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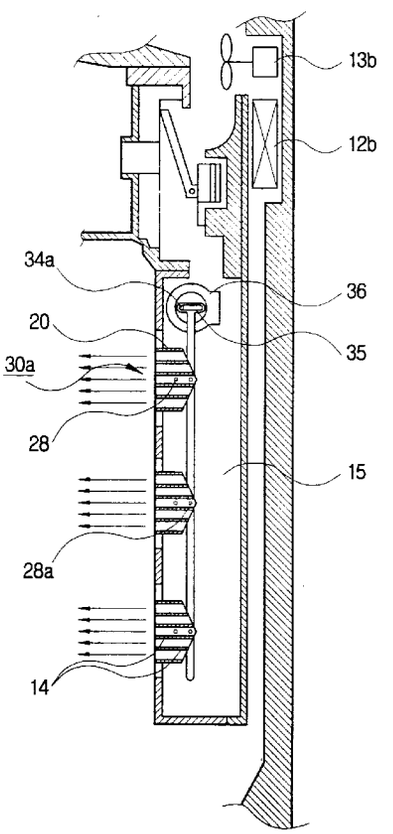
## (54) Refrigerator with cool air directing means

(57) Cool air is driven into a cooling compartment (3) of a refrigerator through apertures (16) in the rear wall of the cooling compartment (3). The cool air flow through the apertures (16) can be directed up and down by blades (14) associated with the apertures (16). The blades (14) are coupled such that the blades (14) associated with the same aperture (16) are contrained to remain parallel as they are rotated to change the cool air flow direction. The groups of blades (14) associated with different apertures (16) may be independently rotatable.

FIG.8

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## Description

**[0001]** A first aspect of the present invention relates to a refigerator comprising a cooling compartment, means for driving cool air through an aperture into the cooling compartment, and flow directing means associated with the aperture for directing said cool air. A second aspect of the present invention relates to refrigerator comprising a cooling compartment, means for driving cool air through a plurality of apertures into the cooling compartment, and flow directing means associated with the apertures for directing said cool air.

**[0002]** Generaly, a refrigerator comprises a freezing compartment and a fresh food compartment in a cabinet. The compartments are separated by a partition. Doors to the freezing compartment and fresh food compartments are provided and a cooling system is provided for supplying the freezing compartment and the fresh food compartment with cool air. The cooling system comprises a compressor, a condenser and an evaporator. The cool air generated by the evaporator flows along a cool air duct formed in a rear wall of each compartment and is then driven into the cooling compartments through cool air discharge ports by a fan.

**[0003]** In such a conventional refrigerator, however, there exist an area in which the cool air discharged through the cool air discharge ports is concentrated, and an area into which a relatively small amount of cool air is supplied. Consequently, the temperature varies in the cooling compartments and uniform cooling cannot be achieved. Therefore, a refrigerator adopting the so called tri-dimensional cooling method, which has ameliorate this problem, has been proposed.

**[0004]** In a refrigerator using the tri-dimensional cooling method, the cool air discharge ports are provided in both side walls as well as in the rear wall of the cooling compartment in order to promote the uniform cooling. However, in such a refrigerator, since the cool air is discharged through the cool air discharge ports in fixed directions, there may still be a dead-zone in an edge area which is not supplied with sufficient the cool air. Furthermore, since the cool air duct has to be provided not only in the rear wall but also in the side walls, there are the problems that the space for storing food is reduced and the manufacturing cost increases due to the increased number of components and processes.

**[0005]** Figures 1 to 3 are a side view, a partial, enlarged sectional view and an exploded perspective view of a refrigerator that is disclosed in WO-A-95/27278.

**[0006]** Referring to Figures 1 to 3, the disclosed refrigerator has a device for dispersing cool air and a pair of cooling compartments 2, 3 in a cabinet 1 and which are separated from each other by a partition 5. The cooling compartments 2, 3 are respectively a freezing compartment 2 and a fresh food compartment 3. Doors 6, 7 provide access to respective cooling compartments 2, 3. A cooling system is installed in the cabinet 1 and comprises a compressor 11, a condenser (not shown), a freezing compartment evaporator 12a, and a fresh food compartment evaporator 12b. The cool air generated by the evaporators 12a, 12b is supplied to the corresponding compartments 2, 3 by a freezing compartment fan 13a and a fresh food compartment fan 13b respectively.

**[0007]** A duct plate 9 of a partial cylinder shape is attached to an innner wall plate 23. The duct plate 9 has cool air discharge ports 16 opening into the fresh food compartment 3 and forms a rear inner wall of the fresh food compartment 3. A cool air duct 15 and a circulation duct 17, separated from each other by a seal plate 25, are provided between the duct plate 9 and the rear wall 4 of the cabinet 1. A duct member 21 for guiding downwards the cool air driven by the fresh food compartment fan 13b is installed in the cool air duct 15. The cool air generated by the fresh food compartment evaporator 12b is driven by the fresh food compartment fan 13b and then supplied to the fresh food compartment 3 via the cool air duct 15 and the cool air discharge ports 16.

**[0008]** A cool air dispersing device 130 is installed in the cool air duct 15. The cool air dispersing device 130 is comprises a vertical, rotary shaft 131, cool air dispersing blades 132 assembled to the rotational shaft 131, adjacent to respective cool air discharge ports 16, and a driving motor 135 for routing the vertical shaft 131. Each of the cool air dispersing blades 132 comprises three discs 136, 137, 138, disposed in parallel with each other along the axis of the vertical shaft 131, and a first blade part 133 and a second blade part 134 disposed between the discs 136, 137, 138. Each of the blade parts 133, 134 is substantially S-shaped in cross-section. The blade parts 133, 134 are bent to the opposite directions to each other.

**[0009]** In the refrigerator having the above-described constitution, when the driving motor 135 rotates the vertical shaft 131 at a low speed, the cool air flowing along the cool air duct 15 changes direction along the curved surfaces of the cool air dispersing blades 132, and is discharged into the fresh food compartment 3 and dispersed horizontally. When concentrated cooling of a specific area is needed, the driving motor 135 stops the vertical shaft 131 in accordance with the direction of the cool air dispersing blades 132 so that the cool air is concentrated on the specific area.

**[0010]** However, since the blade parts 133, 134 of the cool air dispersing device 130 S-shaped, the smooth flow of cool air may be impeded by vortices in the cool air flow which form at the cool air discharge ports 16.

**[0011]** Moreover, although such a conventional cool air dispersing device 130 can achieve the uniform distribution of the cool air horizontally, the vertical distribution of the cool air is not sufficiently uniform, so there is a limitation in realizing the uniform cooling throughout the fresh food compartment 3.

**[0012]** A refrigerator according to the first aspect of the present invention is characterised in that the flow directing means comprises a plurality of flow-directing blades, which are rotatable about a common horizontal

axis or respective horizontal axes, coupled so as to remain parallel to one another when rotated.

**[0013]** The blades may comprise the slats of a louvred structure. In this case, driving means may be conveniently provided for reciprocally rotating the blades about said common axis. Preferably, the driving means comprises a motor, a vertical actuator member having a transverse slot at one end, and a crank drivingly coupled to the motor and having a shaft received in the slot, the actuator member engaging the louvred structure such the louvred structure reciprocates about said common axis when the actuator member is reciprocated vertically by operation of the motor.

**[0014]** Alternatively, the blades may be rotatable about respective horizontal axes and be coupled such that they are forced to move in unison and remain parallel to one another when being rotated.

**[0015]** A refrigerator according to the second aspect of the present invention is characterised in that the flow directing means comprises a plurality of flow-directing blades and each aperture has associated therewith at least one of said blades, the blades associated with different apertures being independently rotatable for independently controlling the direction of cool air flowing through the associated apertures.

**[0016]** A refrigerator may embody both aspects of the present invention.

**[0017]** Further preferred and/or optional features of the matter for which protection is sought are set out in claim 8 to 18 appended hereto.

**[0018]** Embodiments of the present invention will now be described, by way of example, with reference to Figures 4 to 13 of the accompanying drawings, in which:-

Figure 1 is a side sectional view of a known refrigerator having cool air dispersing blades;
Figure 2 is a partial enlarged sectional view of Figure 1;
Figure 3 is an enlarged exploded perspective view of the main elements of Figure 2;
Figure 4 is a front view of a first refrigerator according to the present invention;
Figure 5 is an enlarged exploded perspective view of a cool air dispersing device shown in Figure 4;
Figure 6 is a perspective view of the assembled state of Figure 5;
Figure 7 is an exploded perspective view of the cool air dispersing device of a second refrigerator according to the present invention;
Figures 8 through 10 are side sectional views of the elements of Figure 7 in their assembled state;
Figure 11 is an exploded perspective view of the cool air dispersing device of a third refrigerator according to the present invention; and
Figures 12 and 13 are side sectional views of the elements of Figure 11 in their assembled state.

**[0019]** In the following description, parts identical or similar to those in the known refrigerator shown in Figures 1 through 3 will not be described in detail again and will be referred to with the same reference numerals.

**[0020]** Referring to Figures 4 and 5, a refrigerator refrigerator has a pair of cooling compartments 2, 3 in a cabinet 1, which are separated from each other by a partition 5. The cooling compartments 2, 3 are respectively a freezing compartment 2 and a fresh food compartment 3. Doors 6, 7 provide access to respective cooling compartments 2, 3. Shelves 8, on which food can be placed are installed in the fresh food compartment 3. The shelves 8 divide the fresh food compartment 3 into three stratified areas, i.e., an upper area, a middle area, and a lower area. A special fresh chamber 18 for storing food which requires a specific temperature range is formed in the upper part of the fresh food compartment 3 and a vegetable chamber 19 for storing vegetables is formed in the lower part of the fresh food compartment 3.

**[0021]** A cooling system is installed in the cabinet 1 and comprises a compressor (not shown), a condenser (not shown) and an evaporator 12b. The cool air generated by the evaporator 12b is supplied to the fresh food compartment 3 by a fresh food compartment fan 13b.

**[0022]** A duct housing 50 forming a cool air duct 15, providing a passage for cool air supplied from the evaporator 12b, is installed at the back of the fresh food compartment 3. The duct housing 50 comprises a duct member 21, a front plate 23 installed in front of the duct member 21, a seal plate 25 attached to the rear side of the duct member 21, and a duct cover 40, which has the form of a partial cylinder, surrounding the cool air dispersing device 30.

**[0023]** The duct cover 40 is formed with cool air discharge ports 16 one above another, which open into the fresh food compartment 3. The front plate 23 is disposed in the same plane with the inner wall of the fresh food compartment 3 and the duct cover 40 protrudes from the front plate 23 into the fresh food compartment 3. Thus, the duct cover 40 protrudes somewhat from the rear wall of the fresh food compartment 3 and thereby the cool air guided by the cool air dispersing device 30 is distributed through a great angular range.

**[0024]** The cool air dispersing device 30 comprises a plurality of vertically dispersing blades 14 and frames 20. Each of the vertically dispersing blades 14 is a rectangular plate and is disposed near a discharge port 16. The vertically dispersing blades 14 is rotatable around horizontal axes and control the vertical discharge direction of cool air supplied to the fresh food compartment 3 according to their angular positions.

**[0025]** The frames 20 are formed together with groups of the vertically dispersing blades 14 and support their respective groups of vertically dispersing blades 14 so that blades of a group are maintained parallel to each other. Three discharge ports 16 are provided in the duct cover 40 and three frames 20 respectively correspond to the three discharge ports 16. Horizontal stub shafts 28 project sideways from the sides of the frames 20 and

are received in shaft holes 41 formed in the side flanges of the duct cover 40. Thus, the frames 20 are rotatable around the horizontal shafts 28 and the vertically dispersing blades 14 are therefore also rotatable around the horizontal shafts 28.

**[0026]** A user can control the rotational position of the vertically dispersing blades 14 manually. If the vertically dispersing blades 14 are rotated upward, cool air is discharged upwards into the fresh food compartment 3, and if the vertically dispersing blades 14 are rotated downward, cool air is discharged downwards into the fresh food compartment 3. Accordingly, cool air is discharged in a direction set by the user, so cool air can be discharged toward a particular area of the fresh food compartment 3. When food is newly placed in a particular area of the fresh food compartment 3, the user can concentrate the cool air towards the newly placed food by setting the angular positions of the vertically dispersing blades 14. Furthermore, since the rotational positions of the respective frames 20 can be controlled independently of each other, their cool air discharge directions can be controlled independently of each other.

**[0027]** The construction of the cool air dispersing device 30 is simple, so it is easy to manufacture and manufacturing costs are reduced. Moreover, since the vertically dispersing blades 14 have a planar plate shape, vortices do not form in the cool air stream.

**[0028]** Referring to Figures 7 to 10, in a cool air dispersing device 30a of a second refrigerator bodiment, the constructions of the duct cover 40, vertically dispersing blades 14, and the frames 20 are substantially the same as those of the first embodiment. In this embodiment, however, the cool air dispersing device 30a further comprises a device 32 for reciprocally rotating the vertically dispersing blades 14 through a predetermined angular range.

**[0029]** The rotating device 32 comprises a driving motor 36, and a transmission device 39 for transmitting the rotation of the driving motor 36 to the frames 20 as reciprocal rotation. The transmission device 39 comprises a raising and lowering member 33 and a driving cam 34.

**[0030]** The raising and lowering member 33 takes the form of a long rod disposed vertically in the cool air duct 15. Each of the frames 20 has a pivot pin 28a formed at a position distanced from its horizontal shafts 28. The raising and lowering member 33 is formed with three pivot holes 31 corresponding to respective ones of the three frames 20. The pivot pins 28a are inserted into respective pivot holes 31, so the frames 20 reciprocally rotate about the axes of their respectivw pivot pins 28a while the raising and lowering member 33 is being raised and lowered.

**[0031]** The crank, or driving cam, 34 has a body 34b coupled to the driving shaft 37 of the driving motor 36 and an eccentric shaft 34a formed on the body 34b. The eccentric shaft 34a is eccentric with respect to the driving shaft 37. A slot 35 is disposed horizontally at the top of the raising and lowering member 33. The eccentric shaft 34a is accommodated in the slot 35. Accordingly, as the crank 34 is rotated by the driving motor 36, the raising and lowering member 33 is raised and lowered by the eccentric shaft 34a as shown in Figures 8 through 10, thereby reciprocally rotating the vertically dispersing blades 14 about horizontal axes.

**[0032]** When the vertically dispersing blades 14 are disposed horizontally as shown in Figure 8 while the driving motor 36 is operating, cool air in the cool air duct 15 is discharged horizontally into the fresh food compartment 3 and when the vertically dispersing blades 14 are rotated upwards or downwards as shown in Figures 9 and 10 respectively, while the driving motor 36 is operating, cool air in the cool air duct 15 is discharged upwards and downwards into the fresh food compartment 3 depending on the angular positions of the vertically dispersing blades 14. As the vertically dispersing blades 14 are reciprocally rotated continuously, cool air is dispersed into the fresh food compartment 3.

**[0033]** When a rise in temperature of a particular area in the fresh food compartment 3 is detected by a temperature sensor (not shown), concentrated cooling is performed by stopping the driving motor 36 when the vertically dispersing blades 14 are rotated so that the cool air is discharged toward that area.

**[0034]** The construction of the cool air dispersing device 30a is simple, so it is easy to manufacture it and manufacturing costs are reduced. Moreover, since the vertically dispersing blades 14 have a planar plate shape, vortices do not form in the cool air stream.

**[0035]** Referring to Figures 11 to 13, in a cool air dispersing device 30b of a third refrigerator, the constructions of the duct cover 40 and vertically dispersing blades 14 are similar to those of the first and second embodiments.

**[0036]** Three vertically dispersing blades 14 are provided for each discharge port 16. Each of the vertically dispersing blades 14 has horizontal stub shafts 58 projecting sideways from opposite sides and a plurality of shaft holes 41a are provided in side flanges of the duct cover 40. The horizontal shafts 58 are received in the shaft holes 41a, so each of the vertically dispersing blades 14 is capable of rotating around its horizontal shafts 58.

**[0037]** A hinge part 59 is formed at the rear edge of each vertically dispersing blade 14. Three vertical blades 14 are provided at each discharge port 16 and are linked together one link member 60. The link member 60 has comprises a vertical rod and each link member 60 has three hinge assembly parts 61 which engage the hinge parts 59 of respective vertically dispersing blades 14. The vertically dispersing blades 14 within each group are maintained parallel with each other by the link member 60.

**[0038]** In the present embodiment, like the above-described first embodiment, the user can control the rotational position of the vertically dispersing blades 14 manually. When the vertically dispersing blades 14 are

rotated upwards, cool air is discharged upwards into the fresh food compartment 3, and when the vertically dispersing blades 14 are rotated downwards, cool air is discharged downwards into the fresh food compartment 3. Accordingly, cool air is discharged in directions set by the user so cool air can be discharged toward a particular area. Furthermore, the cool air discharge directions can be controlled independently for each group of vertically dispersing blades 14 as shown in Figure 13.

**[0039]** The construction of the cool air dispersing device 30b is simple, so it is easy to manufacture and manufacturing costs are reduced. Moreover, since the vertically dispersing blades 14 have a planar plate shape, votices do not form in the cool air stream.

**[0040]** As described above, according to the present invention, cool air can be dispersed vertically by the vertically dispersing blades, and the vortices do not form in the cool air stream near cool air discharge ports. Further, since the construction of the cool air dispersing device is simple, it can be manufactured easily and the manufacturing cost is low.

**[0041]** Although the present invention has been described and illustrated in detail, it is clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation.

## Claims

1. A refrigerator comprising a cooling compartment (3), means (13b) for driving cool air through an aperture (16) into the cooling compartment (3), and flow directing means (30; 30a; 30b) associated with the aperture (16) for directing said cool air, characterised in that the flow directing means (30; 30a; 30b) comprises a plurality of flow-directing blades (14), which are rotatable about a common horizontal axis or respective horizontal axes, coupled so as to remain parallel to one another when rotated.

2. A refrigerator according to claim 1, wherein the blades (14) comprise the slats of a louvred structure (20).

3. A refrigerator according to claim 2, including driving means (32) for reciprocally rotating the blades about said common axis.

4. A refrigerator according to claim 3, wherein the driving means (32) comprises a motor (36), a vertical actuator member (33) having a transverse slot (35) at one end, and a crank (34) drivingly coupled to the motor (36) and having a shaft (34a) received in the slot (35), the actuator member (33) engaging the louvred structure (20) such the louvred structure (20) reciprocates about said common axis when the actuator member (33) is reciprocated vertically by operation of the motor (36).

5. A refrigerator according to claim 1, wherein the blades (14) are rotatable about respective horizontal axes and are coupled such that they are forced to move in unison and remain parallel to one another when being rotated.

6. A refrigerator comprising a cooling compartment (3), means (13b) for driving cool air through a plurality of apertures (16) into the cooling compartment (3), and flow directing means (30; 30a; 30b) associated with the apertures (16) for directing said cool air, **characterised in that** the flow directing means (30; 30a; 30b) comprises a plurality of flow-directing blades (14) and each aperture (16) has associated therewith at least one of said blades (14), the blades (14) associated with different apertures (16) being independently rotatable for independently controlling the direction of cool air flowing through the associated apertures (16).

7. A refrigerator according to claims 1 and 6.

8. A refrigerator comprising:

   a duct housing forming a cool air duct for guiding cool air generated by an evaporator, said duct housing having a cool air discharge port open into a cooling compartment;
   a plurality of cool air dispersing blades of planar plate shape being installed near the discharge port in said cool air duct so as to be capable of rotating, said blades for controlling a discharge direction of the cool air supplied into said cooling compartment according to a rotational position thereof; and
   a means for supporting said blades so as to be maintained parallel with each other.

9. The refrigerator as claimed in claim 7, wherein said supporting means is a frame formed together with said blades.

10. The refrigerator as claimed in claim 7, wherein said supporting means is a link member having a plurality of hinge assembly parts respectively assembled with said blades at positions distanced from rotational axes thereof.

11. The refrigerator as claimed in claim 7, wherein a plurality of discharge ports are provided, and a plurality of blades corresponding to every discharge port.

12. The refrigerator as claimed in claim 11, wherein the plurality of discharge ports are disposed vertically.

13. The refrigerator as claimed in claim 11, wherein said blades corresponding to each of the discharge ports

can be rotated independently of said blades corresponding to the other discharge ports.

**14.** The refrigerator as claimed in claim 9, further comprising a means for reciprocally rotating said blades within a predetermined angular range.

**15.** The refrigerator as claimed in claim 14, wherein said rotating means comprises:

a driving motor; and
a means for transmitting rotation of said driving motor to said frame as a reciprocal rotation.

**16.** The refrigerator as claimed in claim 15, wherein said transmitting means comprises:

an elevation/de-elevation member assembled with said frame at a position distanced from a rotational axis thereof; and
a driving cam rotated by said driving motor and elevating/de-elevating said elevation/de-elevation member.

**17.** The refrigerator as claimed in claim 16, wherein said driving cam has an eccentric shaft which is eccentric against a driving shaft of said driving motor, and said elevation/de-elevation member has a slot being formed horizontally, said slot for receiving said eccentric shaft.

**18.** The refrigerator as claimed in claim 8, wherein said blade is a vertically dispersing blade capable of rotating with respect to a horizontal axis, said vertically dispersing blade for controlling a vertical discharge direction of the cool air supplied into said cooling compartment according to the rotational position thereof.

FIG.1
(PRIOR ART)

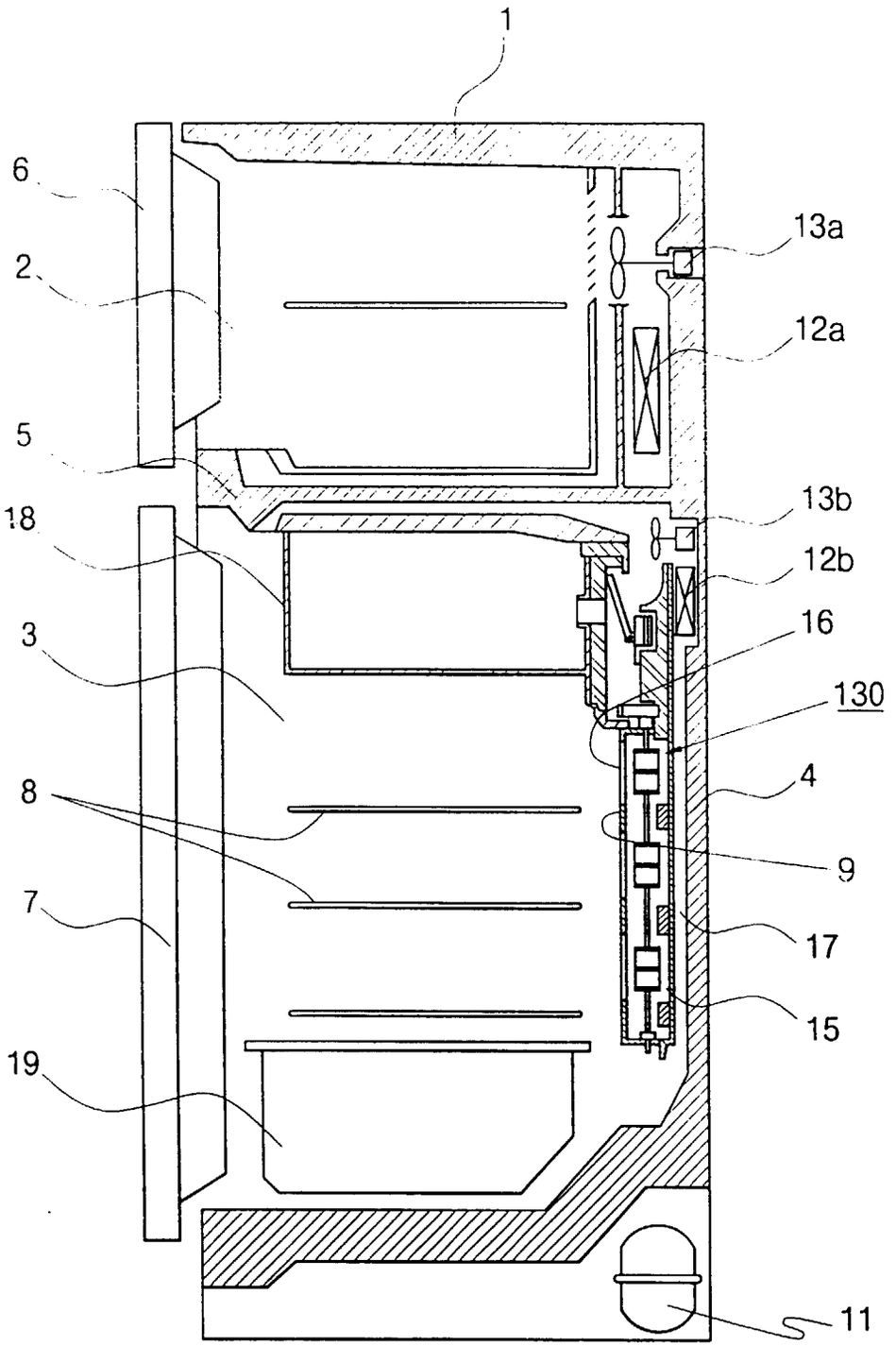

FIG.2
(PRIOR ART)

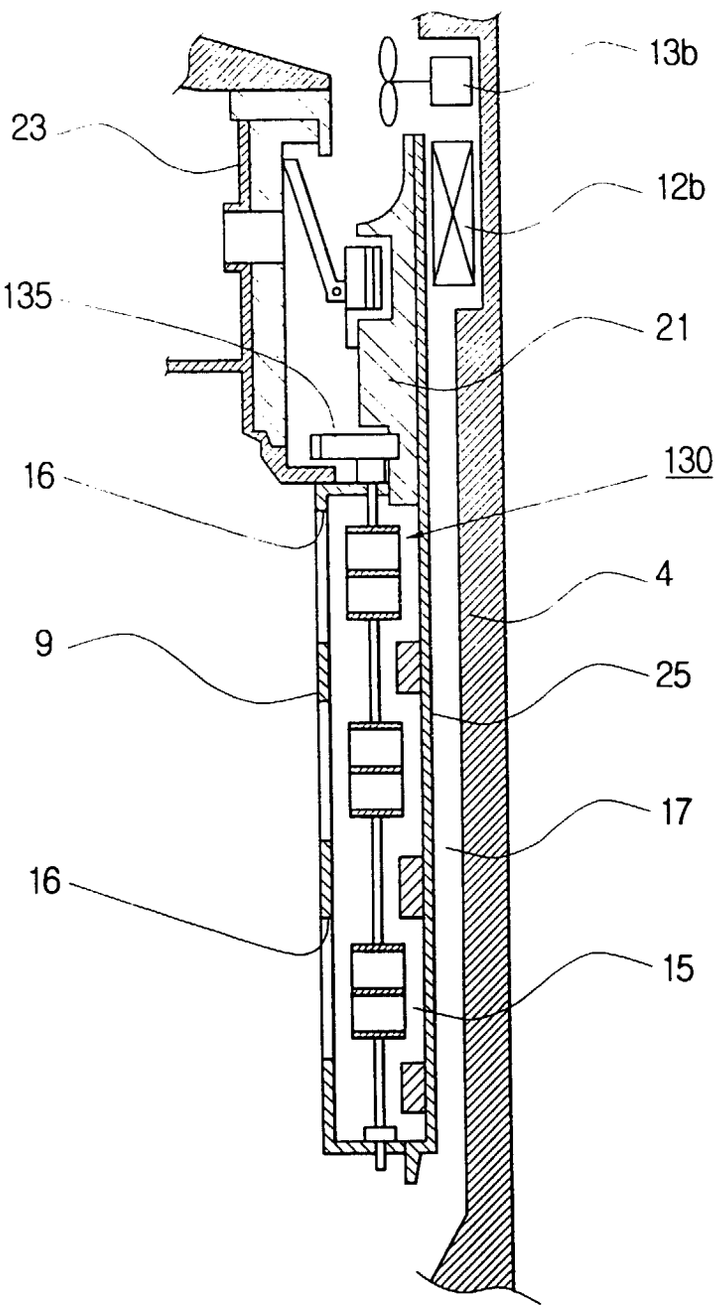

FIG.3
(PRIOR ART)

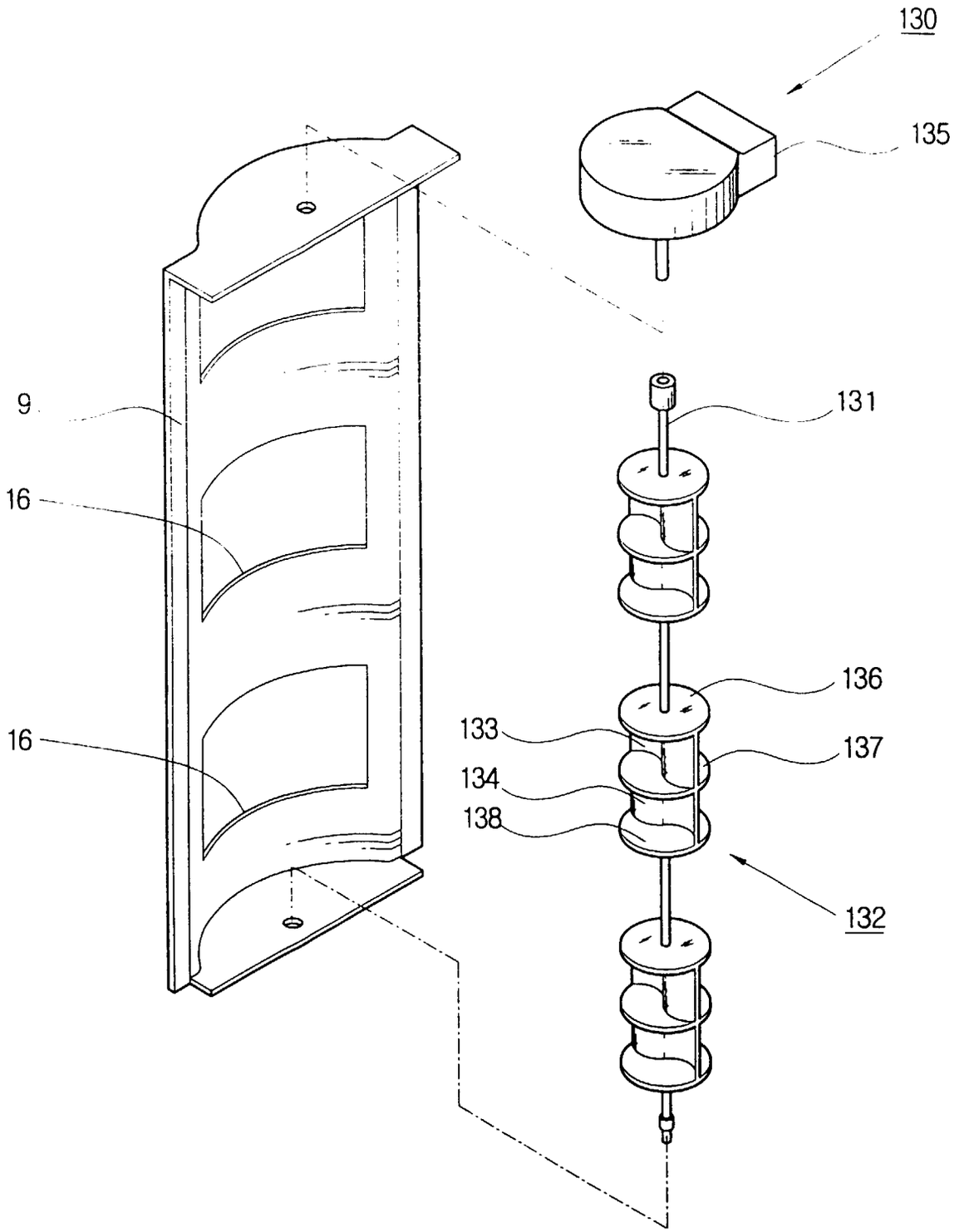

FIG.4

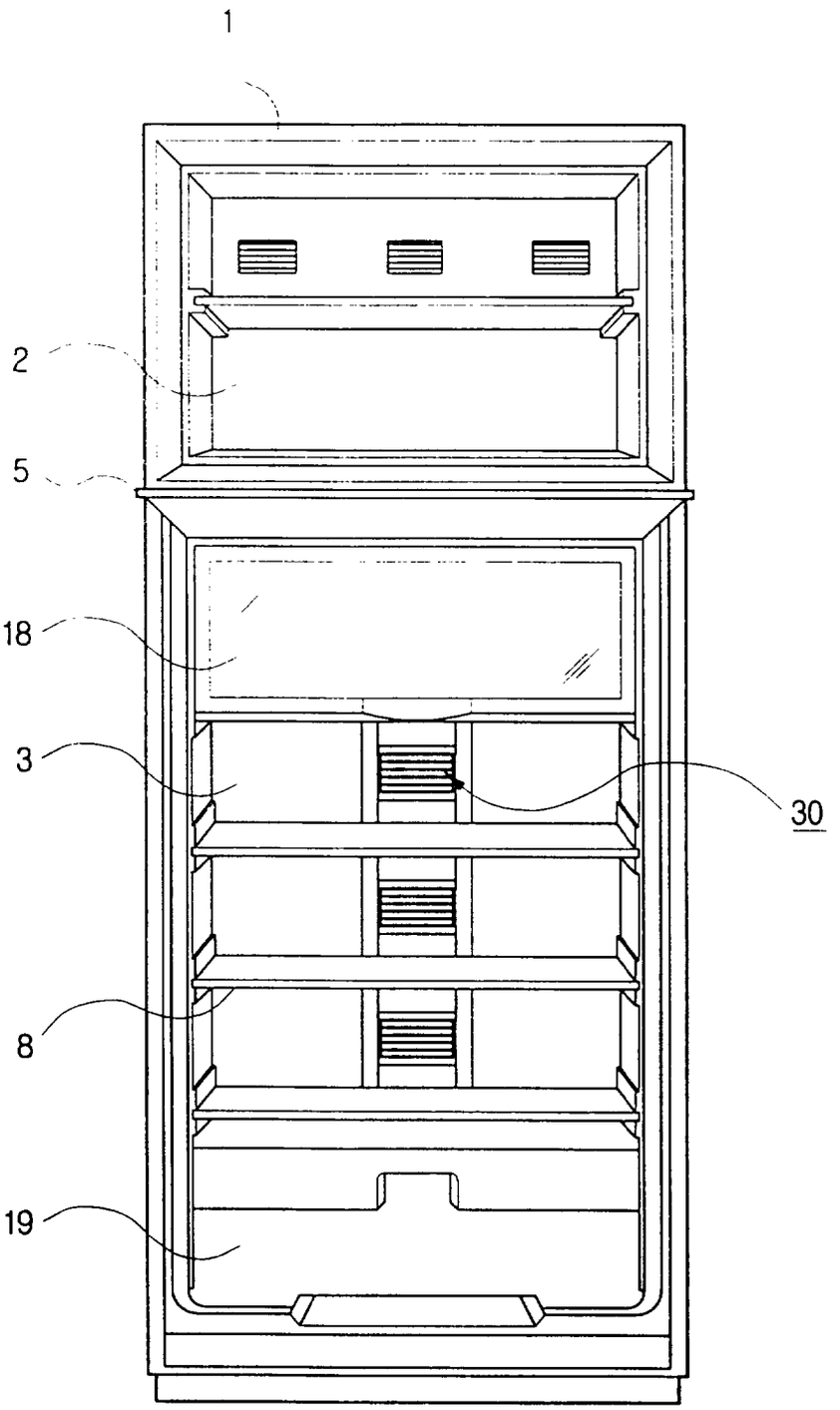

FIG.5

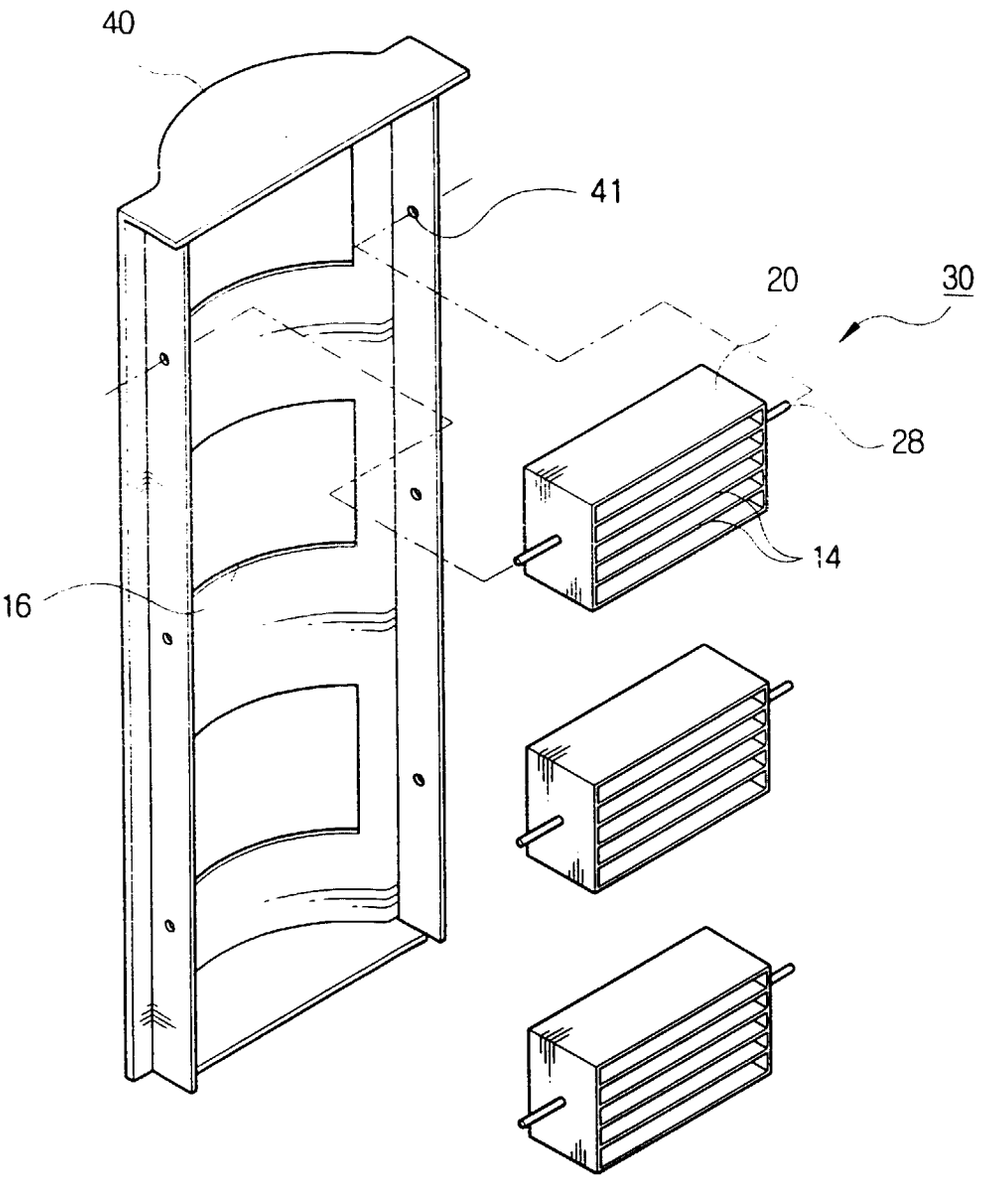

FIG.6

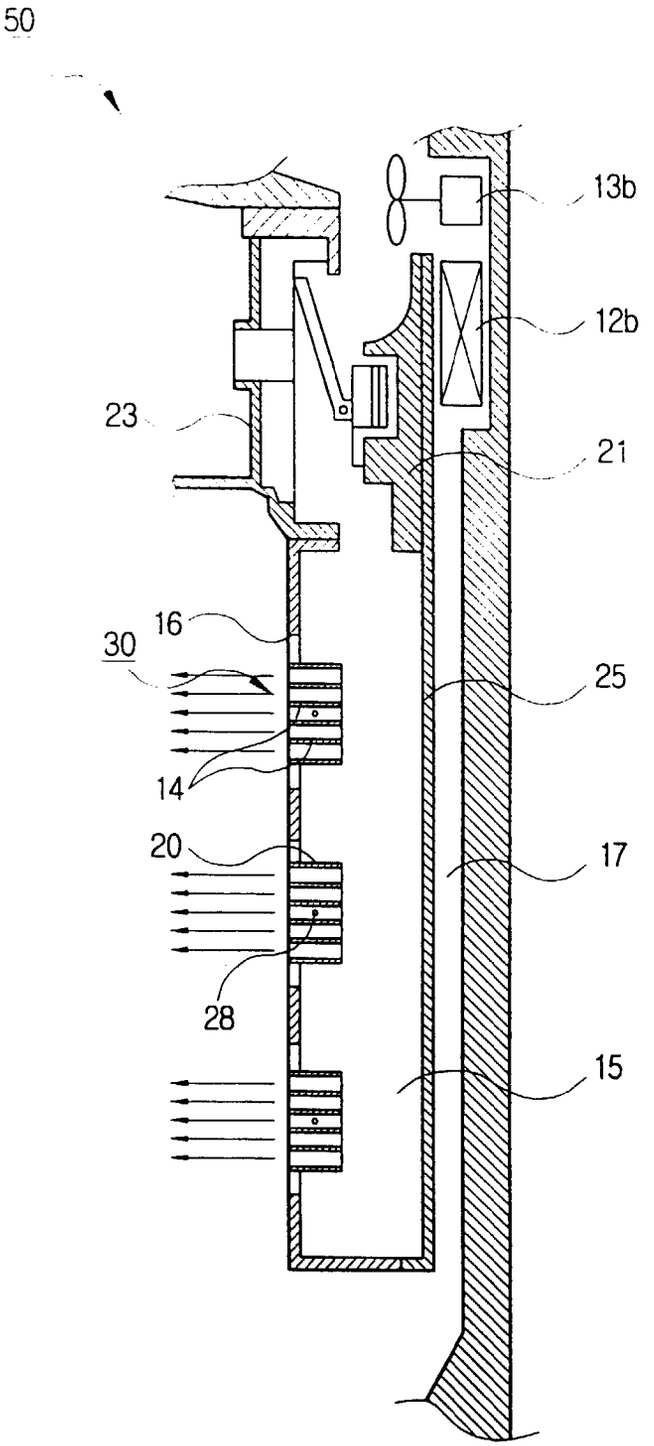

FIG.7

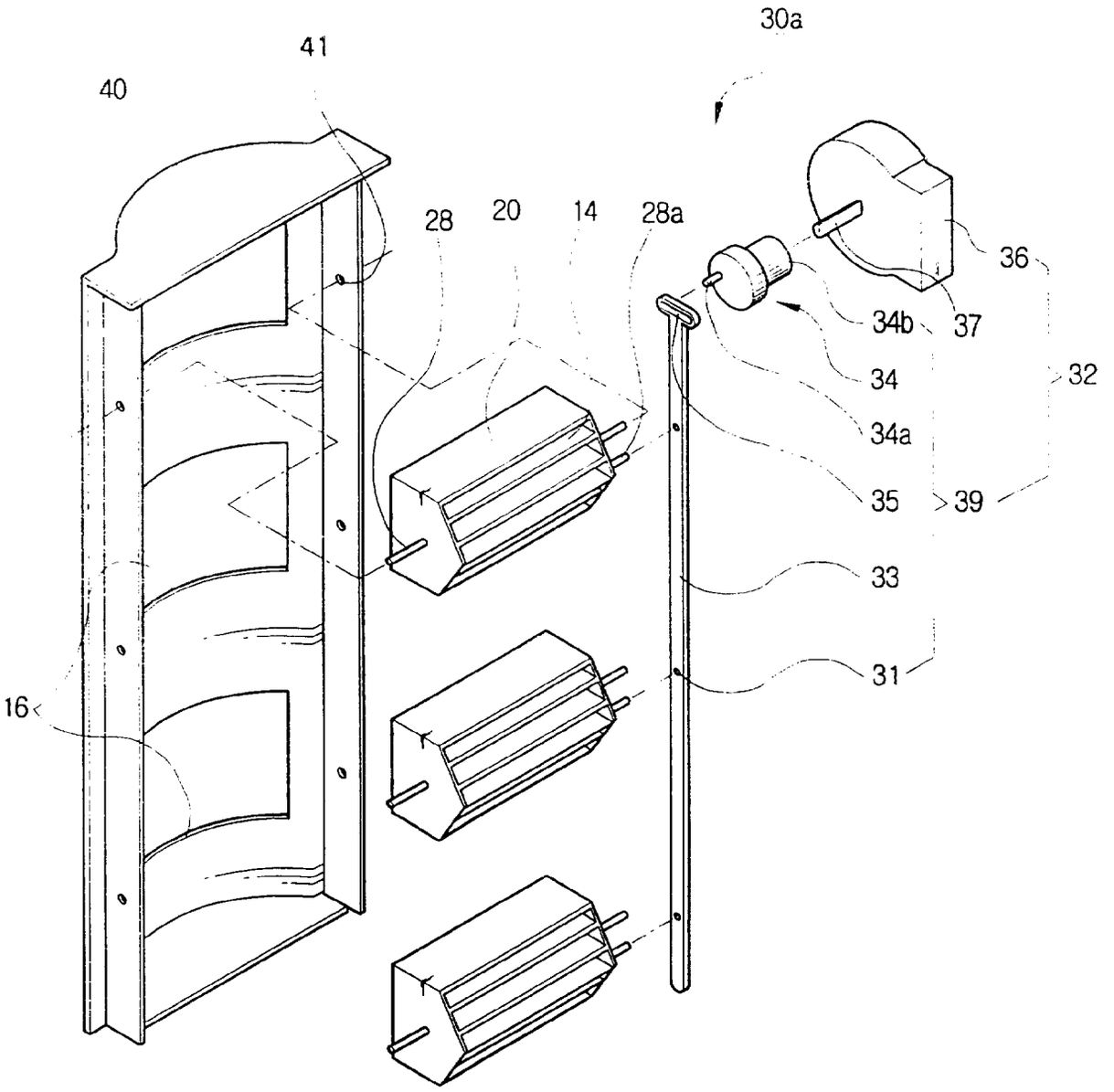

FIG.8

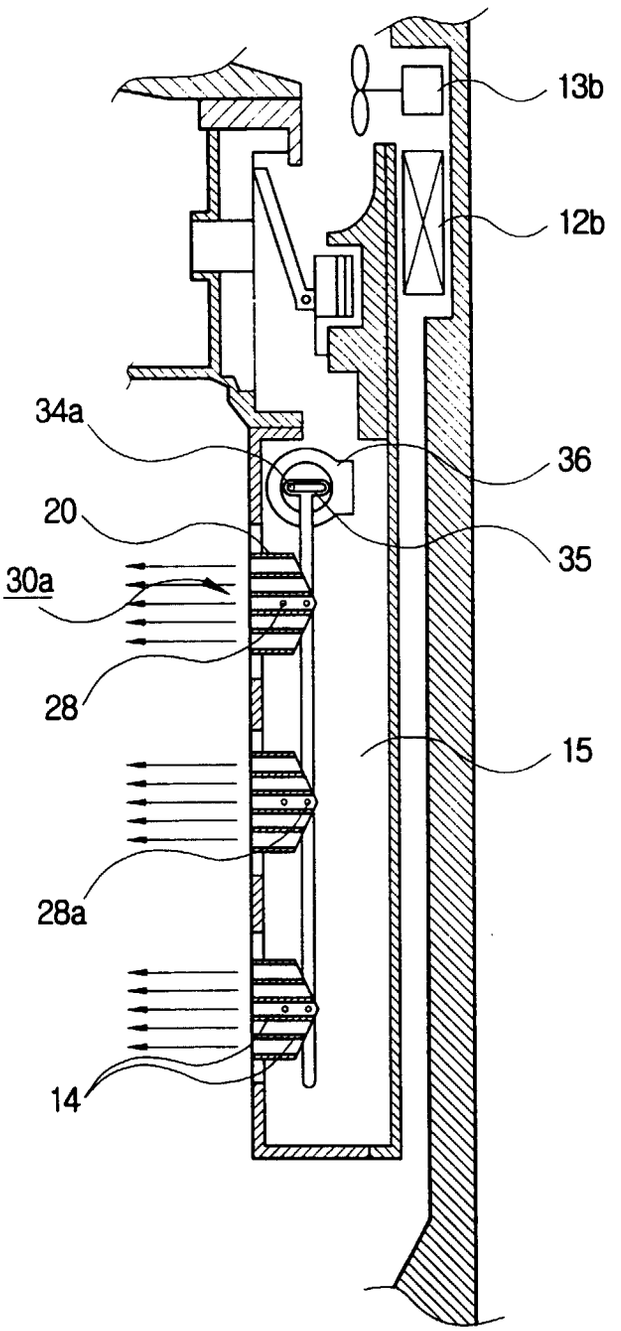

FIG.9

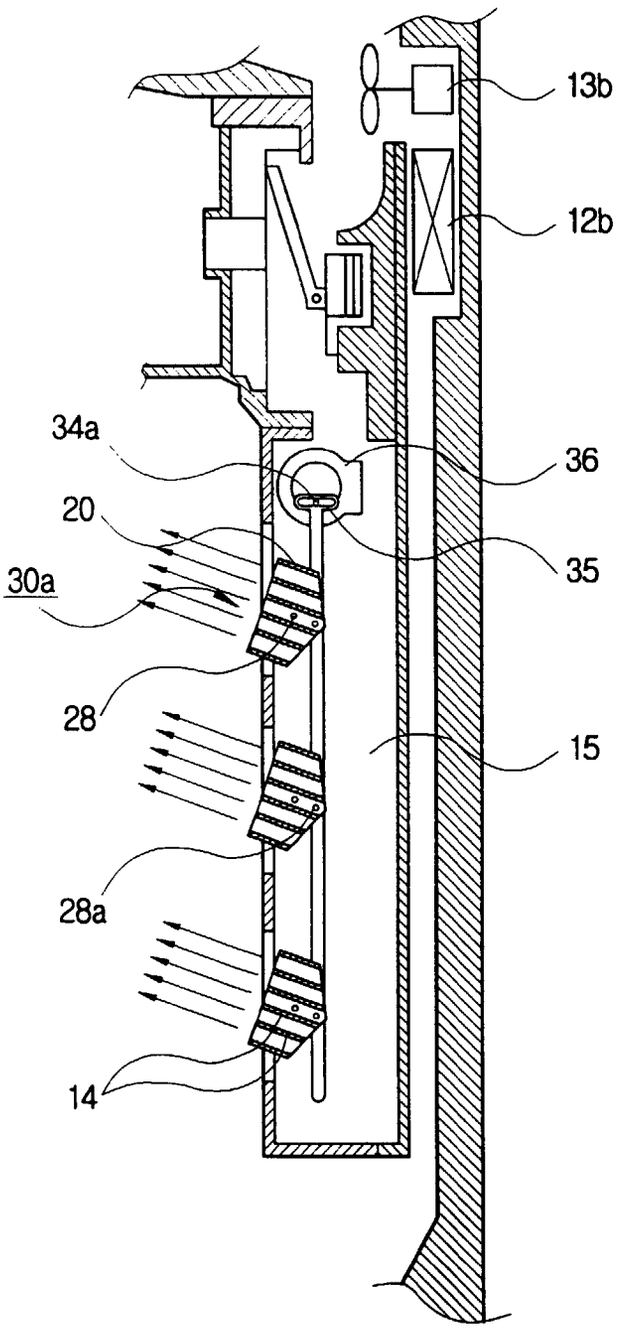

FIG. 10

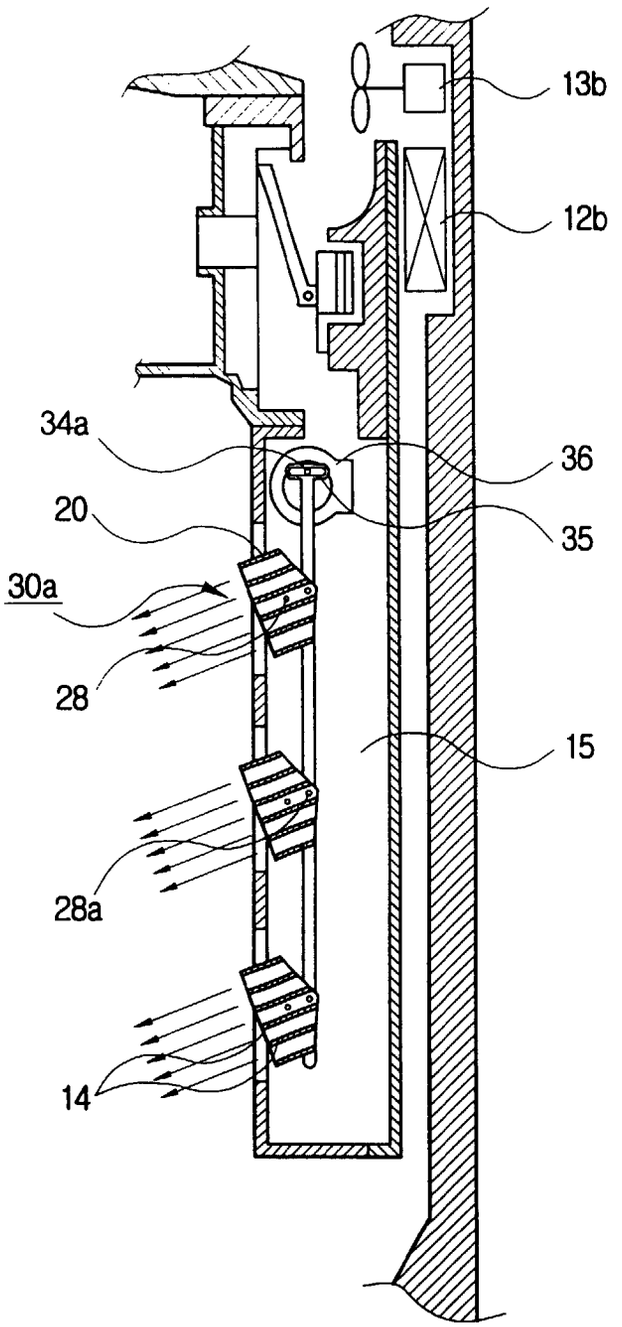

FIG. 11

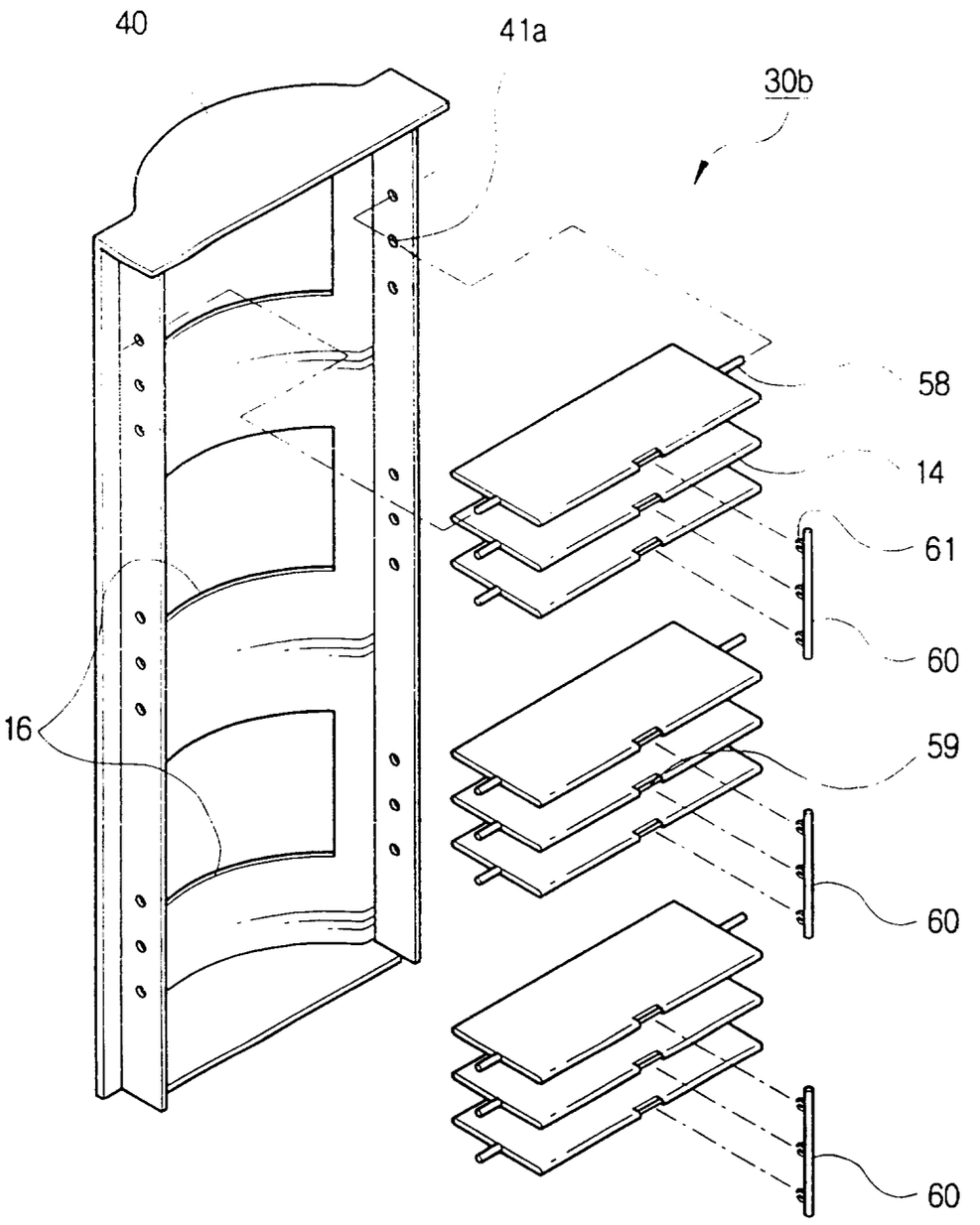

FIG. 12

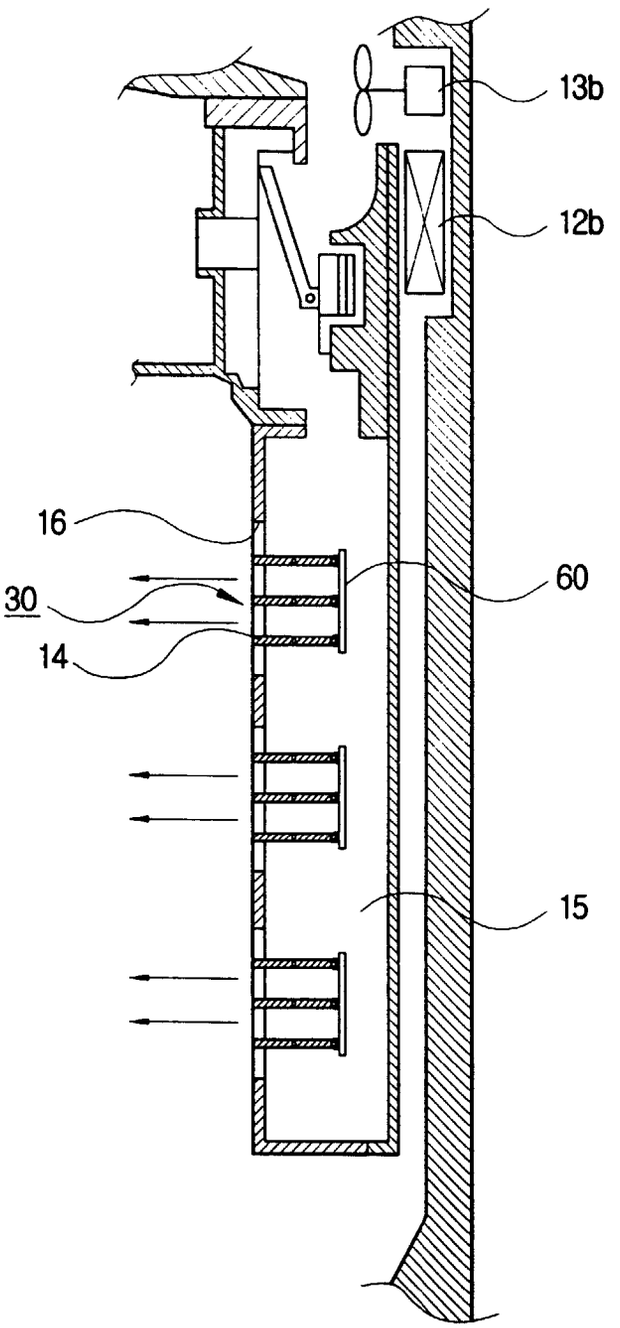

FIG. 13