew condensation does not occur on the surface of partition plate 80.

[0022] Refrigerating room door 38 is provided at a front surface opening portion of refrigerating room 35, switching room door 39 is provided at a front surface opening portion of switching room 36, and freezing room door 40 is provided at a front surface opening portion of freezing room 37, which are capable of being opened and closed.

[0023] A temperature of refrigerating room 35 can be set at usually 1°C to 5°C. The lower limit of the temperature can be set at a temperature enough to prevent freezing in order to carry out refrigeration storage. Switching room 36 is configured such that temperatures can be changed from a freezing temperature range to a refrigerating temperature range, and can be set at -18°C to 4°C at an interval of 1°C. Freezing room 37 is usually set at a freezing temperature range from -22°C to -15°C in order to carry out freezing storage. Furthermore, it can be set at lower temperatures, for example, -30°C or -25°C, for enabling a freezing storage state to be improved. Note here that when switching room 36 is set at a refrigerating temperature range, an aluminum foil heater (not shown) provided on the upper surface of first dividing wall 41 is electrified so as to set the temperature of switching room 36 at a predetermined temperature.

[0024] The inside of the refrigerating room 35 is divided into a plurality of up and down parts by a plurality of shelves 61. Vegetable room 64 is provided in the lower part of refrigerating room 35. Vegetable room 64 includes open/close lid 64a formed on the front surface, and vegetable case 64b capable of being drawn in the front-rear direction. Refrigerating room duct 81 is provided at the rear surface of vegetable room 64. Note here that in the above mention, as vegetable room 64, an example having an opening portion on the front surface is described. However, a configuration having an opening portion in the upper surface, and housing a box case capable of being tightly closed by an upper lid provided on the opening portion may be employed.

[0025] Furthermore, the width of vegetable room 64 is usually configured in a dimension smaller than the full width dimension of refrigerating room 35, but the configuration is not necessarily limited to this configuration. That is to say, the width of vegetable room 64 may be conformed to the full width dimension of the inside of refrigerating room 35.

[0026] Switching room 36 is provided with upper drawer case 69 and lower drawer case 70 in such a manner that they can move in the front-rear direction. Upper drawer case 69 includes upper surface opening portion 69a at the upper surface, bottom portion 69b at the bottom surface, and rear wall 69c at the rear surface. Similarly, lower drawer case 70 includes upper surface opening portion 70a at an upper surface, bottom portion 70b at a bottom surface, and rear wall 70c at a rear surface.

[0027] Duct device 49 for allowing cooled air to flow into refrigerating room 35 and switching room 36 is provided at the rear surface of switching room 36. Duct device 49 includes damper device 50 for adjusting an amount of the cooled air flowing into refrigerating room 35 and switching room 36. Furthermore, control board 66 for controlling entire refrigerator 30 is placed on outer box 32 at a rear surface side of switching room 36.

[0028] Cooling room 43 for generating cooled air is provided at a rear surface side of freezing room 37, and cooler 44 is disposed inside of cooling room 43. Cooling room 43 is thermally insulated by first cover 45 with which cooling room 43 is divided from freezing room 37. Fan 46 for forcibly allowing the generated cooled air to flow is placed above cooler 44, and defrosting heater 47 for defrosting frost or ice attached on cooler 44 is provided below cooler 44. Specifically, defrosting heater 47 is formed of a glass tube heater made of glass. In particular, when a refrigerant of cooler 44 is hydrocarbon refrigerant gas, a double glass tube heater is employed in which double glass tubes are provided in order to prevent explosion.

[0029] As shown in Fig. 2, water supply tank 53 of an automatic ice making apparatus is provided at the side (for example, left side) of vegetable room 64 in the lower part of refrigerating room 35, and ice tray 54 is provided in the upper part of freezing room 37. Water supply tank 53 stores water for automatic ice making, and is detachably housed. Water supply pipe 55 connected to water supply tank 53 is extended from refrigerating room 35 to freezing room 37 through switching room 36. Water in water supply tank 53 is pumped up by a motor (not shown) and introduced into water supply pipe 55.

[0030] Hereinafter, arrangement of each duct and an air-flow path of refrigerator 30 in accordance with the exemplary embodiment of the present invention are described with reference to Figs. 2 and 3. Fig. 3 is a schematic view for illustrating an air-flow path in the refrigerator in accordance with the exemplary embodiment of the present invention.

[0031] As shown in Figs. 2 and 3, discharge port 35a for discharging cooled air to refrigerating room 35 and refrigerating room return port 35b for returning the cooled air in refrigerating room 35 to cooler 44 are formed at a rear surface of refrigerating room 35.

[0032] Upper discharge port 36a for discharging the cooled air to switching room 36 is placed in the portion upper than upper surface opening portion 69a (see Fig. 1) of upper drawer case 69 at a rear surface of switching room 36. Furthermore, lower discharge port 36b, which is opened in duct system 49 and which discharges cooled air to switching room 36, is formed in a portion upper than upper surface opening portion 70a of lower drawer case 70, and between upper surface opening portion 70a and bottom portion 69b (see Fig. 1).

[0033] Note here that lower discharge port 36b may be provided in a position facing rear surface wall 69c by inclining rear surface wall 69c of upper drawer case 69 (see Fig. 1) forward with respect to lower drawer case 70. Thus, rear surface wall 69c of upper drawer case 69 works as a guide plate of the cooled air discharged from lower discharge port 36b, and the cooled air can be efficiently introduced into lower drawer case 70.

[0034] Furthermore, at the rear surface of switching room 36, switching room return port 36c for returning the cooled air in lower drawer case 70 in switching room 36 to cooler 44 is formed between upper surface opening portion 70a and bottom portion 70b in lower drawer case 70.

[0035] Then, refrigerating room temperature sensor 67 for detecting a temperature of refrigerating room 35 is installed in refrigerating room return port 35b. Switching room temperature sensor 68 for detecting a temperature of switching room 36 is installed in switching room return port 36c.

[0036] As shown in Fig. 3, refrigerating room flow duct 48a for allowing cooled air to flow into refrigerating room 35 and switching room flow duct 48b for allowing cooled air to flow into switching room 36 are provided laterally in the right and left direction in flow duct 48 in duct system 49, and they communicate with each other in the vertical direction. Refrigerating room flow duct 48a is formed at the rear surface of switching room 36, communicates with refrigerating room duct 81 in the vertical direction, and is provided with refrigerating room discharge ports 62 corresponding to shelves 61 of refrigerating room 35.

[0037] Furthermore, damper device 50 for adjusting an amount of the cooled air flowing into refrigerating room 35 and switching room 36 is provided in duct system 49. Specifically, refrigerating room damper 50a is provided in refrigerating room flow duct 48a, and switching room damper 50b is provided in switching room flow duct 48b, respectively, and refrigerating room damper 50a and switching room damper 50b control the amount of the passing cooled air separately.

[0038] At this time, it is preferable that duct system 49 is provided at the rear surface of switching room 36 such that the size thereof is formed in the same area of the rear surface of switching room 36. Refrigerating room flow duct 48a and switching room flow duct 48b are placed in the vicinity of the middle portion in the right and left width direction of switching room 36, that is, the width direction of duct system 49. Refrigerating room feedback duct 51a and switching room feedback duct 51b are provided at one side of duct system 49 with respect to refrigerating room flow duct 48a and switching room flow duct 48b as a center.

[0039] Furthermore, refrigerating room feedback duct 51a is placed laterally with respect to flow duct 48. Thus, in duct system 49, three ducts, that is, refrigerating room flow duct 48a, switching room flow duct 48b and refrigerating room feedback duct 51a communicate with each other in the vertical direction and they are placed laterally. At this time, as described in Fig. 7, switching room feedback duct 51b is placed adjacent to refrigerating room feedback duct 51a, and switching room feedback duct 51b is placed in the forward part with respect to refrigerating room feedback duct 51a in the front-rear position relation with respect to the direction of the door.

[0040] Refrigerating room feedback duct 51a and switching room feedback duct 51b are provided such that they pass through freezing room 37 that is a region whose temperature range is lower than that of switching room 36 and refrigerating room 35, and communicate with the lower side of cooler 44. Thus, refrigerating room feedback duct 51a in which the temperature of the returned cooled air is higher than the temperature range of freezing room 37 is placed in a distant position from freezing room 37. As a result, it is possible to reduce a possibility of dew condensation generated by cooling in freezing room 7 in refrigerating room feedback duct 51a, and freezing in refrigerating room feedback duct 51a. That is to say, switching room feedback duct 51b of switching room 36 which can be set to temperatures ranging from a temperature near a temperature of freezing room 37 to a temperature near a temperature of the refrigerating room is placed in the forward part (switching room door 39 side) of refrigerating room feedback duct 51a, thereby enabling dew condensation or freezing in refrigerating room feedback duct 51a to be reduced.

[0041] Hereinafter, a configuration of dividing wall 42 that divides between refrigerating room 35 and switching room 36 is described with reference to Figs. 4 and 5. Fig. 4 is a perspective view of a dividing wall of the refrigerator in accordance with the exemplary embodiment of the present invention. Fig. 5 is an exploded perspective view of the dividing wall of the refrigerator in accordance with the exemplary embodiment of the present invention.

[0042] As shown in Figs. 4 and 5, for example, dividing wall 42 made of a synthetic resin material and dividing refrigerating room 35 from switching room 36 includes upper surface cover member 42d, heat insulation plate 42a, discharge duct plate 42b, and lower surface cover member 42c.

[0043] The upper surface of heat insulation plate 42a is covered with upper surface cover member 42d, discharge duct plate 42b formed on the lower surface of heat insulation plate 42a is provided as a separated body from heat insulation plate 42a, forming a guide wall to switching room 36. The lower surface side of heat insulation plate 42a and discharge duct plate 42b is covered with lower surface cover member 42c formed on the lower surface of discharge duct plate 42b. Discharge duct portion 42f is formed, for example, integrally at the lower surface of lower surface cover member 42c. Discharge duct portion 42f is connected to switching room flow duct 48b of duct system 49 installed at the rear surface of switching room 36 and discharges cooled air to switching room 36.

[0044] With the above-mentioned configuration, a simple air-flow path structure for allowing cooled air to flow from switching room flow duct 48b to discharge duct portion 42f in duct system 49 at the rear surface of switching room 36 is configured, and uniformly dispersing the cooled air into switching room 36, and thereby the inside of switching room 36 can be set at a predetermined temperature more reliably.

[0045] Furthermore, discharge duct portion 42f is formed by stepped portion 42e in such a manner that it is placed on the upper surface opening portion 69a (see Fig. 1) of upper drawer case 69 of switching room 36, and stepped portion 42e is provided with upper discharge port 36a that discharges cooled air.

[0046] Note here that one upper discharge port 36a may be provided, but it is preferable that a plurality of discharge ports are formed. For example, a plurality of upper discharge ports 36a provided in discharge duct portion 42f of lower surface cover member 42c are formed they have a smaller opening area of opening 42g provided in discharge duct plate 42b. Thus, upper discharge ports 36a can be formed such that it is possible to prevent foreign matters from entering into upper discharge port 36a, and the discharged cooled air can be discharged uniformly inside upper drawer case 69.

[0047] Furthermore, stepped portion 42e may not be formed on the lower surface of lower surface cover member 42c, and, for example, upper discharge port 36a may be provided on the same plane as lower surface cover member 42c. This configuration improves the volume efficiency of upper drawer case 69 of switching room 36.

[0048] Furthermore, by integrally forming dividing wall 42 and discharge duct portion 42f with a resin member, when the cooled air discharged from cooler 44 is branched into refrigerating room 35 and switching room 36, the cooled air can be introduced into each duct part without leakage to the outside in midstream. As a result, the cooled air can be branched into refrigerating room 35 and switching room 36 efficiently while the increase of the air-flow path resistance is suppressed, thus achieving a refrigerator that is excellent in energy saving performance.

[0049] Hereinafter, a method for fixing partition plate 80, first dividing wall 41 and dividing wall 42 to heat insulation box 31 is described.

[0050] Note here that partition plate 80 is placed in the right and left width direction of inner box 33 before foaming heat-insulating material 34 is filled in heat insulation box 31, and then foaming heat-insulating material 34 is filled to be fixed. At this time, by bringing a gasket of refrigerating room door 38 and a gasket of switching room door 39 into partition plate 80, thus preventing the cooled air inside the room from leaking to the outside.

[0051] Furthermore, dividing wall 42 installed at the rearward part to partition plate 80 is installed at the rearward part of partition plate 80 before foaming heat-insulating material 34 is filled in heat insulation box 31, and foaming heat-insulating material 34 is filled and fixed in heat insulation box 31. Similarly, first dividing wall 41 is also fixed by filling foaming heat-insulating material 34 into heat insulation box 31.

[0052] Then, duct system 49 is placed at the rear surface of switching room 36 between first dividing wall 41 and dividing wall 42, discharge duct portion 42f of first dividing wall 41 and duct system 49 are connected to each other. This simplifies a configuration of the duct system of switching room 36, reduces variation of installation of the duct system , and facilitates assembly thereof.

[0053] Hereinafter, a configuration of duct system 49 connected to the above-mentioned discharge duct portion 42f is described with reference to Figs. 6 to 10.

[0054] Fig. 6 is a perspective view of a duct system of the refrigerator in accordance with the exemplary embodiment of the present invention.

[0055] As shown in Fig. 6, in duct system 49, refrigerating room flow duct 48a for allowing cooled air to flow into refrigerating room 35, switching room flow duct 48b for allowing cooled air to flow into switching room 36, and refrigerating room feedback duct 51a for returned cooled air from refrigerating room 35 are aligned independently laterally.

[0056] With the above-mentioned configuration, it is not necessary to provide a plurality of discharge ports in each duct, and air-flow path resistance is not increased in each duct. Therefore, storage rooms can be cooled indirectly and efficiently by one cooler 44. Furthermore, since the air-flow path resistance is not increased, a cross sectional area of the air-flow path needs not be increased. Furthermore, since the ducts are aligned laterally, the depth dimension of switching room 36 is increased and a storage volume can be increased.

[0057] Thus, it is possible to provide refrigerator 30 having duct system 49 for allowing cooled air to flow into refrigerating room 35 and securing a storage volume.

[0058] As shown in Fig. 6, at the right side of duct system 49, concave portion 56 for receiving water supply pipe 55 is provided. On the wall surface of the duct in refrigerating room feedback duct 51a formed in the lower part at the left side of duct system 49, aluminum foil heater 57 is provided. Aluminum foil heater 57 controls a temperature to a predetermined temperature by electrifying aluminum foil heater 57 when switching room 36 is set to a freezing temperature range that is lower than the refrigeration temperature range, or when the outside air temperature is lower. Furthermore, cooled air containing moisture, which passes through refrigerating room feedback duct 51a and which has been circulated in refrigerating room 35, has a temperature higher than the cooled air introduced by switching room feedback duct 51b. Therefore, the inside of refrigerating room feedback duct 51a is cooled, and the cooled air containing moisture which has been circulated in refrigerating room 35 may cause dew condensation or freezing. Then, by electrifying aluminum foil heater 57, generation of freezing or dew condensation inside refrigerating room feedback duct 51a is prevented.

[0059] Fig. 7 is an exploded perspective view of a duct system of the refrigerator in accordance with the exemplary embodiment of the present invention. The left side of Fig. 7 shows a front surface, that is, a door side, and the right side shows a rear surface, that is, a side opposite to the door side.

[0060] As shown in Fig. 7, duct system 49 includes upper duct member 49a and lower duct member 49b made of, for example, foam polystyrene, and duct panel 49c made of resin, which covers the front surface of upper duct member 49a and lower duct member 49b. The lower surface portion of upper duct member 49a and the upper surface portion of lower duct member 49b are connected to each other in the vertical direction. At this time, the connection portion of upper duct member 49a and lower duct member 49b is sealed, and the front surface is covered with duct panel 49c. Refrigerating room flow duct 48a and switching room flow duct 48b shown in, for example, Fig. 6, which penetrate through duct system 49, form a duct wall surface by connecting upper duct member 49a and lower duct member 49b.

[0061] Damper device 50 is included in lower duct member 49b as described hereinafter with reference to Fig. 8.

[0062] Fig. 8 is an exploded perspective view of a duct system of the refrigerator in accordance with the exemplary embodiment of the present invention. In Fig. 8, a front side shows a rear surface, that is, a side opposite to the door side, and a rear side shows a front surface, that is, a door side.

[0063] As shown in Fig. 8, damper device frame 50c of damper device 50 is embedded such that it is placed in a lower part than seal connection portion 49d of lower duct member 49b as a connection surface with upper duct member 49a.

[0064] Seal connection portion 49d of lower duct member 49b is a connection surface with respect to upper duct member 49a of duct system 49. Seal connection portion 49d is positioned in the lower part than upper surface opening portion 70a of lower drawer case 70 and in a position located in the upper side than bottom portion 70b and corresponding to rear surface wall 70c of lower drawer case 70 as shown in, for example, Fig. 1.

[0065] Fig. 9 is an exploded perspective view of a duct system of the refrigerator in accordance with the exemplary embodiment of the present invention. In Fig. 9, the left side shows a rear surface, that is, a side opposite to the door side, and the right side shows a front surface, that is, a door side.

[0066] As shown in Fig. 9, linking portions between members of refrigerating room flow duct 48a, switching room flow duct 48b and refrigerating room feedback duct 51a and members of first dividing wall 41 and dividing wall 42 shown in Fig. 1 are sealed with seal member 79 at the periphery of the opening portion of each duct. This prevents generation of gaps in the linking portions between members of refrigerating room flow duct 48a, switching room flow duct 48b, and refrigerating room feedback duct 51a and first dividing wall 41 and dividing wall 42.

[0067] Note here that in this exemplary embodiment, one seal member 79 having a length of about the periphery of each duct opening portion is attached along the duct opening portion, but an integrated seal member having openings is attached so that openings are provided in the positions of each duct opening portion. Furthermore, it is desirable that a seal surface to which seal member 79 is attached is a plane without having stepped portions. This enables a seal member to be attached without gap therebetween, so that cooled air can be prevented from leaking more reliably.

[0068] Furthermore, as shown in Fig. 9, for example, wiring housing portion 52 and concave portion 56 are provided at the opposite side to refrigerating room feedback duct 51a of lower duct member 49b in the front-rear direction with respect to the door side.

[0069] Hereinafter, wiring housing portion 52 and concave portion 56 are described.

[0070] For example, when switching room 36 is set at a freezing temperature range, water in water supply pipe 55 may be frozen. Then, freezing may be prevented by providing, for example, a heater (not shown) for preventing freezing in the outer periphery of water supply pipe 55 and electrifying thereof. Furthermore, water supply pipe 55 may be placed between inner box 33 of heat insulation box 31 and duct system 49, and heat insulation may be carried out by concave portion 56 formed on the rear surface of duct system 49. At this time, wiring housing portion 52 may be provided on the rear surface of duct system 49 so as to house wiring and a connector of damper device 50.

[0071] That is to say, when concave portion 56 and wiring housing portion 52 are formed, a housing space in the front-rear direction necessary to water supply pipe 55 and wiring housing portion 52 can be reduced, thereby increasing the inner volume of switching room 36. Furthermore, concave portion 56 and wiring housing portion 52 are provided at the opposite side to refrigerating room feedback duct 51a of duct system 49, thereby preventing the heat-insulating property from being reduced.

[0072] Fig. 10 is a schematic view of a duct system of the refrigerator in accordance with the exemplary embodiment of the present invention. Fig. 10 shows a view of the duct system of the refrigerator seen from a front surface that is a door side toward the rear surface that is an opposite side to the door side.

[0073] As shown in Fig. 10, wiring housing portion 52 is made in stepped portion 74 formed between upper duct member 49a or lower duct member 49b and duct panel 49c. Wiring housing portion 52 communicates with upper duct member 49a through seal connection portion 49d of lower duct member 49b. Wiring housing portion 52 is formed in upper duct member 49a and lower duct member 49b in the forward part with respect to concave portion 56 that houses water supply pipe 55. The outer peripheries of upper duct member 49a and lower duct member 49b have a structure in which sectional areas of upper duct member 49a and lower duct member 49b are increased in the duct member toward seal connection portion 49d. Specifically, the side surface portion of upper duct member 49a is formed in an inclination shape (taper) that widens from the upper surface portion toward the lower surface portion. Furthermore, the side surface portion of lower duct member 49b is formed in an inclination shape (taper) that widens from the lower surface portion toward the upper surface portion. Therefore, a seal area of seal connection portion 49d is increased, so that the sealing property of seal connection portion 49d is improved and leakage of cooled air to the outside can be further reduced.

[0074] Furthermore, since stepped portion 74 can be easily secured between seal connection portion 49d and duct panel 49c, for example, a concave portion formed over upper duct member 49a and lower duct member 49b formed of, for example, a styrol material from the outside to the inside is made to be wiring housing portion 52. Thus, a void space of duct system 49 can be efficiently used as wiring housing portion 52. As a result, it is possible to prevent water from entering into the wiring, and to improve the efficient inner volume of switching room 36.

[0075] As described above, according to this exemplary embodiment, refrigerating room flow duct 48a and switching room flow duct 48b are provided in the vicinity of the middle of the width direction of duct system 49, and refrigerating room feedback duct 51a and switching room feedback duct 51b are placed at one side of duct system 49 in the front-rear direction with respect to heat insulation box 31. Furthermore, at the other side of duct system 49, water supply pipe 55 connected to water supply tank 53 and wiring housing portion 52 are placed. Thus, a distance between duct system 49 and inner box 33 as a void space in the rearward part of switching room 36 is reduced, and thereby a depth dimension of switching room 36 can be secured.

[0076] Furthermore, according to this exemplary embodiment, refrigerating room flow duct 48a can form each duct portion from the inside of duct system 49 of switching room 36 to branch path 63 in refrigerating room 35 in substantially the vertical direction in a state in which each duct does not meander. Therefore, it is possible to reduce air-flow path resistance in each duct portion and to supply a sufficient air volume of cooled air to refrigerating room 35.

[0077] Next, configurations of first dividing wall 41 and first cover 45 are described with reference to Figs. 11 and 12.

[0078] Fig. 11 is a schematic perspective view showing first dividing wall 41 and first cover 45 of the refrigerator in accordance with the exemplary embodiment of the present invention.

[0079] As shown in Fig. 11, in first dividing wall 41 connected to a lower surface portion of the duct system , refrigerating room feedback communication port 58 communicating with refrigerating room feedback duct 51a, and switching room feedback communication port 59 communicating with switching room feedback duct 51b are provided. Switching room feedback communication port 59 is placed at the door side, and refrigerating room feedback communication port 58 is placed at an opposite side to the door side, and they communicate with cooling room 43 through opening portions provided in refrigerating room feedback communication port 58 and switching room feedback communication port 59.

[0080] First dividing wall 41 includes first dividing wall member 41a formed of foam polystyrene, first upper surface dividing cover 41b for covering the upper surface of first dividing wall member 41a, and first lower surface dividing cover 41c for covering the lower surface of first dividing wall member 41a. Then, by filling urethane between first upper surface dividing cover 41b and first lower surface dividing cover 41c, first dividing wall 41 is fixed to heat insulation box 31. First dividing wall 41 is constructed in a predetermined position before urethane is filled in heat insulation box 31, and furthermore, urethane to be filled in heat insulation box 31 is used also for fixing first dividing wall 41, thereby enhancing the heat-insulating performance of refrigerator 30.

[0081] First cover 45 includes panel 45a made of resin, and second cover 45b formed of a heat-insulating material such as a styrol material and provided with a holding portion of fan 46 and cooled air passage. At the rear surface of panel 45a, cooled air discharge port 72 for feeding cooled air to refrigerating room 35 and switching room 36 communicates with first dividing wall 41 by sealing, and branch duct 76 that branches such that a refrigerating room returned cooled air and a switching room returned cooled air are not joined with each other.

[0082] Branch duct 76 provided in an upstream portion of cooled air return passage 71 prevents the cooled air that has passed through refrigerating room feedback duct 51a from flowing backward to switching room feedback communication port 59 and flowing backward from switching room return port 36c of duct system 49 to the inside of switching room 36 instead of flowing downward. That is to say, branch duct 76 works as a backflow prevention duct, and prevents the refrigerating room returned cooled air from flowing backward from switching room return port 36c to switching room 36 through switching room feedback communication port 59. This can cool switching room 36 to a predetermined temperature efficiently and prevent dew condensation and the like in advance.

[0083] Next, a configuration of a rear surface of first cover 45 is described with reference to Fig. 12.

[0084] Fig. 12 is a perspective view showing a main part of first cover 45 of the refrigerator in accordance with the exemplary embodiment of the present invention.

[0085] As shown in Fig. 12, first cover 45 is provided together in the forward part of cooler 44 shown in, for example, Fig. 1, cooled air return passage 71 is formed in such a manner that it is partitioned by cooler 44, partition member 75, and a rear surface wall of cooling room 43. First cover 45 includes fan 46 and cooled air discharge port 72 for feeding cooled air to refrigerating room

35 and switching room 36. Furthermore, cooled air discharge port 72 is formed between fan 46 and cooled air return passage 71, and partition member 75 is provided between cooled air discharge port 72 and cooled air return passage 71.

[0086] Cooled air that has passed through refrigerating room feedback communication port 58 and switching room feedback communication port 59 in first dividing wall 41 flows in cooled air return passage 71. Branch duct 76 is provided at the upstream side of cooled air return passage 71. Branch duct 76 communicates with first dividing wall 41 by sealing and branches such that the refrigerating room returned cooled air and the switching room returned cooled air not joined with each other,.

[0087] In this exemplary embodiment, branch duct 76 connected to switching room feedback communication port 59 is formed so as to branch the switching room returned cooled air from the refrigerating room returned cooled air. By forming branch duct 76 only at the upstream side of cooled air return passage 71, the refrigerating room returned cooled air (arrow B) and the switching room returned cooled air (arrow D) are joined to each other from the middle way of cooled air return passage 71.

[0088] This is configured for the following reasons. When branch duct 76 is not provided, the cooled air (arrow D) that has passed through switching room feedback duct 51b and the cooled air (arrow B) that has passed through refrigerating room feedback duct 51a pass through cooled air return passage 71 and are joined to each other, the cooled air flows backward through refrigerating room feedback communication port 58 and switching room feedback communication port 59 in first dividing wall 41. Then, the refrigerating room returned cooled air (arrow B) whose temperature is higher than the switching room returned cooled air (arrow D) ascends through switching room feedback communication port 59, and flows backward from switching room return port 36c to switching room 36. As a result, switching room 36 cannot be cooled to a predetermined temperature efficiently, and dew condensation or the like occurs.

[0089] As described above, branch duct 76 is formed only at the upstream side so that the cooled air is allowed to branch at the upstream portion of cooled air return passage 71 and the air is prevented from mixing. Thus, the cooled air that has passed through refrigerating room feedback duct 51a does not flow downward. It is possible to prevent the cooled air from flowing backward to switching room feedback communication port 59, and from flowing backward from switching room return port 36c of duct system 49 to the inside of switching room 36. That is to say, branch duct 76 works as a backflow prevention duct.

[0090] Note here that branch duct 76 is formed only at the upstream portion in order to secure an opening sectional area of cooled air return passage 71, but branch duct 76 may be extended to the downstream portion if an opening sectional area at the downstream side of cooled air return passage 71 can be secured. This enables the backflow prevention effect to be enhanced.

[0091] Furthermore, the lower part of lower end 75a of partition member 75 is provided with cooled air feedback port 77 through which cooled air passing through cooled air return passage 71 is returned to the lower part of cooler 44. Partition member 75 has a configuration with lower end 75a opened.

[0092] Hereinafter, configurations in the vicinity of first cover 45 and cooling room 43 mentioned above are described.

[0093] Fig. 13 is a view for illustrating a main part of a vicinity of cooling room 43 of the refrigerator in accordance with the exemplary embodiment of the present invention.

[0094] As shown in Fig. 13, the lower part of partition member 75 is provided with cooled air feedback port 77 through which cooled air that passes through cooled air return passage 71 is returned to the lower part of cooler 44. An end of defrosting heater 47 placed substantially horizontally on the lower part of cooler 44 extends off the one end of cooler 44, and is located extending to cooled air return passage 71 through cooled air feedback port 77.

[0095] This prevents the cooled air containing moisture in cooled air return passage 71 from being cooled by the cooled air in cooler 44 and freezing room 37 and from being frozen in cooled air return passage 71. As a result, it is possible to enhance the reliability at the time of operation.

[0096] Hereinafter, operations and effects of refrigerator 30 configured as mentioned above are described.

[0097] A part of cooled air generated by cooler 44 of cooling room 43 is allowed to forcibly flow forward, and freezing room 37 is cooled with the cooled air discharged from the discharge port of first cover 45. The cooled air is introduced into the lower part of cooler 44 through a return port opened at the lower part of first cover 45, subjected to heat exchange by cooler 44, and circulated by fan 46 again. Thus, freezing room 37 is controlled to a predetermined temperature by control of a freezing room sensor (not shown).

[0098] Furthermore, the cooled air discharged to the upper side of fan 46 is introduced from cooled air discharge port 72 of first cover 45 to duct system 49 through a communication hole of first dividing wall 41. Then, when a temperature inside the room is determined to be not lower than a set temperature by refrigerating room temperature sensor 67, refrigerating room damper 50a of damper device 50 is opened, cooled air is discharged from discharge port 35a of the refrigerating room through refrigerating room flow duct 48a for cooling (arrow A in Fig. 3). Then, the cooled air that has cooled refrigerating room 35 becomes air containing moisture included in refrigerating room 35 or stored items, and is introduced into refrigerating room return port 35b (arrow B in Fig. 3). Thereafter, the cooled air passes through refrigerating room feedback duct 51a of duct system 49, and cooled air return passage 71 made by first cover 45 and cooling room 43 sequentially in this order, and is introduced into the lower part of cooler 44 from cooled air feedback port 77. Then, the air is subjected to heat exchange with cooler 44, and the cooled air is allowed to forcibly flow by fan 46 again.

[0099] By allowing the cooled air to forcibly flow to refrigerating room flow duct 48a that communicates with cooler 44 by fan 46, refrigerating room 35 can be cooled easily even if it is placed in a position distant from cooler 44. That is to say, the cooled air is allowed to be discharged to refrigerating room 35 through refrigerating room flow duct 48a in duct system 49, opening/closing of refrigerating room damper 50a is controlled by refrigerating room temperature sensor 67, thus controlling the set temperature inside the room.

[0100] Furthermore, when a temperature inside the room is determined to be not lower than the set temperature by switching room temperature sensor 68, switching room damper 50b of damper device 50 is opened, and cooled air is discharged to switching room 36. At this time, the cooled air discharged to switching room 36 passes through switching room flow duct 48b and is discharged from upper discharge port 36a provided in the upper part than upper surface opening portion 69a of upper drawer case 69 , thus cooling the inside of upper drawer case 69.

[0101] Inside lower drawer case 70 of switching room 36, cooled air is discharged from lower discharge port 36b provided at a higher position than upper surface opening portion 70a of lower drawer case 70 (arrow C in Fig. 3). At this time, rear surface wall 69c of upper drawer case 69 is allowed to work as a guide for regulating the flow of the cooled air to introduce the cooled air into lower drawer case 70. Then, the cooled air circulated in switching room 36 is introduced into switching room return port 36c, and passes through switching room feedback communication port 59 through switching room feedback duct 51b (arrow D in Fig. 3). Thereafter, the cooled air is introduced from cooled air feedback port 77 into the lower part of cooler 44 through branch duct 76 formed in first cover 45, subjected to heat exchange with cooler 44, and heat-exchanged cooled air is allowed to forcibly flow by fan 46.

[0102] Thus, even if switching room 36 is located distant from cooler 44, cooled air is allowed to forcibly flow to switching room flow duct 48b that communicates with cooler 44 by fan 46 and discharged to switching room 36 through duct system 49. Furthermore, since opening/closing of switching room damper 50b is controlled by switching room temperature sensor 68, the inside of switching room 36 can be controlled to a set temperature.

[0103] Note here that in this exemplary embodiment, the set temperature inside switching room 36 can be switched from -18°C in a freezing temperature range of to 4°C in a refrigeration temperature range by controlling the opening rate of switching room damper 50b.

[0104] In particular, when the set temperature of switching room 36 is set to a temperature range that is lower than the refrigeration temperature, cooled air discharged from upper discharge port 36a and lower discharge port 36b of switching room 36 is introduced into switching room feedback duct 51b through switching room return port 36c. At this time, since the cooled air passing through refrigerating room feedback duct 51a has a higher temperature than the cooled air passing through switching room feedback duct 51b, dew condensation may be generated on the surface of a duct of refrigerating room feedback duct 51a. In particular, when the outside air temperature is low, moisture from dew condensation may be frozen, or dew condensation water may flow in refrigerating room feedback duct 51a and may be frozen in cooled air return passage 71. Then, even if dew condensation water is generated, it can be evaporated by operating aluminum foil heater 57 provided in refrigerating room feedback duct 51a. Thereby, freezing inside the duct can be prevented.

[0105] As mentioned above, the present invention has a configuration in which refrigerating room flow duct 48a, switching room flow duct 48b, and refrigerating room feedback duct 51a are allowed to communicate with each other independently in the vertical direction in duct system 49, and aligned laterally in the right and left direction. Furthermore, discharge duct portion 42f of dividing wall 42 through which cooled air is discharged to switching room 36 and switching room flow duct 48b of duct system 49 installed at the rear surface of switching room 36 are connected to each other.

[0106] Thus, it is possible to achieve refrigerator 30, in which an air-flow path structure inside duct system 49 at the rear surface of switching room 36 can be simplified, cooled air can be dispersed uniformly, and the inside of each storage room linked to the air-flow path can be cooled at a predetermined temperature more reliably.

INDUSTRIAL APPLICABILITY

[0107] A refrigerator according to the present invention can be applied for household refrigerator or industrial-use refrigerator which requires high volume efficiency and energy saving.

REFERENCE MARKS IN DRAWINGS

[0108]

1, 30	refrigerator
2, 33	inner box
3, 32	outer box
4	heat-insulating material
5, 31	heat insulation box
6, 35	refrigerating room
7, 36	switching room
8, 37	freezing room
9, 38	refrigerating room door
10, 39	switching room door
11, 40	freezing room door

12, 13	partition board
14, 18	duct
15	tube-on-sheet
16, 44	cooler
17, 46	fan
19	damper
20	refrigerating room shelf
21	refrigerating room case
22	switching room case
34	foaming heat-insulating material
35a	discharge port
35b	refrigerating room return port
36a	upper discharge port
36b	lower discharge port
36c	switching room return port
41	first dividing wall
41a	first dividing wall member
41b	first upper surface dividing cover
41c	first lower surface dividing cover
42	dividing wall
42a	heat insulation plate
42b	discharge duct plate
42c	lower surface cover member
42d	upper surface cover member
42e	stepped portion
42f	discharge duct portion
43	cooling room
45	first cover
45a	panel
45b	second cover
47	defrosting heater
48	flow duct
48a	refrigerating room flow duct
48b	switching room flow duct
49	duct system
49a	upper duct member
49b	lower duct member
49c	duct panel
49d	seal connection portion
50	damper device
50a	refrigerating room damper
50b	switching room damper
50c	damper device frame
51a	refrigerating room feedback duct
51b	switching room feedback duct
52	wiring housing portion
53	water supply tank
55	water supply pipe
56	concave portion
57	aluminum foil heater
58	refrigerating room feedback communication port
59	switching room feedback communication port
61	shelf
63	branch path
64	vegetable room
64a	open/close lid
64b	vegetable case
66	control board
67	refrigerating room temperature sensor
68	switching room temperature sensor
69	upper drawer case
69a	upper surface opening portion
69b	bottom portion
69c	rear surface wall
70	lower drawer case
70a	upper surface opening portion
70b	bottom portion
70c	rear surface wall
71	cooled air return passage
72	cooled air discharge port
74	stepped portion
75	partition member
75a	lower end
76	branch duct
77	cooled air feedback port
79	seal member
81	refrigerating room duct

Claims

1. A refrigerator comprising:

a refrigerating room provided in an upper part;
a freezing room provided in a lower part;
a switching room provided between the refrigerating room and the freezing room, the switching room being configured such that temperature ranges are changed;
a cooler provided in a rearward part of the freezing room for generating cooled air;
a fan placed above the cooler for delivering the cooled air generated by the cooler into the refrigerating room, the freezing room and the switching room;
a duct system including a refrigerating room flow duct for allowing the cooled air to flow into the refrigerating room, a switching room flow duct for allowing the cooled air to flow into the switching room, and a refrigerating room feedback duct for returning the cooled air discharged into the refrigerating room to the cooler; and
a dividing wall for vertically separating between the refrigerating room and the switching room, wherein a discharge duct portion for discharging the cooled air into the switching room is provided on a lower surface of the dividing wall, and connected to the switching room flow duct of the duct system which is installed on a rear surface of the switching room.

2. The refrigerator of claim 1, wherein the dividing wall includes a heat insulation plate, an upper surface cover member and a lower surface cover member for covering an upper surface

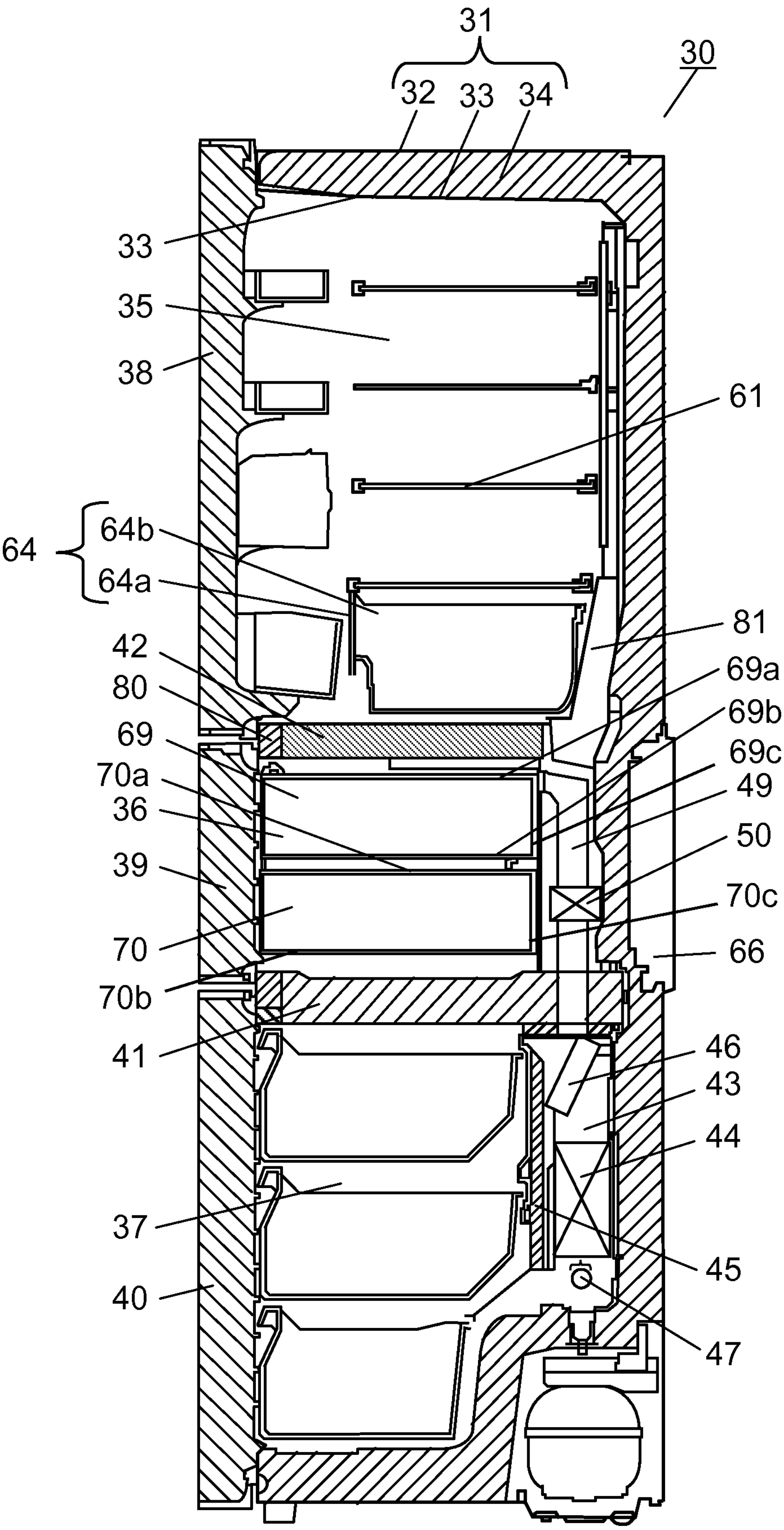
and a lower surface of the heat insulation plate, and a discharge duct plate, which is provided on the lower surface of the heat insulation plate, for introducing the cooled air into the switching room, and
the heat insulation plate and the discharge duct plate are covered with the upper surface cover member and the lower surface cover member and provided in such a manner that the discharge duct portion is integrated with the cover members of the dividing wall.

3. The refrigerator of any one of claims 1 and 2, wherein the dividing wall is attached to a predetermined position of an inner box before a foaming heat-insulating material is filled and foamed between an outer box and the inner box forming a main body of the refrigerator, and
the duct system is linked to the discharge duct portion after the foaming heat-insulating material is filled and foamed.

4. The refrigerator of claim 3, wherein a stepped portion is formed on the lower surface cover member, and the stepped portion is provided with a discharge port for discharging the cooled air to the switching room.

5. The refrigerator of claim 1, wherein the discharge duct portion includes a plurality of discharge ports.

FIG. 1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64b
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69b
69
69c
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FIG. 2

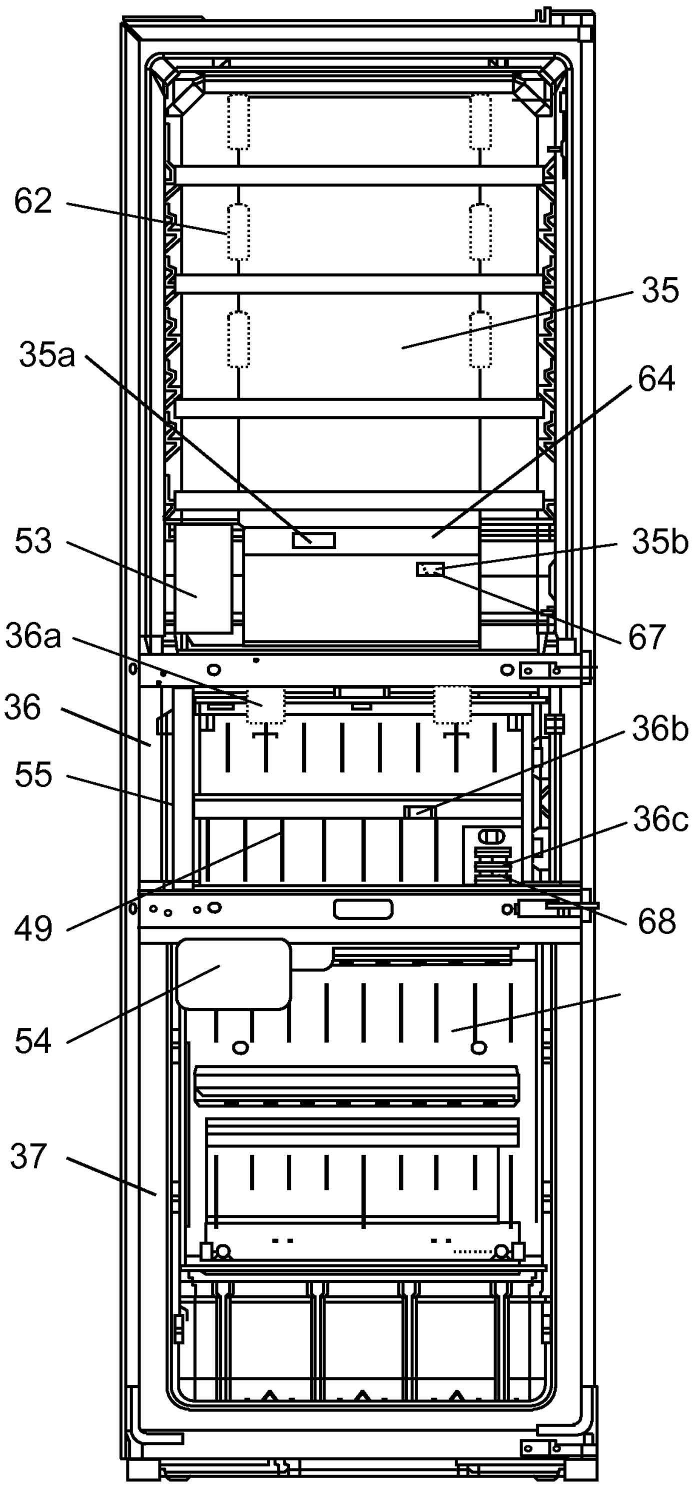
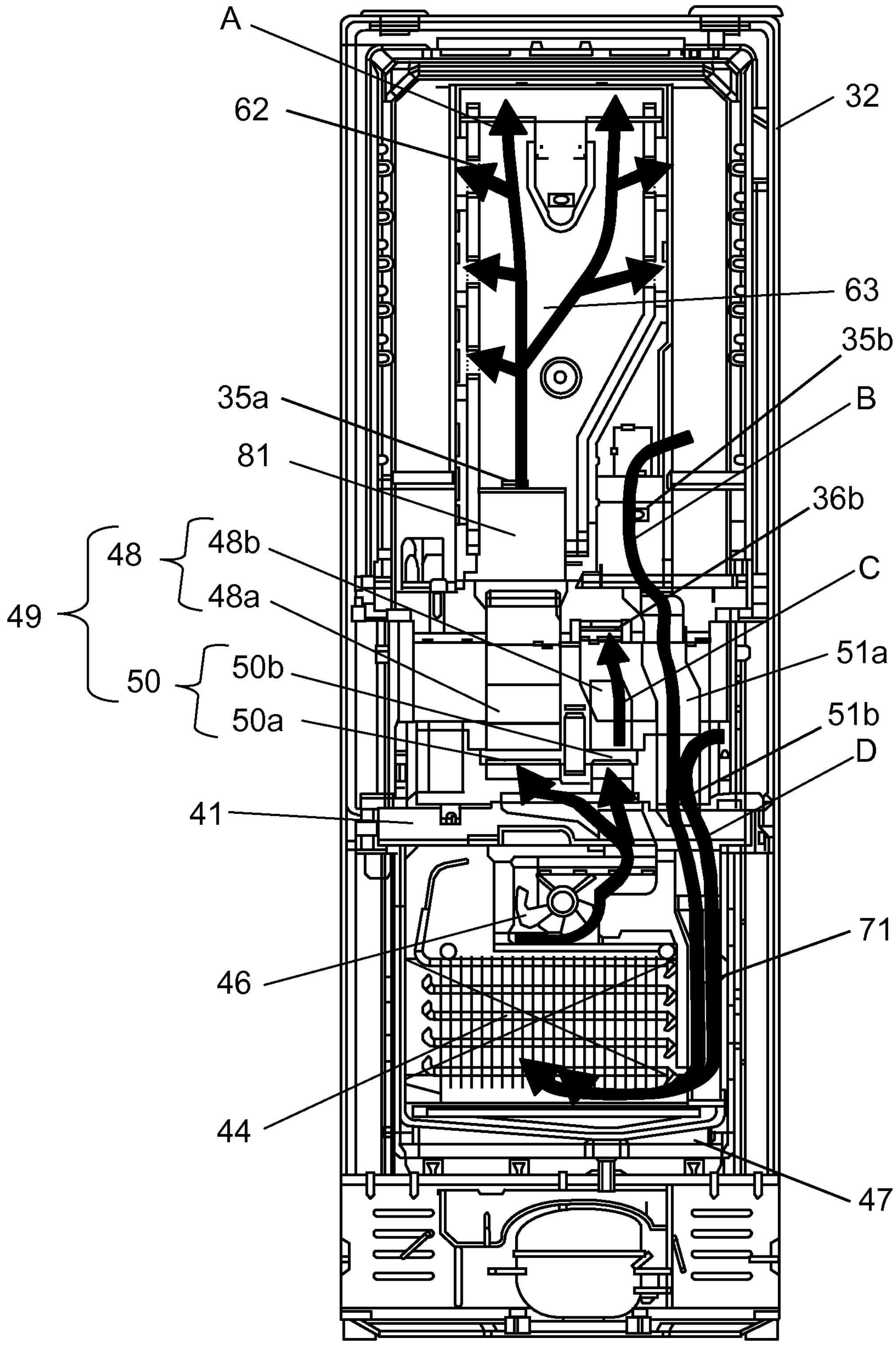


FIG. 3



A
62
32
63
35b
35a
B
81
36b
48
48b
C
49
48a
51a
50
50b
50a
51b
D
41
46
71
44
47

FIG. 4

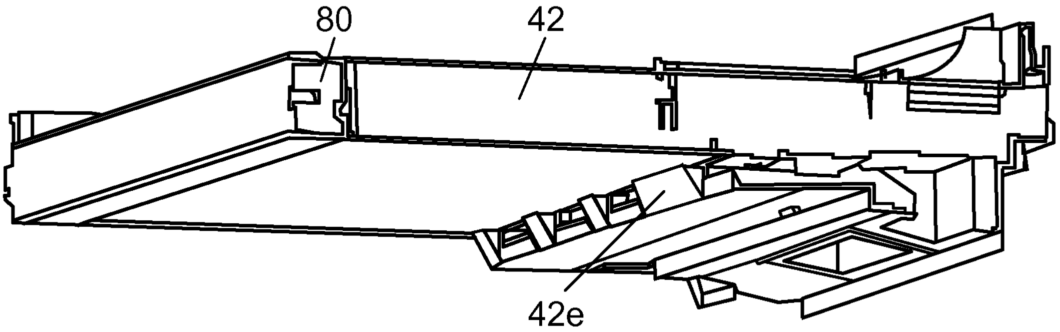


FIG. 5

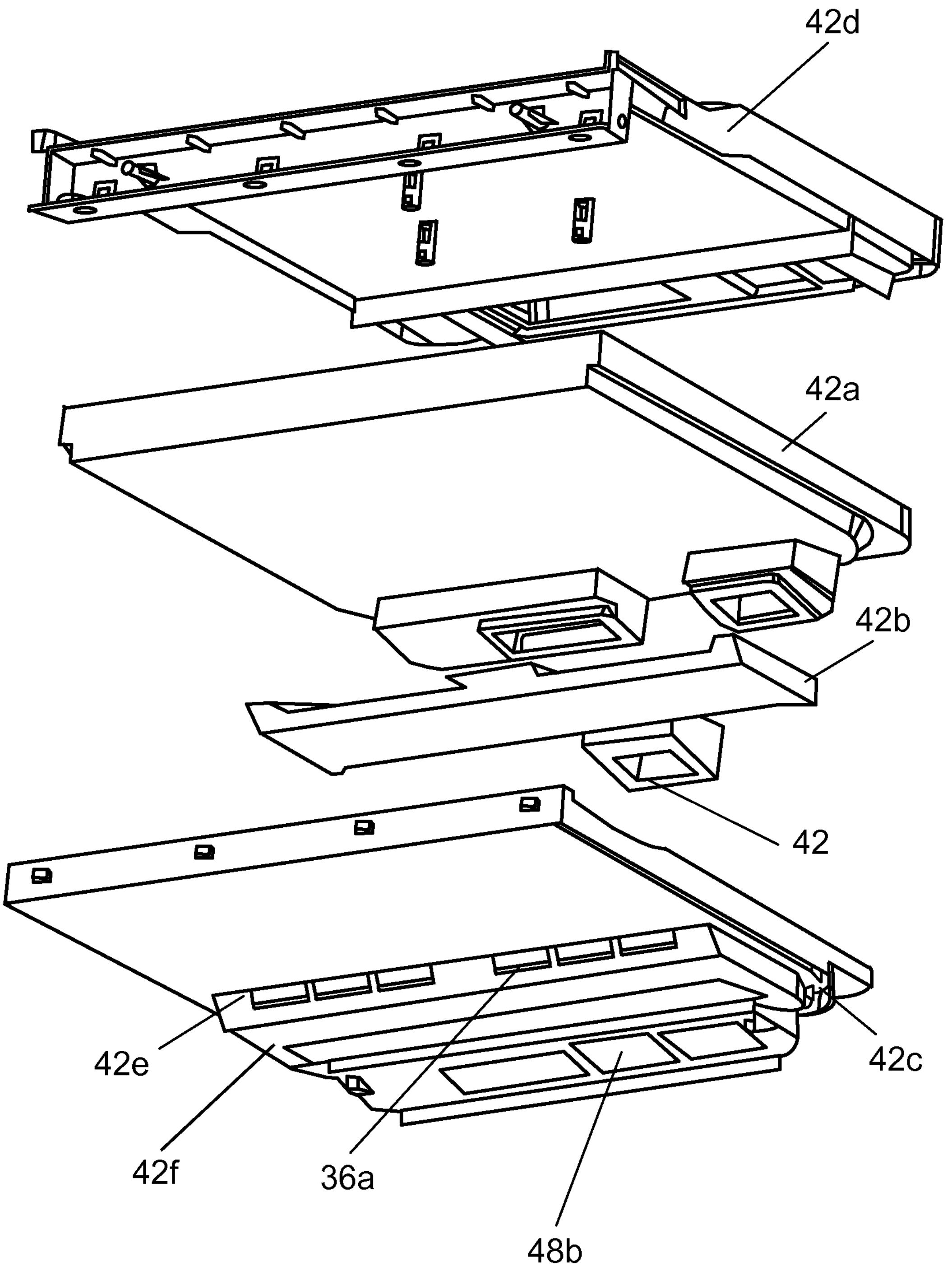


FIG. 6

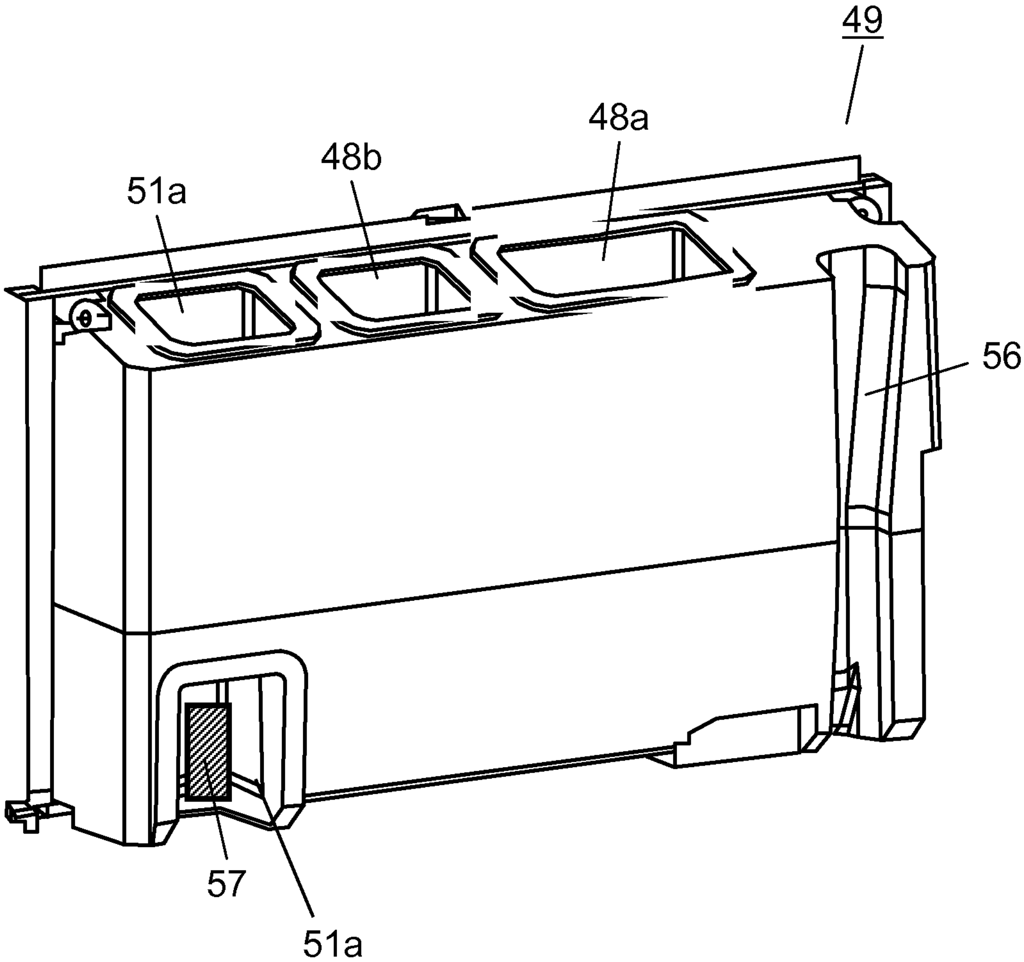


FIG. 7

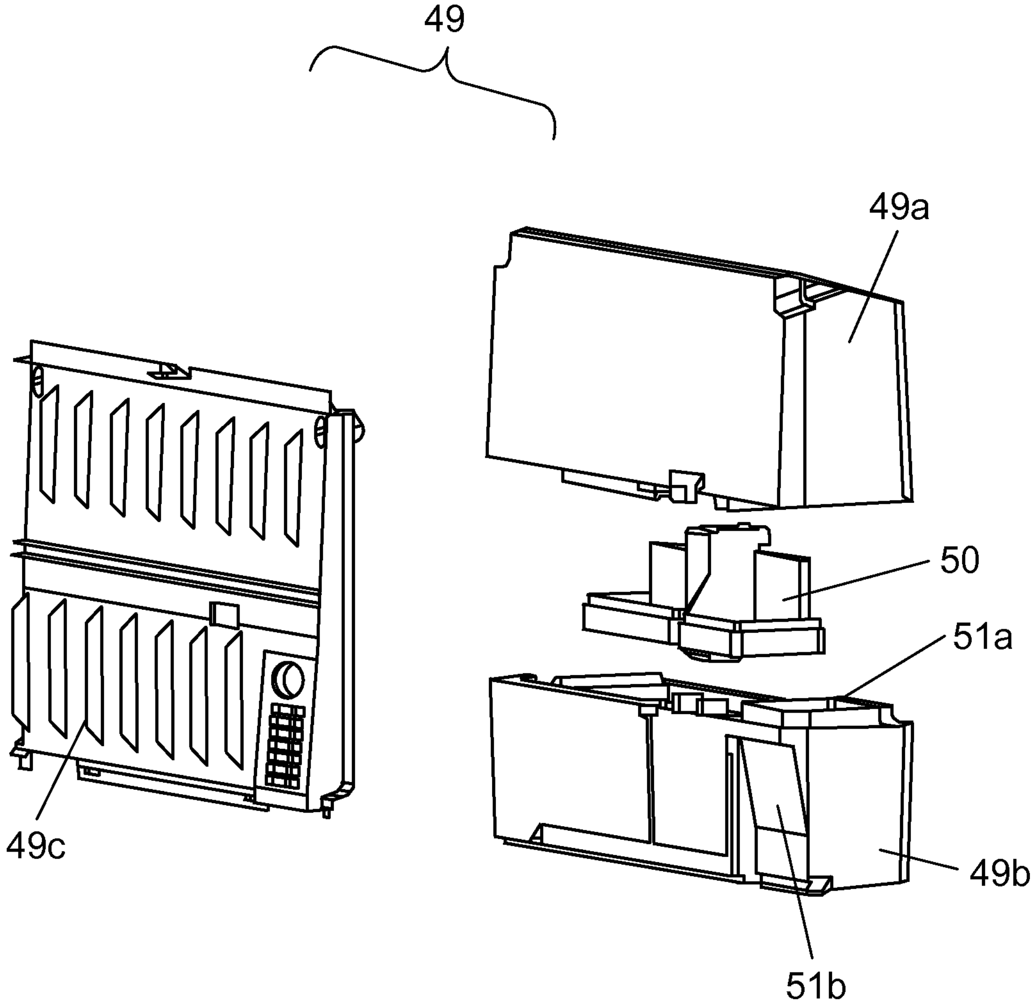


FIG. 8

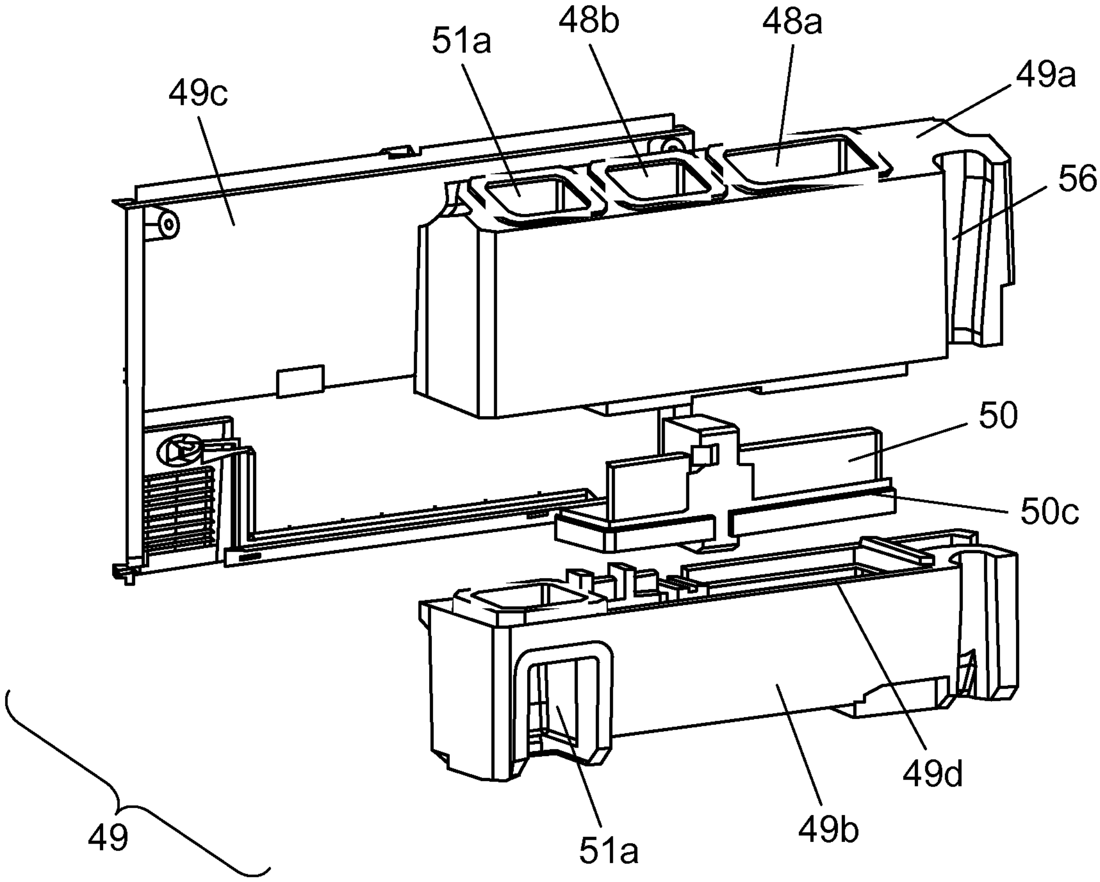


FIG. 9

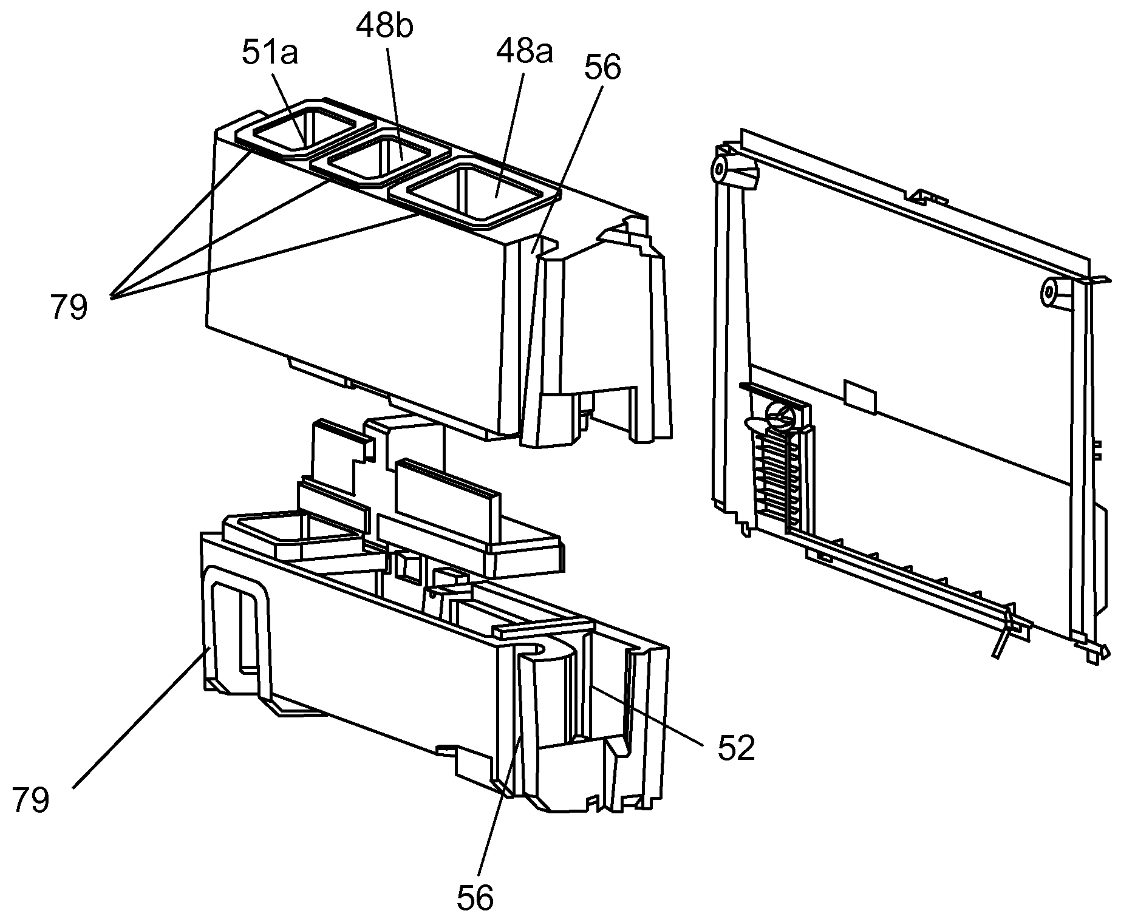


FIG. 10

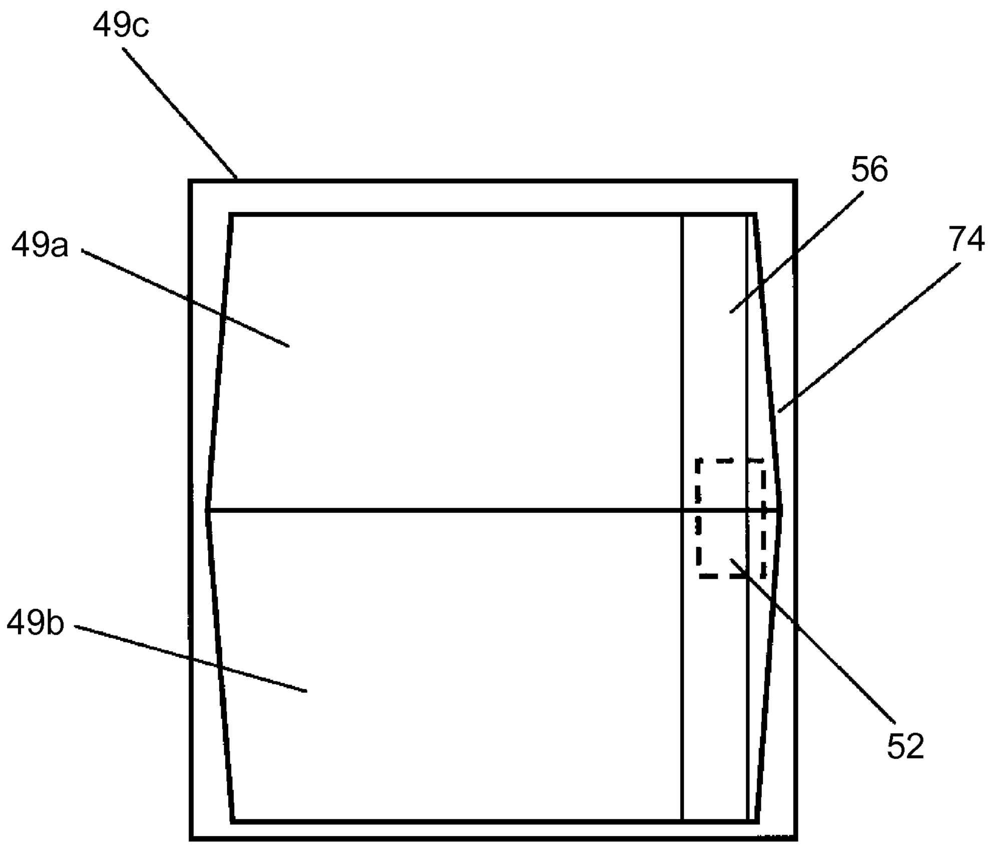


FIG. 11

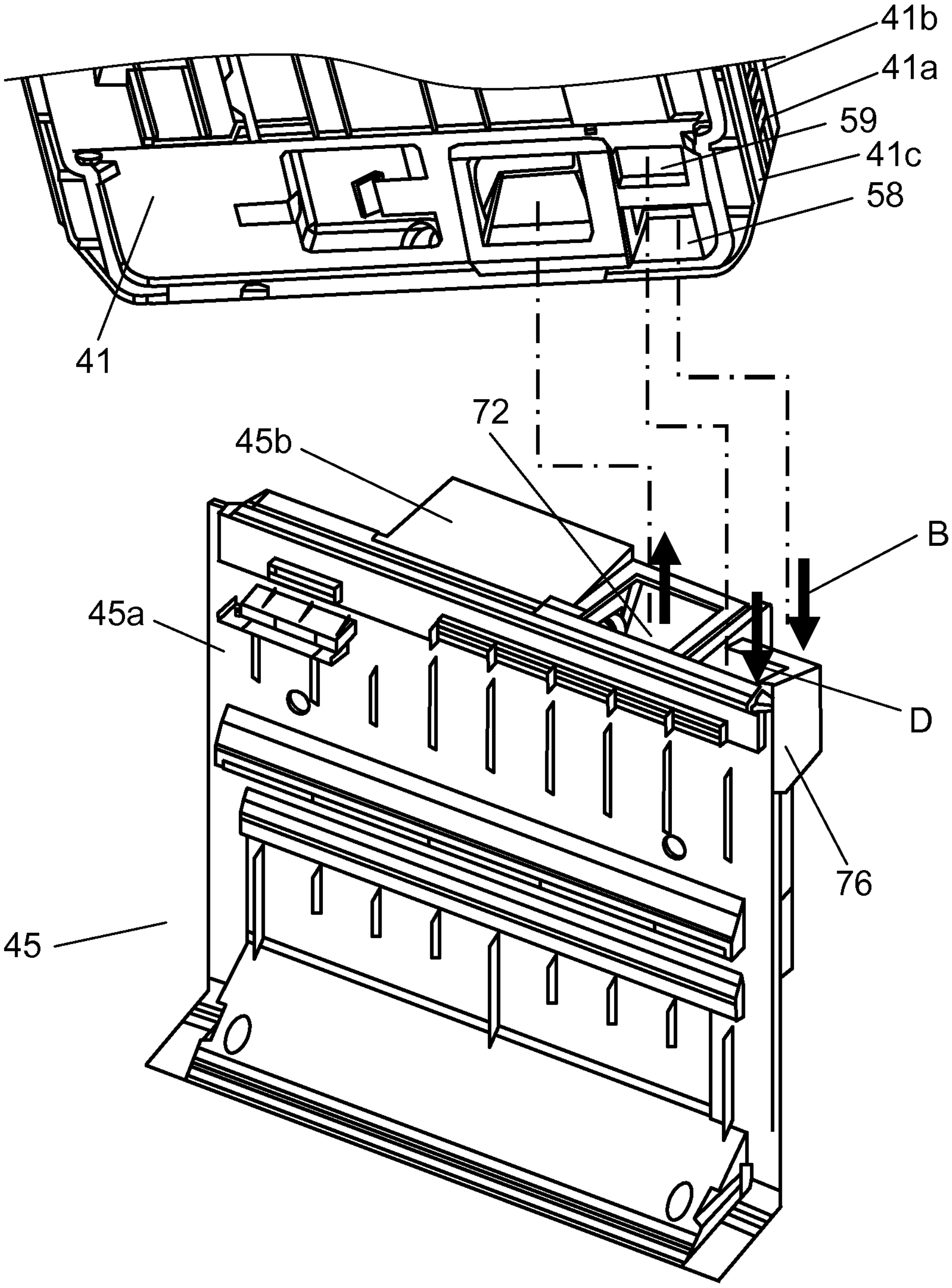


FIG. 12

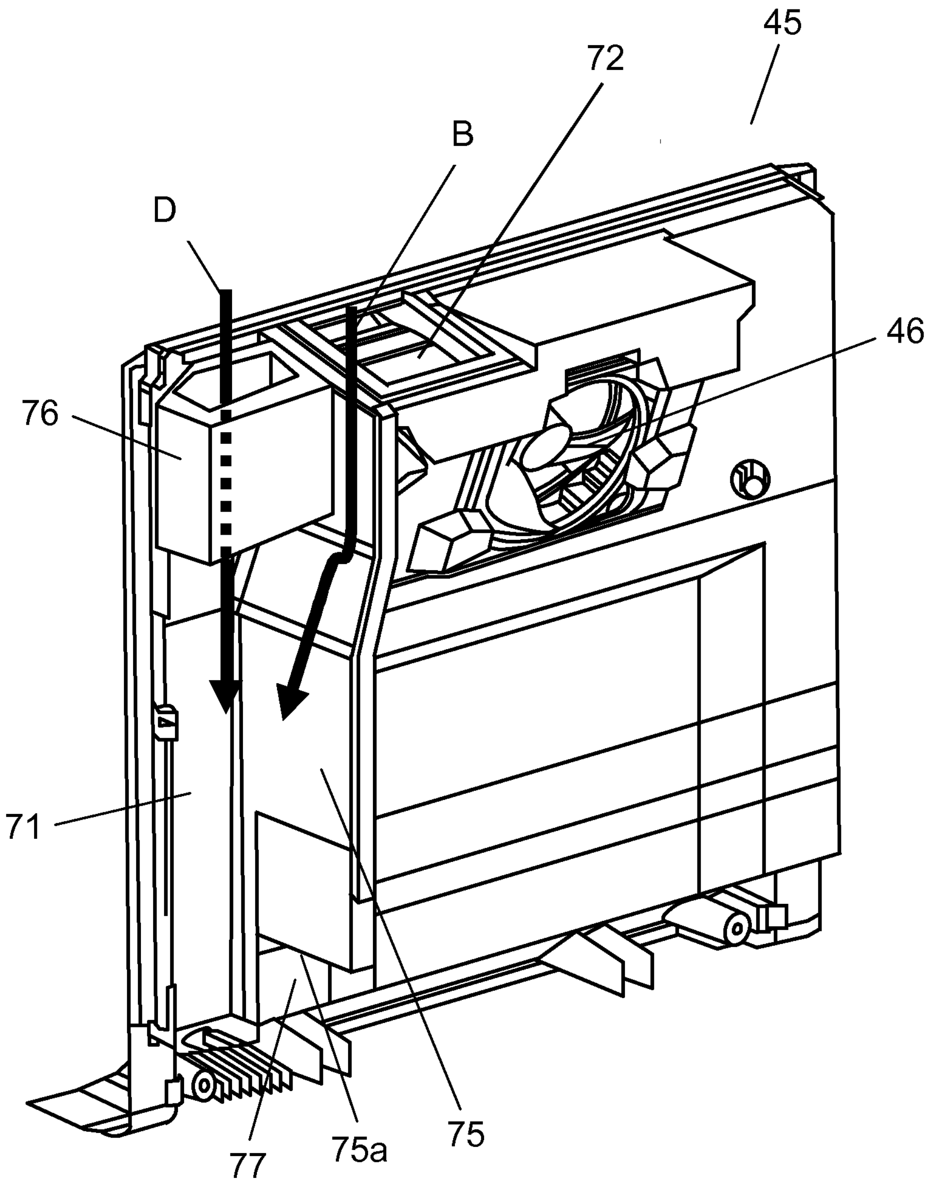


FIG. 13

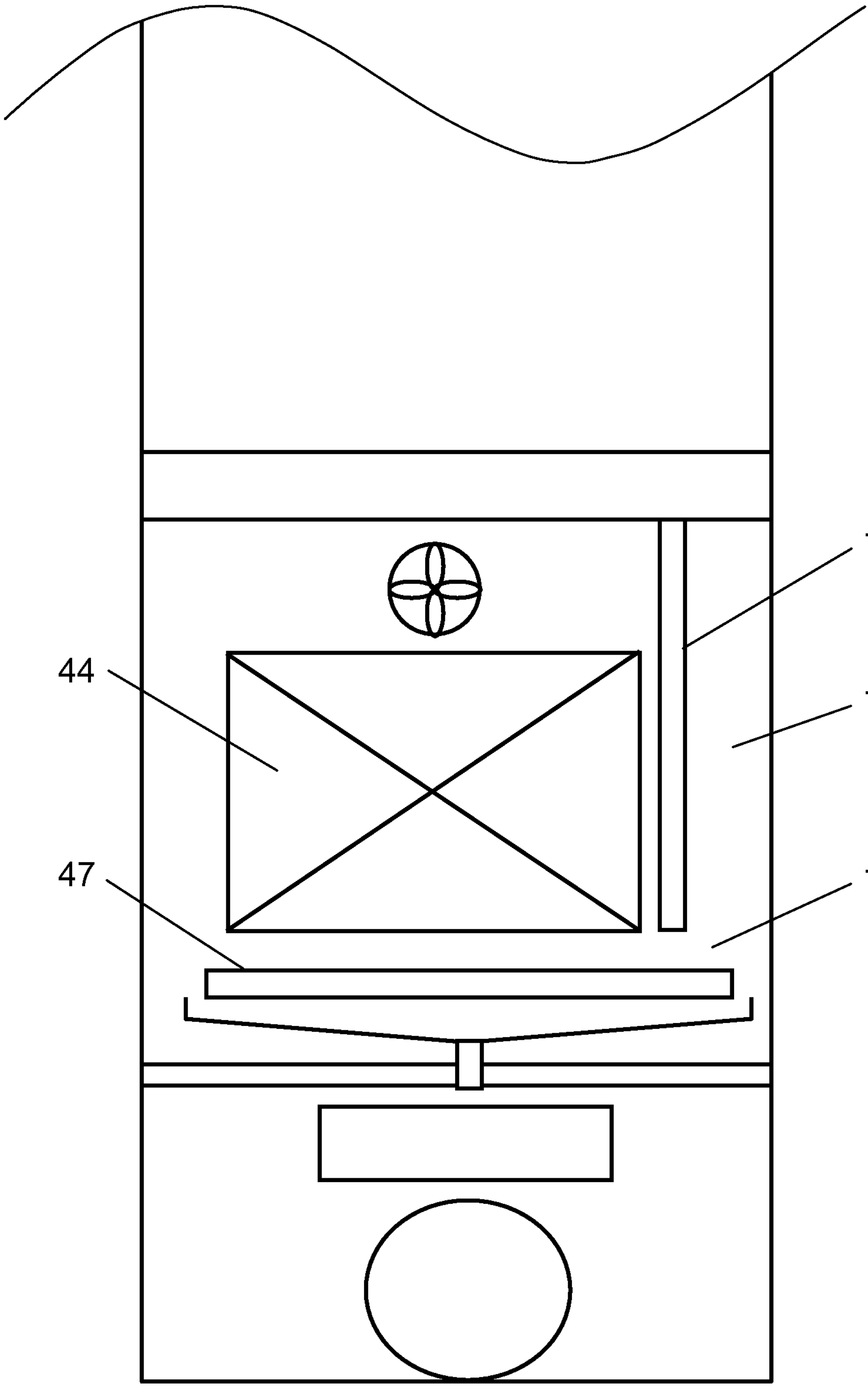
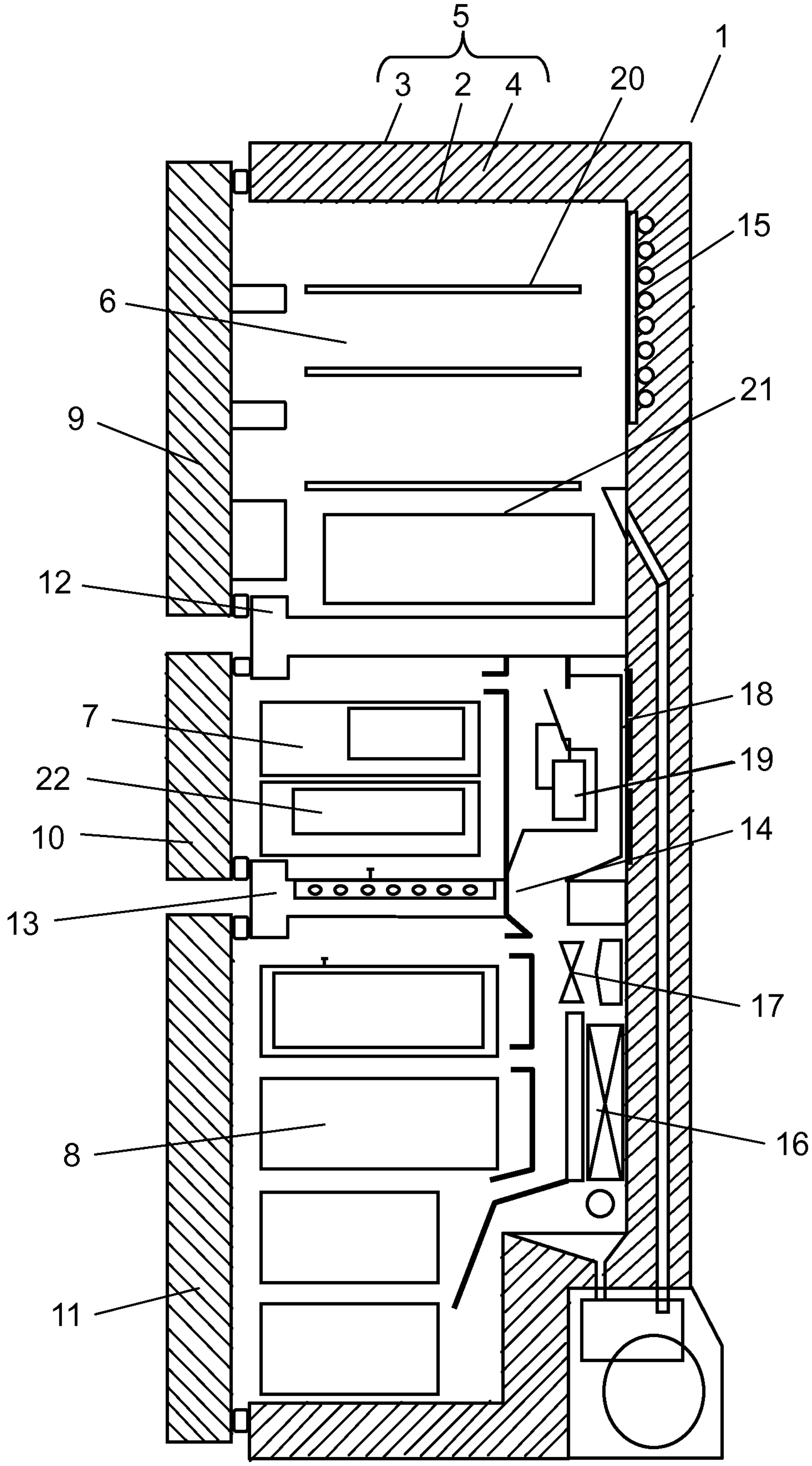


FIG. 14



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/003401

A. CLASSIFICATION OF SUBJECT MATTER
F25D17/08(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F25D17/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2011
Kokai Jitsuyo Shinan Koho	1971-2011	Toroku Jitsuyo Shinan Koho	1994-2011

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	JP 2002-295952 A (Sanyo Electric Co., Ltd.), 09 October 2002 (09.10.2002), fig. 1; paragraphs [0009] to [0015] (Family: none)	1,3,5 4 2
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 149352/1985(Laid-open No. 57077/1987) (Matsushita Refrigeration Co.), 09 April 1987 (09.04.1987), fig. 1 to 6; specification, page 8, line 13 to page 12, line 7 (Family: none)	4

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 July, 2011 (26.07.11)	02 August, 2011 (02.08.11)

Name and mailing address of the ISA/	Authorized officer
Japanese Patent Office	
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/003401

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 11-23132 A (Toshiba Corp.), 26 January 1999 (26.01.1999), fig. 1 to 4; entire text (Family: none)	1-5
A	JP 2008-267646 A (Mitsubishi Electric Corp.), 06 November 2008 (06.11.2008), entire text; all drawings & US 2010/0083687 A & WO 2008/129718 A1 & CN 101636625 A & AU 2007351997 A	1-5
A	JP 2008-286516 A (Mitsubishi Electric Corp.), 27 November 2008 (27.11.2008), entire text; all drawings & US 2001/0009100 A1 & SG 75968 A & ID 23199 A & TW 233479 B & CN 1249419 A & SG 94752 A	1-5

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2005195293 A **[0013]**