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(71) Applicant: **Samsung Electronics Co., Ltd.**
Suwon-city, Gyungki-do (KR)

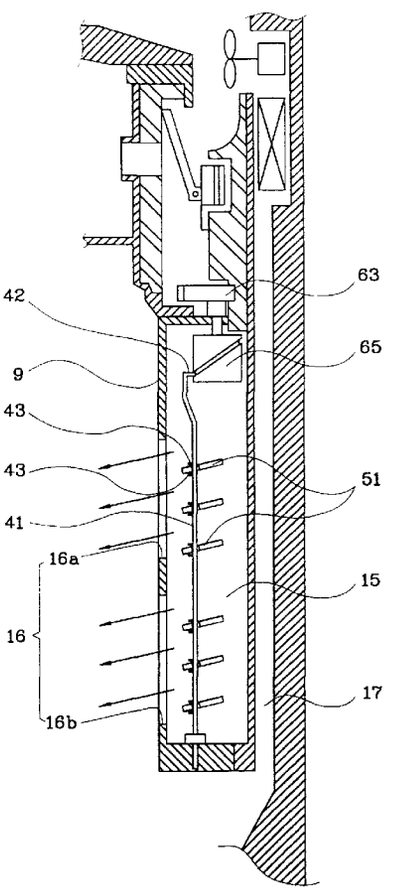
(72) Inventor: **Ji, Joon Dong**
Paldal-ku, Suwon-City, Kyungki-do (KR)

(74) Representative: **Geary, Stuart Lloyd et al**
Venner, Shipley & Co.,
20 Little Britain
London EC1A 7DH (GB)

(54) Refrigerator with cool air distributing means

(57) Cool air is supplied to the food compartment (3) of a refrigerator through a plurality of apertures (16) in the rear wall of the food compartment (3). Behind each aperture is a plurality of blades (51) that are reciprocated about respective horizontal axes in such a way that they remain plane parallel to each other.

FIG.8



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Description

[0001] The present invention relates to a refrigerator comprising a cooling compartment, an aperture opening into the compartment, a heat pump and cool air distributing means for supplying cool air generated by the heat pump to the compartment through the aperture.

[0002] Generally, a refrigerator has a cabinet in which there are a freezing compartment and a fresh food compartment. A partition wall separates these compartments. Doors are provided at the front of the freezing and cooling compartments. A cooling system supplies the freezing compartment and the fresh food compartment with cool air and comprises a compressor, a condenser and an evaporator. The cool air generated by the evaporator flows along a supply duct formed at the back of each compartment, and is then supplied into each cooling compartment through cool air discharge ports opening thereinto by a fan.

[0003] In such a conventional refrigerator, however, cool air tends to be supplied into a particular area of the cooling compartment and other areas tend to be less well served. Consequently, a uniform temperature is not maintained throughout the cooling compartment.

[0004] This problem has been addressed by providing cool air discharge ports in the side walls of the cooling compartment as well as in its rear wall. However, there may be still a dead-zone at an edge area which is not supplied with the cool air sufficiently. Furthermore, the ducting required to supply cool air from the sides of the cooling compartment reduces the space available for food and increases the cost of manufacture.

[0005] The problem of adequately distributing cool air in a refrigerator is worse for larger refrigerators.

[0006] Figures 1 through 3 are a side view, a partial enlarged sectional view, and an exploded perspective view of the main elements of a refrigerator having a device for dispersing cool air as disclosed in WO-A-95/27278.

[0007] Referring to Figures 1 to 3, a refrigerator comprises freezing and fresh food compartments 2, 3 in a cabinet 1, which are separated from each other by a partition 5. Respective doors 6, 7 are provided for closing the compartments 2, 3. A cooling system, comprising a compressor 11, a condenser (not shown), a freezing compartment evaporator 12a, and a fresh food compartment evaporator 12b, is installed in the cabinet 1. 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.

[0008] A partially cylindrical duct plate 9 is attached to an inner wall plate 23 forming the rear inner wall surface of the fresh food compartment 3. The duct plate 9 has cool air discharge ports 16, opening into the fresh food compartment 3, formed in it. A supply duct 15 and a return 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 cool air blown by the fresh food compartment fan 13b, is installed in the supply duct 15. Cool air generated by the fresh food compartment evaporator 12b is blown by the fresh food compartment fan 13b and then supplied to the fresh food compartment 3 via the supply duct 15 and the cool air discharge ports 16.

[0009] A cool air dispersing device 130 is installed in the supply duct 15. The cool air dispersing device 130 comprises a rotational shaft 131 having a vertical axis, cool air dispersing blades 132 assembled with the rotational shaft 131 in correspondence with respective cool air discharge ports 16, and a driving motor 135 for rotating the rotational shaft 131. Each of the cool air dispersing blades 132 comprises three discs 136, 137, 138 disposed in parallel with each other along the shaft 131, and first and second blade parts 133, 134 disposed between pairs of the discs 136, 137, 138. Each of the blade parts 133, 134 is curved so that its cross-section is loosely S-shaped. The blade parts 133, 134 are bent in opposite directions to each other.

[0010] In a refrigerator having the above-described constitution, when the driving motor 131 rotates the rotational shaft 131 at a low speed, cool air flowing along the supply duct 15 changes its direction along the curved surfaces of the cool air dispersing blades 132, and is directed into the fresh food compartment 3 so as to disperse horizontally. When concentrated cooling in a specific area is needed, the driving motor 135 stops the rotational shaft 131 so that the cool air dispersing blades 132 direct cool air to the specific area. However, since the blade parts 133, 134 of the cool air dispersing device 130 are S-shaped, the left or right sides of the fresh food compartment 3 may not be supplied with the cool air sufficiently and the smooth flow of cool air may be impeded by a vortices in the cool air formed about the cool air discharge ports 16.

[0011] A refrigerator according to the present invention is characterised in that the cool air distributing means includes a plurality of blades associated with said aperture and mounted for rotational movement about respective horizontal axes and drive means for reciprocating the blades about said respective axes such that the blades remain plane parallel to each other.

[0012] Preferably, the drive means includes an elongate vertical member, drivingly engaging each of the blades. More preferably, the vertical member passes through each blade and is provided with a plurality of pairs of bulges, respective members of each pair of bulges being located immediately above and immediately below a respective blade. Still more preferably, each blade has a substantially keyhole-shaped hole through which the vertical member extends, the larger portion of each hole being large enough for the bulges to pass therethrough and the smaller portion of each hole being too small for the bulges to pass therethrough.

[0013] Preferably, the drive means comprises a motor drivingly coupled to a cylindrical member, the cylindrical

member having a groove, forming an inclined loop about its circumferential surface, which receives a finger projecting from an end of the vertical member.

[0014] 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 a side sectional view of Figure 4;
Figure 6 is an enlarged exploded perspective view of the cool air dispersing device shown in Figures 4 and 5;
Figure 7 is an enlarged transverse sectional view of the elements of Figure 6 in their assembled state;
Figures 8 and 9 are side sectional views of the elements of Figure 6 in their assembled state;
Figure 10 is an enlarged perspective view of a cool air dispersing device of a second refrigerator according to the present invention;
Figure 11 is an enlarged transverse sectional view of the elements of Figure 10 in their assembled state; and
Figures 12 and 13 are side sectional views of the elements of Figure 10 in their assembled state.

[0015] Hereinafter, an exemplary embodiment of the present invention will be described in detail with reference to the accompanying drawings. Parts that are the same as or similar to parts shown in Figures 1 through 3 will be identified with the same reference numerals. The description of the parts, which are substantially the same as those of the prior art, will be omitted.

[0016] Referring to Figures 4 and 5, a refrigerator according to the present invention comprises a freezing compartment 2 and a cooling compartment 3 in a cabinet 1. The compartments 2, 3 are separated by a horizontal partition. Doors 6, 7 are provided respectively for the compartments 2, 3. Shelves 8 for supporting food are provided in the fresh food compartment 3 and divide it into three areas one above another. A special fresh chamber 18 for storing food that requires a specific temperature range is formed at the top of the fresh food compartment 3 and a vegetable chamber 19 for storing vegetables is formed at the bottom of the fresh food compartment 3. A heat pump, comprising a compressor 11, a condenser (not shown), a freezing compartment evaporator 12a, and a fresh food compartment evaporator 12b, is installed in the cabinet 1. Cool air generated by the evaporators 12a, 12b is supplied into the corresponding cooling compartments 2, 3 by the freezing compartment fan 13a and the fresh food compartment fan 13b. A supply duct 15 and a return duct 17 are provided at the back of the fresh food compartment 3. The cool air generated by the fresh food compartment evaporator 12b is driven by the fresh food compartment fan 13b into the fresh food compartment 3 via the supply duct 15 and the cool air discharge ports 16. A device 30 for dispersing the cool air vertically is installed in the supply duct 15.

[0017] Referring to Figures 6 to 9, the vertically dispersing device 30 comprises a plurality of planar vertically dispersing blades 51, and a rotary device 61 for vertically reciprocating the vertical dispersing blades 51 through a predetermined angle.

[0018] The vertical dispersing blades 51 are installed in the supply duct 15. Three vertical dispersing blades 51 are provided for each of upper and lower cool air discharge ports 16a, 16b. The duct plate 9 is bent so as to protrude into the fresh food compartment 3, and the vertically dispersing blades 51 are generally arcuate so as to be accommodated within the duct plate 9.

[0019] Each of the vertically dispersing blades 51 has a horizontal stub shaft 58 formed on either side. On flanges 45, provided at both vertical edges of the duct plate 9, are formed a plurality of shaft holes 47 into which the stub shafts 58 are inserted. As the horizontal shafts 58 are inserted into the shaft holes 47, the vertically dispersing blades 51 are supported and can be rotated. A hole 57 is formed in each of the vertically dispersing blades 51. A link member 41 which will be described below passes through the hole 57. The holes 57 are formed at positions spaced from the stub shafts 58. The rotation device 61 comprises a driving motor 63, a cam 65 rotated by the driving motor 63, and a link member 41 which is raised and lowered by the cam 65. The driving motor 63 is fixed onto a fixing part 49 provided at the top of the duct plate 9.

[0020] The cam 65 comprises of a cylindrical cam body 66 coupled coaxially with a shaft 64 of the driving motor 63, and a cam groove 67 formed on the circumferential surface of the cam body 66. The cam groove 67 is in the form of an inclined closed loop. The link member 41 comprises a vertical rod and passes through the vertically dispersing blades 51 via the holes 57.

[0021] The lower end of the link member 41 is inserted into a supporting hole 29 provided on a lower flange 28 of the duct plate 9. The link member 41 is supported by the supporting hole 29 so as to be capable of rising and falling. The link member 41 has a plurality of pairs of bulges 43 which serve to engage the vertically dispersing blades 51. Each vertically dispersing blade 51 is held between the members of one of the pairs of bulges 43.

[0022] The cam groove 67 receives the free end of a finger 42 which protrudes from the top of the link member 41. Thus, the link member 41 is caused to rise and fall as the cam 65 rotates.

[0023] The operation of the first refrigerator according to the present invention will now be described.

[0024] Referring to Figures 8 and 9, the cam 65 is ro-

tated by the driving motor 63 continuously. When the vertically dispersing blades 51 are tilted downward as shown in Figure 8, cool air in the supply duct 15 is discharged downwards by the vertically dispersing blades 51. When the vertically dispersing blades 51 are tilted upward as shown in Figure 9, cool air is discharged upwards. Accordingly, as the cam 65 is rotating continuously, the vertically dispersing blades 51 reciprocate through a predetermined angle while remaining plane parallel to each other.

[0025] As described, the discharge direction of the cool air is continuously changed as the angular position of the vertically dispersing blades 51 is changed, so the cool air is dispersed into the fresh food compartment 3 uniformly. Moreover, since the vertically dispersing blades 51 are planar, vortices are not formed in the cool air stream by the rotation of the vertically dispersing blades 51.

[0026] Furthermore, if the concentrated supply of the cool air to a specific area, such as an upper area or a lower area, is required, the concentrated cooling can be realized by stopping the driving motor 63 when the vertically dispersing blades 51 are directed to the corresponding area. In such a situation, temperature sensors placed at a plurality of positions in the fresh food compartment 3, as well as a control part for controlling the driving motor 63 on the basis of the sensing signal from the temperature sensors have to be provided.

[0027] Referring to Figures 10 to 13, the parts of a vertically dispersing device 40 of a second embodiment of the present invention that are identical to those in the above-described first embodiment are referred to with the same reference numerals. in the present embodiment, the constructions of the driving motor 63, the cam 65, and the link member 41 are the same as those in the above-described first embodiment.

[0028] Each of the vertically dispersing blades 51 has a generally keyhole-shaped hole comprising a large portion 67 and a small portion 68. The large portion 67 is large enough to allow the bulges 43 to pass through. That is, the diameter of the large portions 67 is larger than that of the small portions 43. The diameter of the small portions 68 is greater than that of the link member 41 and smaller than that of the bulges 43. During assembly, the link member 41 is passed through the large portions 67. Thereafter, the link member 41 is moved sideways so as to be received in the small portions 68. Each blade 51 is then located between the members of a respective pair of bulges 43 as in the first embodiment.

[0029] Since the small hole 68 is smaller than the bulges 43, the bulges 43 support the vertically dispersing blades 51. Furthermore, since the size of the large portions 67 is greater than that of the small potions 43, the link member 41 can be passed through the vertically dispersing blades 51 easily. Therefore, according to the present embodiment, the link member 41 and the vertically dispersing blades 51 can be assembled easily.

[0030] The operation of the vertically dispersing device 40 according to the present embodiment is the same as that of the first embodiment. That is, while the cam 65 is rotating continuously, the vertically dispersing blades 51 reciprocate between a position rotated downward as shown in Figure 12 and a position rotated upward as shown in Figure 13. Therefore, the cool air is dispersed vertically.

[0031] As described above, according to the present invention, a stable cool air flow and a uniform distribution of cool air in vertical direction can be achieved without vortices being formed in the cool air stream near the cool air discharge ports.

[0032] 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), an aperture (16) opening into the compartment (3), a heat pump (11, 12b) and cool air distributing means (13b, 30) for supplying cool air generated by the heat pump (11, 12b) to the compartment (3) through the aperture (16), **characterised in that** the cool air distributing means (13b, 30) includes a plurality of blades (51) associated with said aperture (16) and mounted for rotational movement about respective horizontal axes and drive means (61) for reciprocating the blades (51) about said respective axes such that the blades (51) remain plane parallel to each other.

2. A refrigerator according to claim 1, wherein the drive means (61) includes an elongate vertical member (41), drivingly engaging each of the blades (51).

3. A refrigerator according to claim 2, wherein the vertical member (41) passes through each blade (51) and is provided with a plurality of pairs of bulges (43), respective members of each pair of bulges (43) being located immediately above and immediately below a respective blade (51).

4. A refrigerator according to claim 3, wherein each blade (51) has a substantially keyhole-shaped hole through which the vertical member (41) extends, the larger portion (67) of each hole being large enough for the bulges (43) to pass therethrough and the smaller portion (68) of each hole being too small for the bulges (43) to pass therethrough.

5. A refrigerator according to claim 2, 3 or 4, wherein the drive means (61) comprises a motor (63) drivingly coupled to a cylindrical member (66), the cylindrical member (66) having a groove (67), forming

an inclined loop about its circumferential surface, which receives a finger (42) projecting from an end of the vertical member (41).

6. A refrigerator comprising: a duct plate being installed on a side wall of a cooling compartment, said duct plate for forming a cool air duct in said side wall, said duct plate having at least one cool air discharge port opened into said cooling compartment; a plurality of vertical dispersing blades of planar plate shape being installed in said cool air duct to be capable of rotating with respect to a horizontal axis, said vertical dispersing blades being disposed in parallel with each other; and a means for rotating said vertical dispersing blades reciprocally within a predetermined angular range with respect to said horizontal axis while said vertical dispersing blades are maintained parallel with each other.

7. The refrigerator as claimed in claim 5, wherein said rotating means comprises: a link member having a plurality of assembly parts respectively assembled with said vertical dispersing blades at positions distanced from said horizontal axis, said link member being capable of moving up and down vertically; and a means for elevating/de-elevating said link member.

8. The refrigerator as claimed in claim 7, wherein said link member has a shape of a rod passing through said vertical dispersing blades, and said assembly parts are comprised of assembly protrusions formed on said link member.

9. The refrigerator as claimed in claim 8, wherein a pair of said assembly protrusions support respectively an upper surface and a lower surface of each of said vertical dispersing blades.

10. The refrigerator as claimed in claim 8, wherein each of said vertical dispersing blades has a through-going hole through which said link member and said assembly protrusions pass, and an assembly hole having diameter greater than that of said link member and smaller than that of said assembly protrusions; whereby said link member which has passed through said vertical dispersing blades through said through-going holes is assembled with said assembly holes by being received thereinto.

11. The refrigerator as claimed in claim 7, wherein said elevating/de-elevating means comprises: a driving motor; and a cam for converting a rotational movement of said driving motor to an elevational/de-elevational movement of said link member.

12. The refrigerator as claimed in claim 8, wherein said cam has a cylindrical cam body installed on said rotational shaft coaxially therewith, and a cam groove formed on a circumference of said cam body, which is a closed loop having an elevating/deelevating cam profile; and said link member has an operation protrusion engaged with said cam groove.

FIG.1
(PRIOR ART)

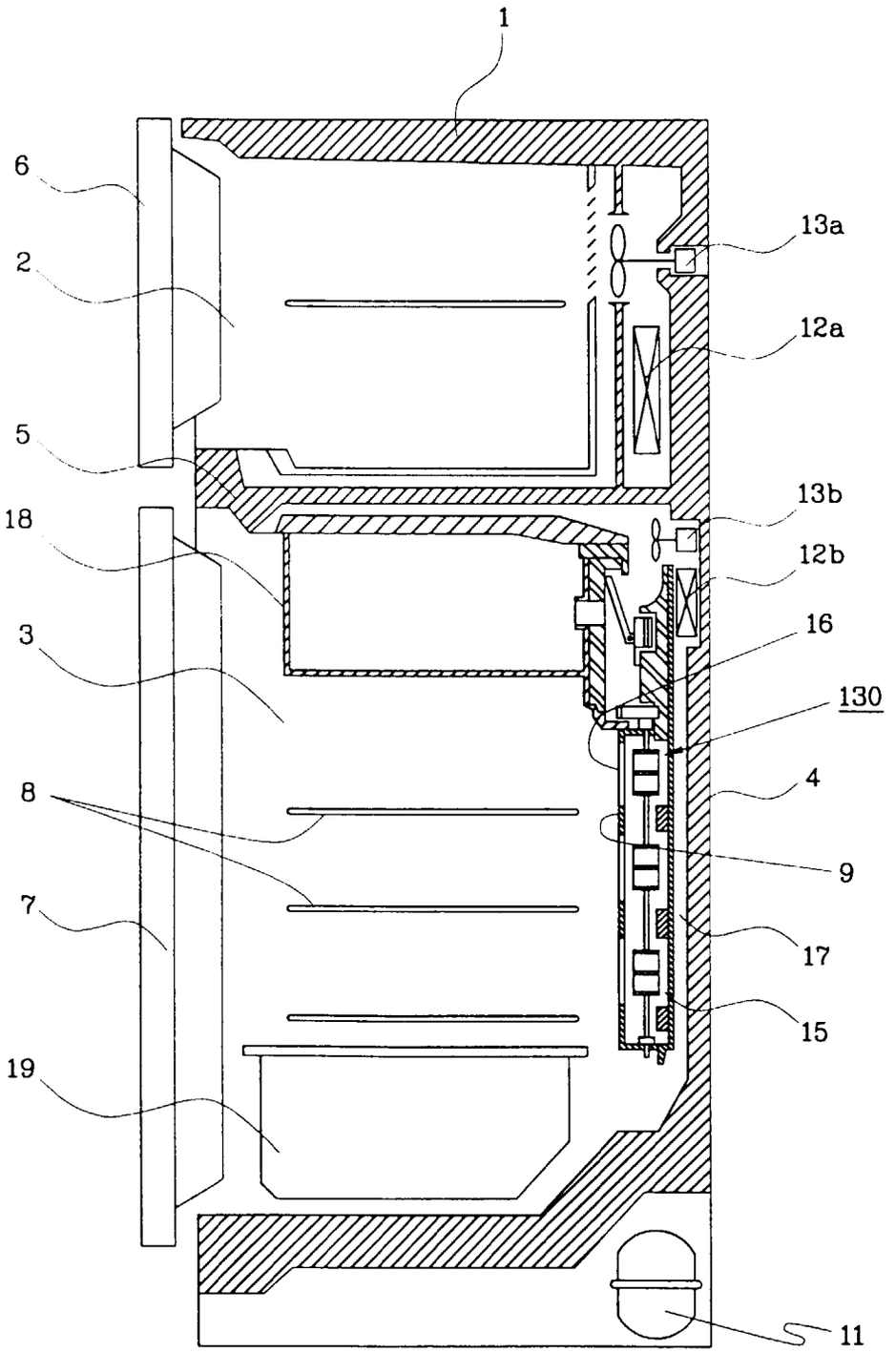

FIG.2
(PRIOR ART)

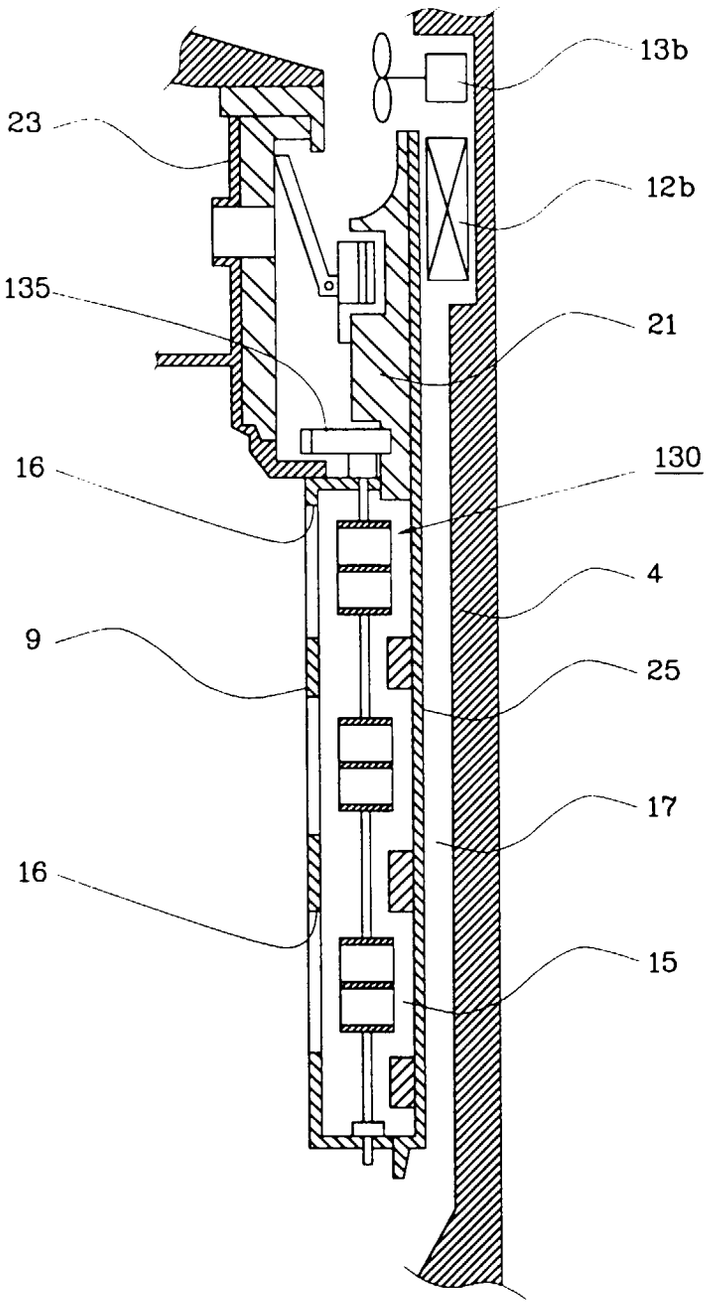

FIG.3
(PRIOR ART)

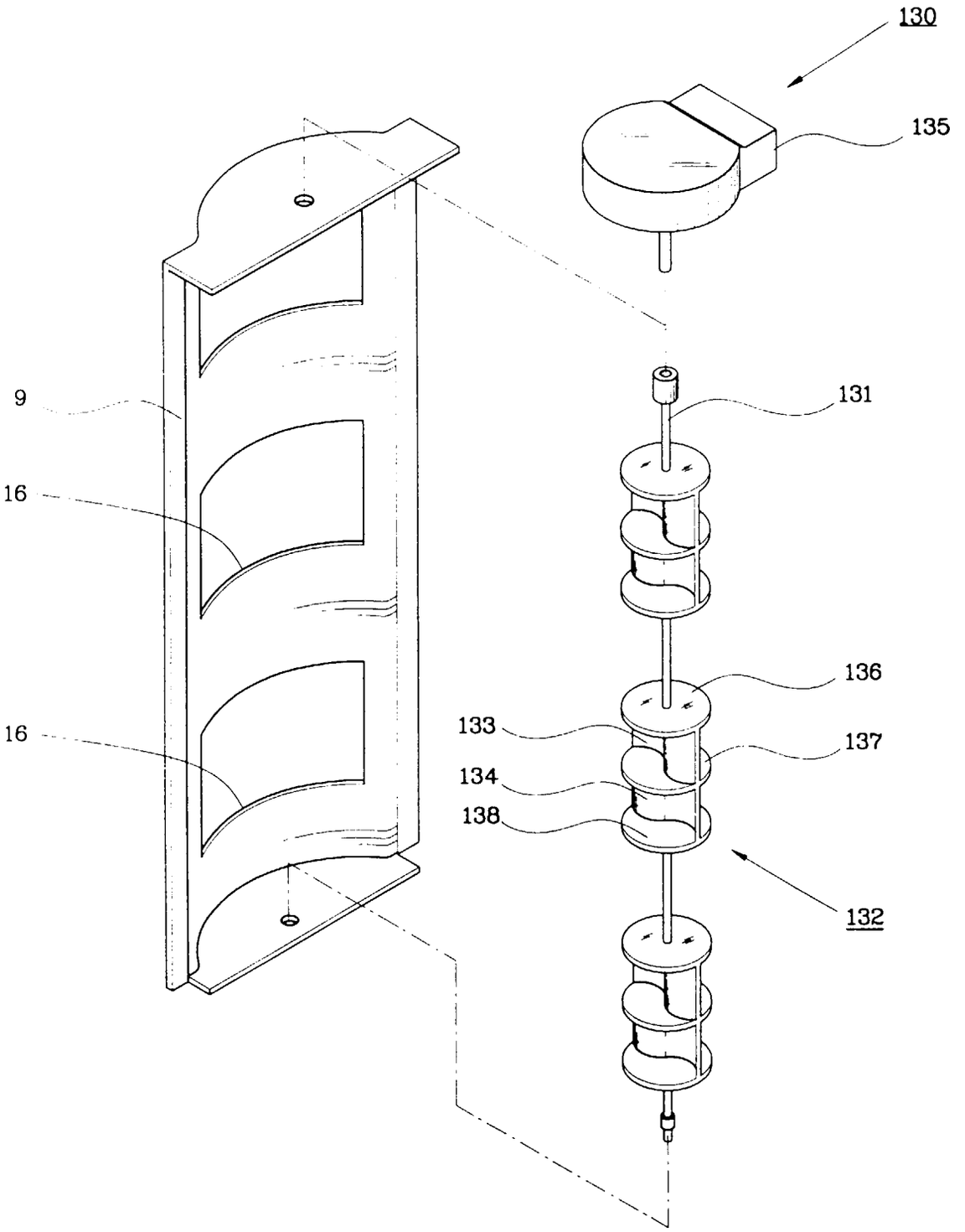

FIG.4

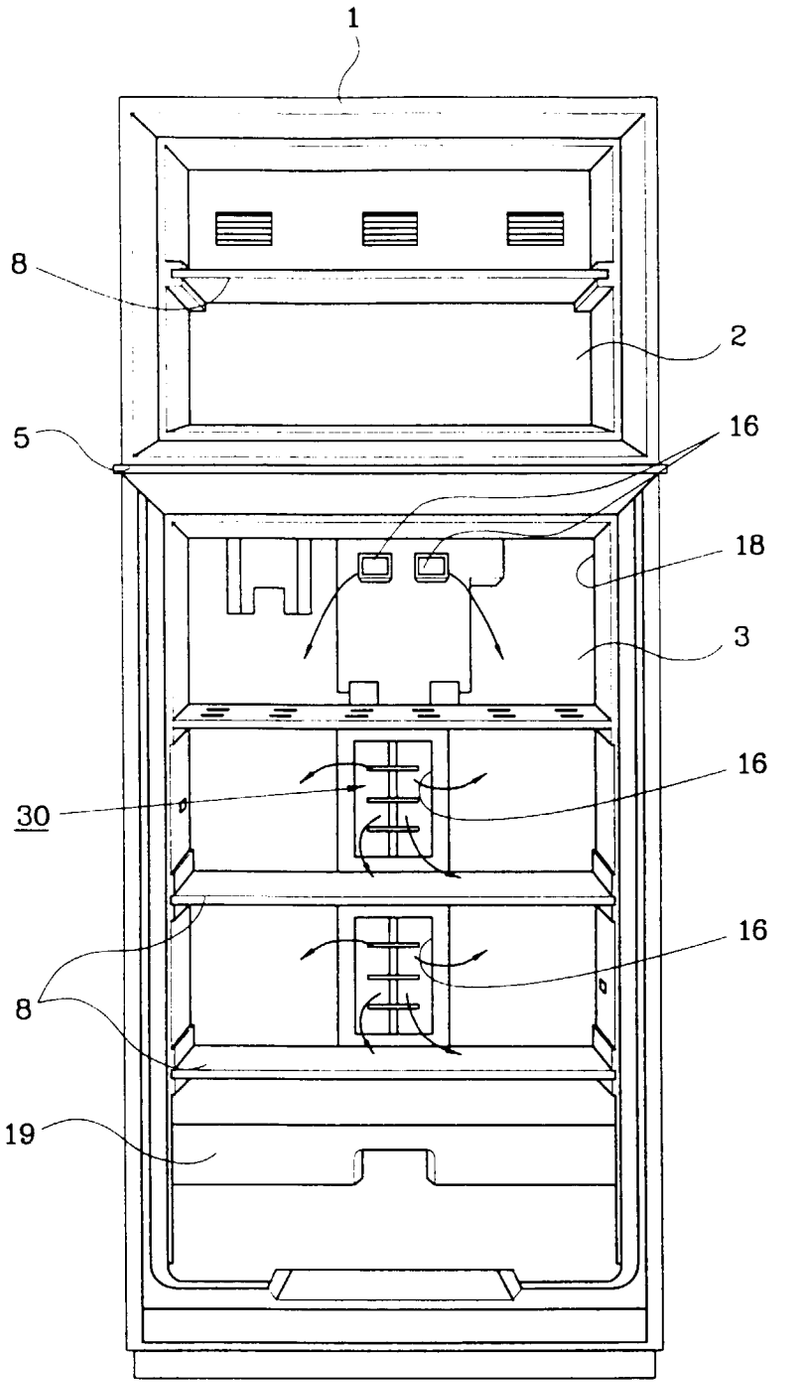

FIG.5

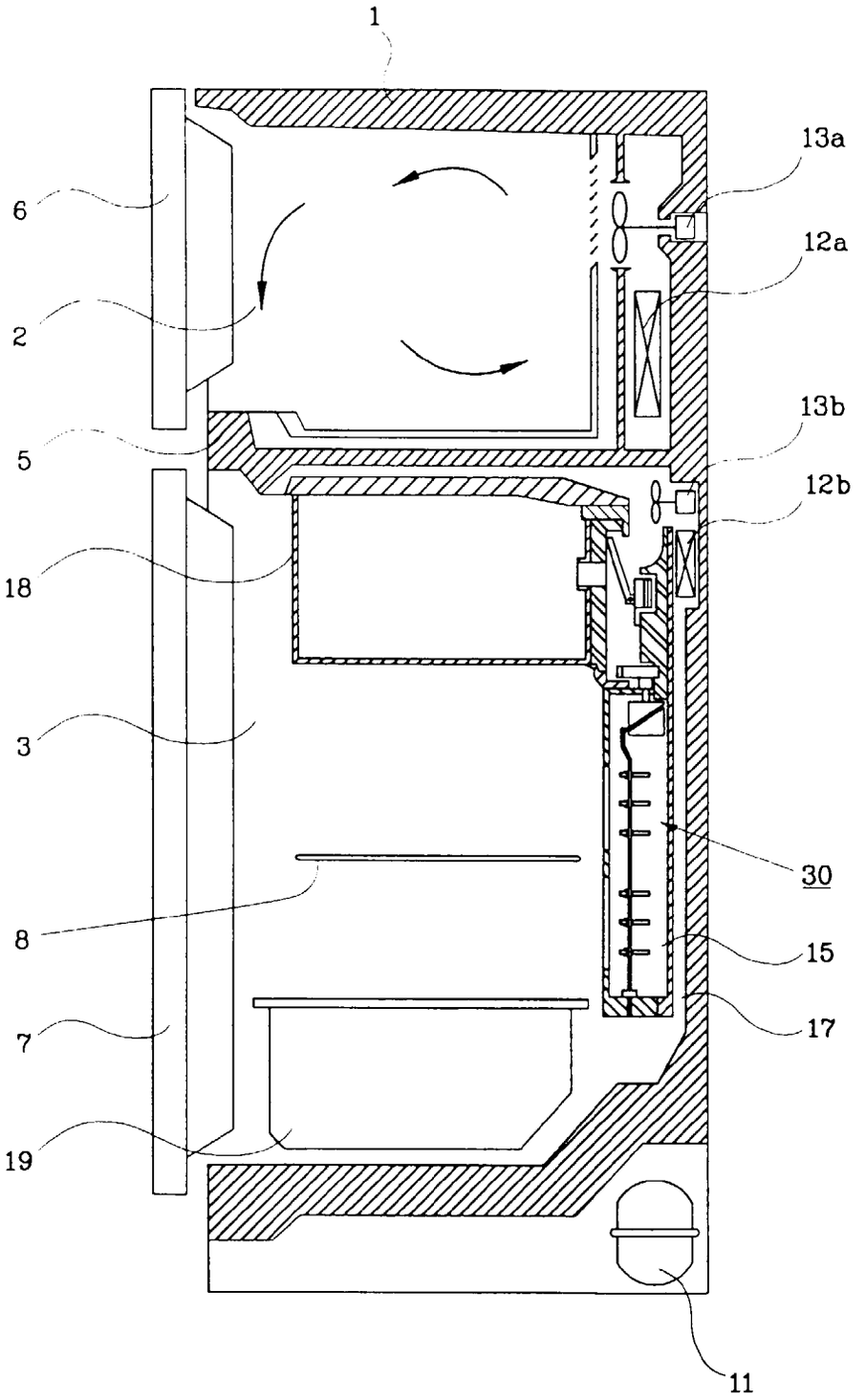

FIG.6

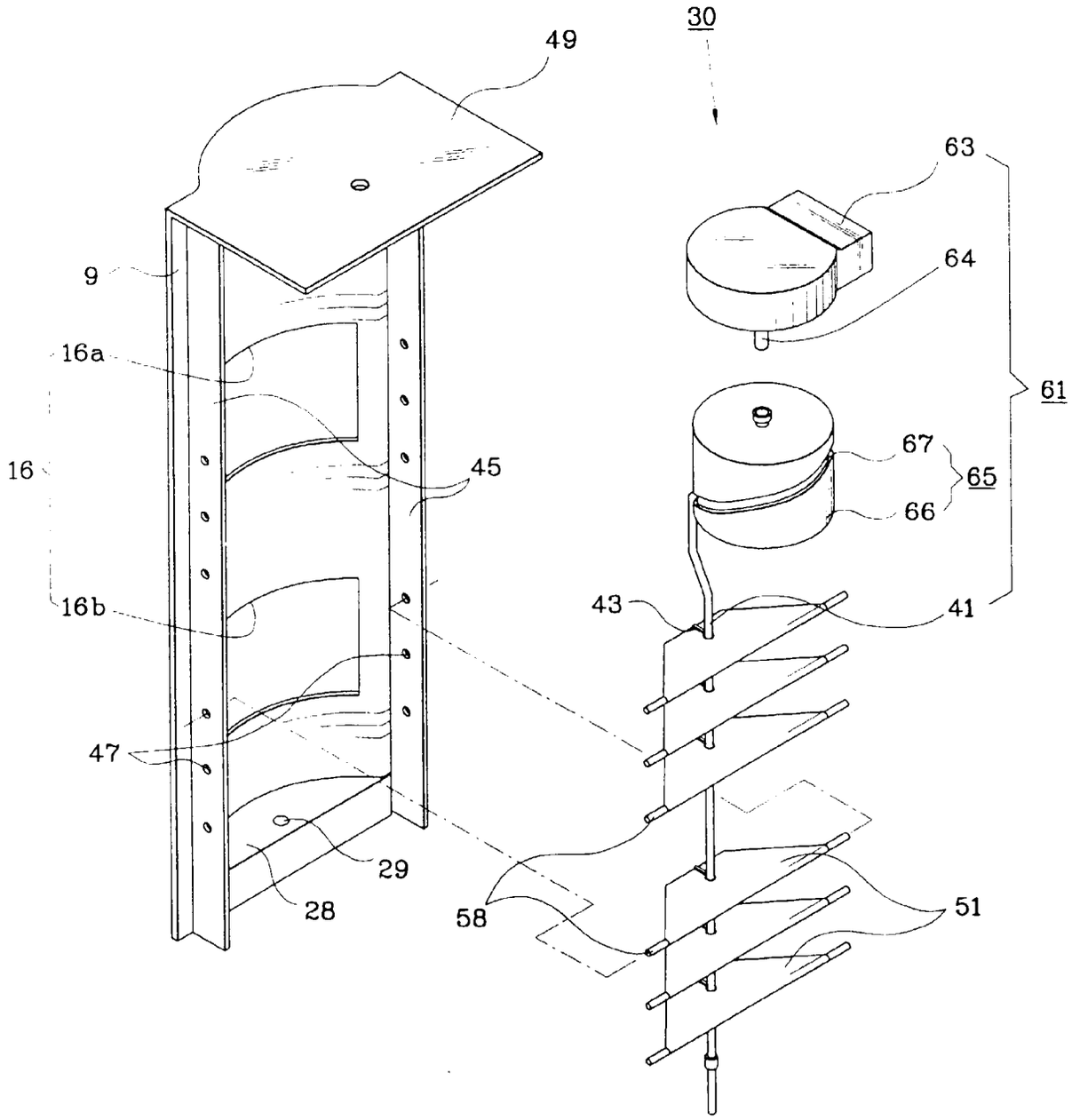

FIG.7

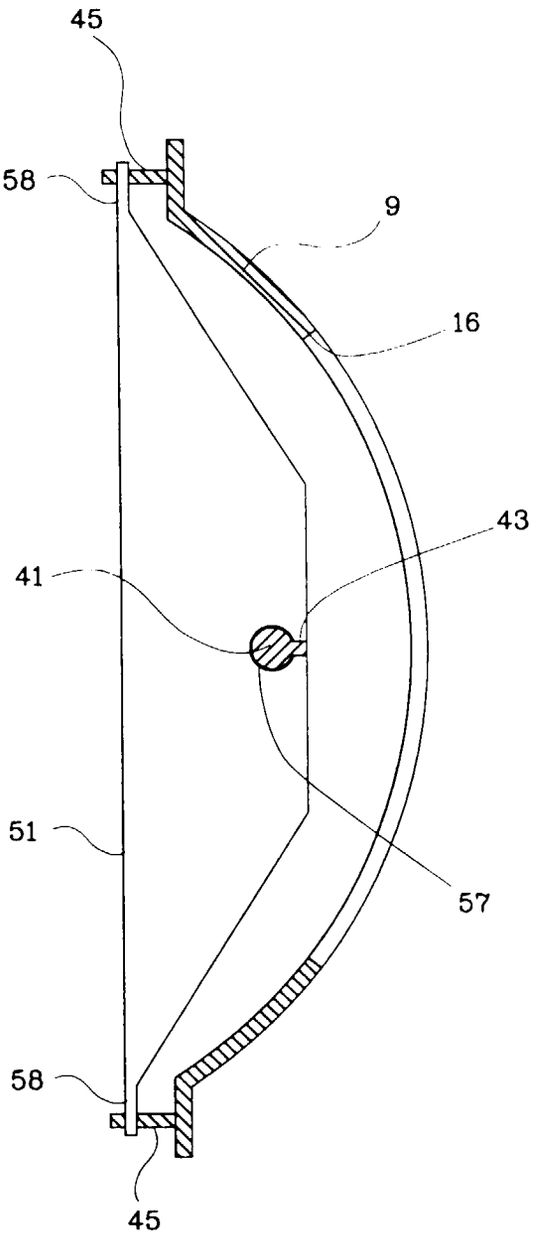

FIG.8

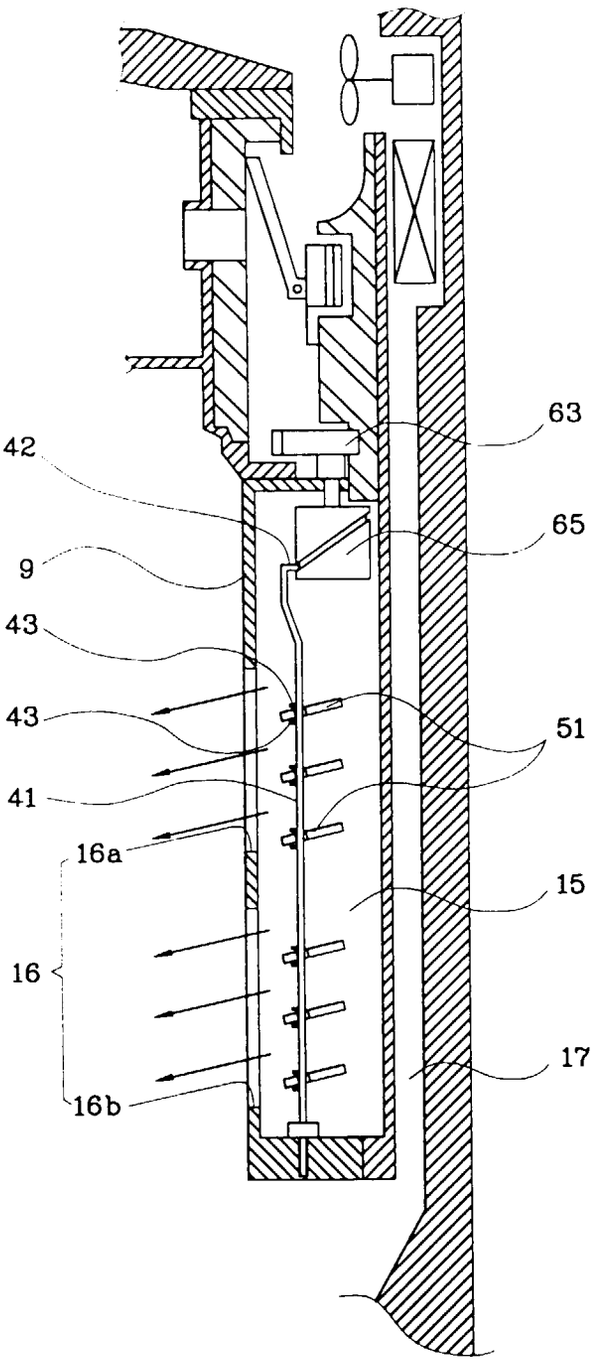

FIG.9

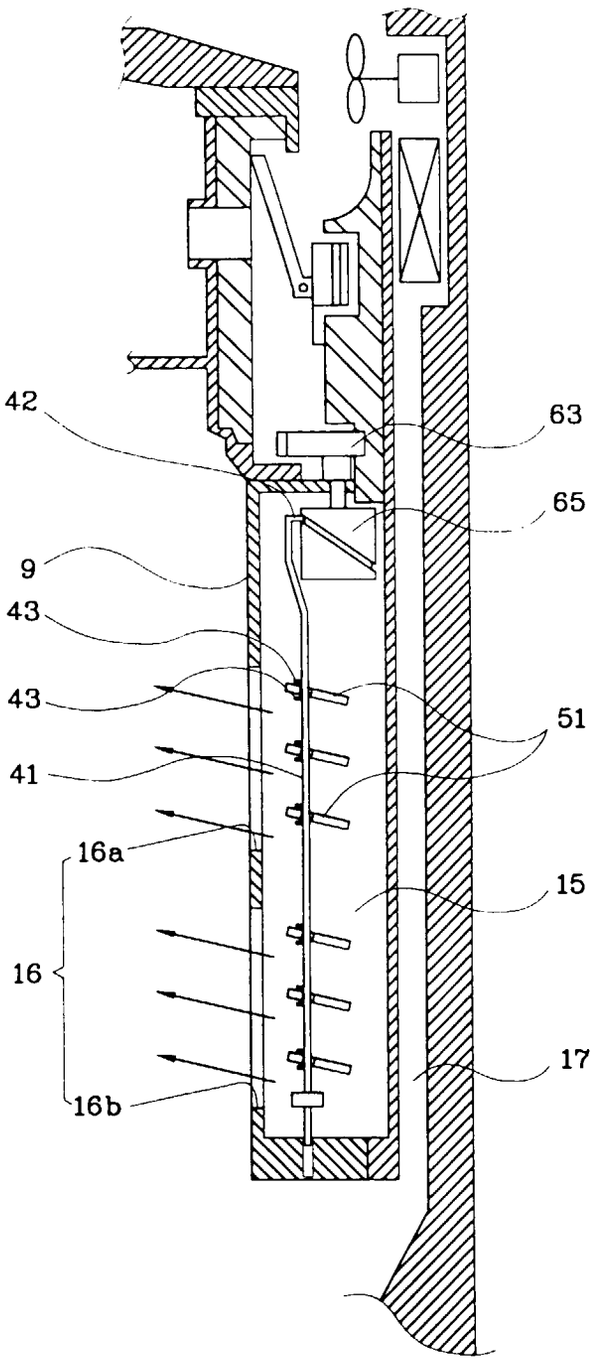

FIG .10

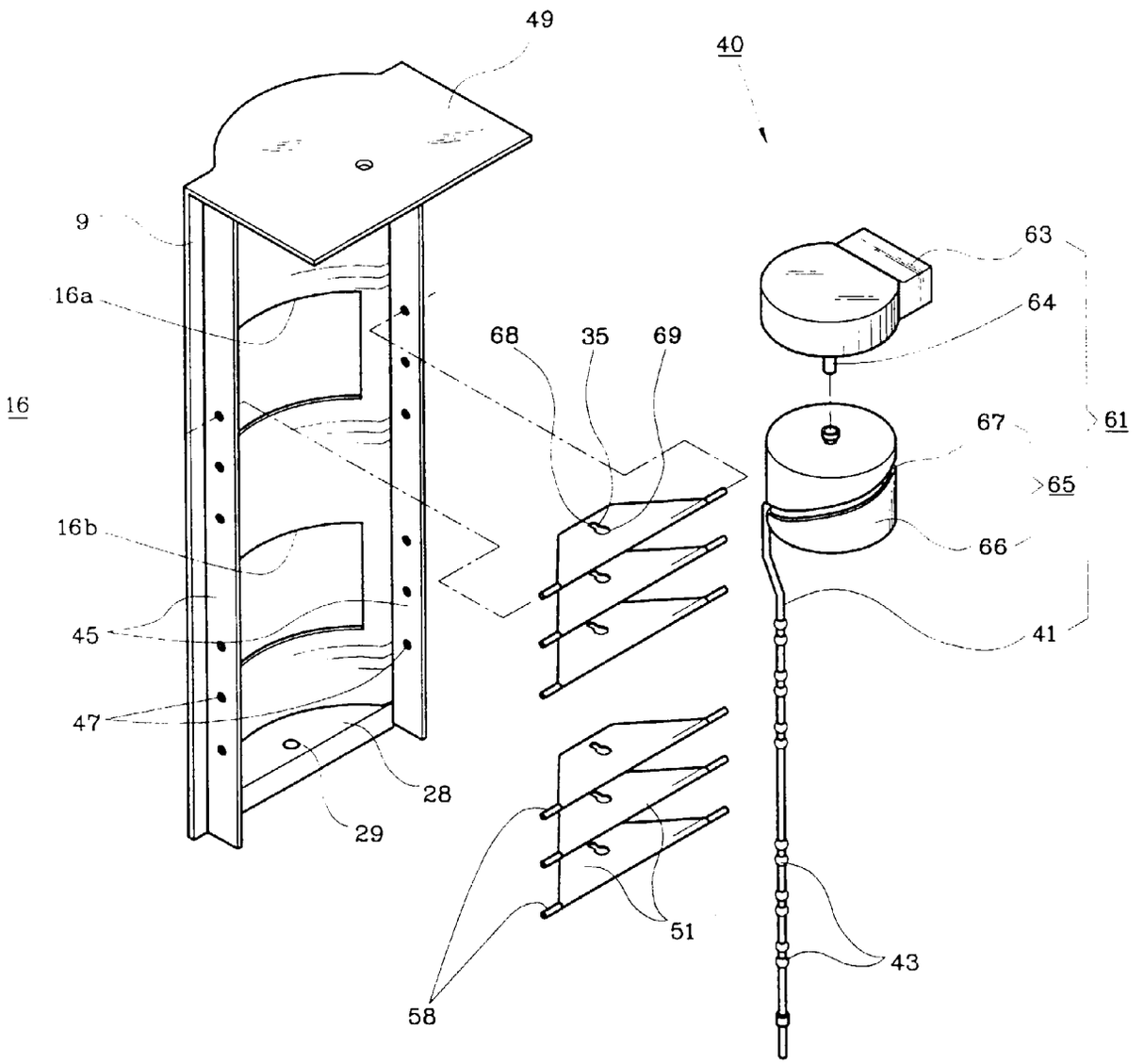

FIG .11

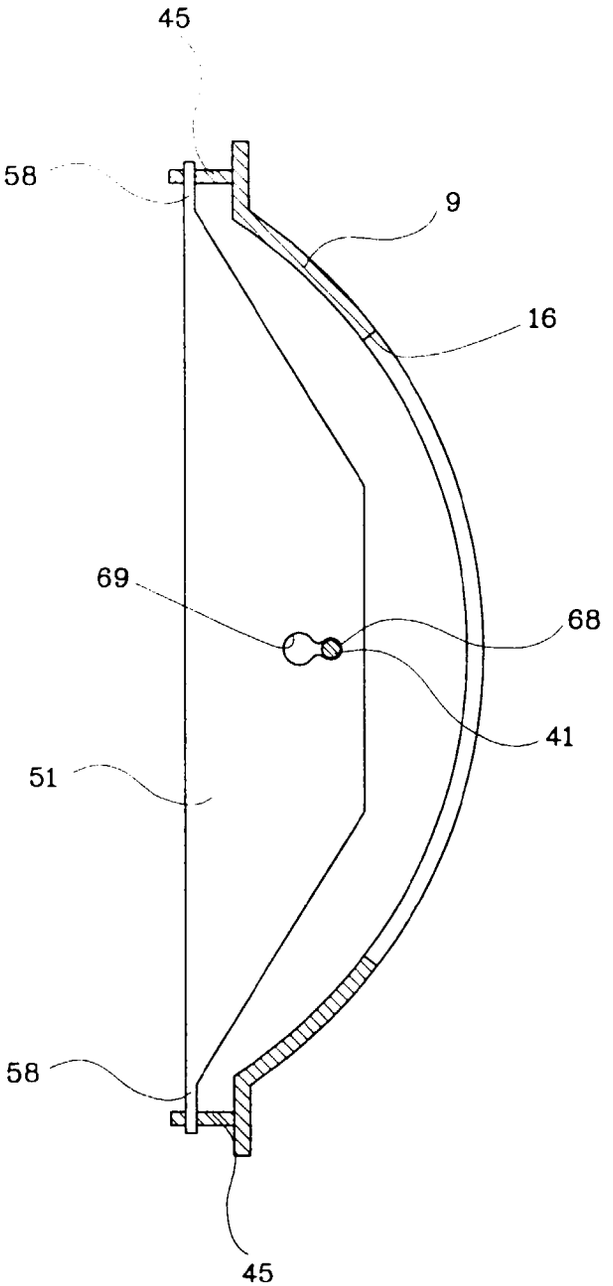

FIG .12

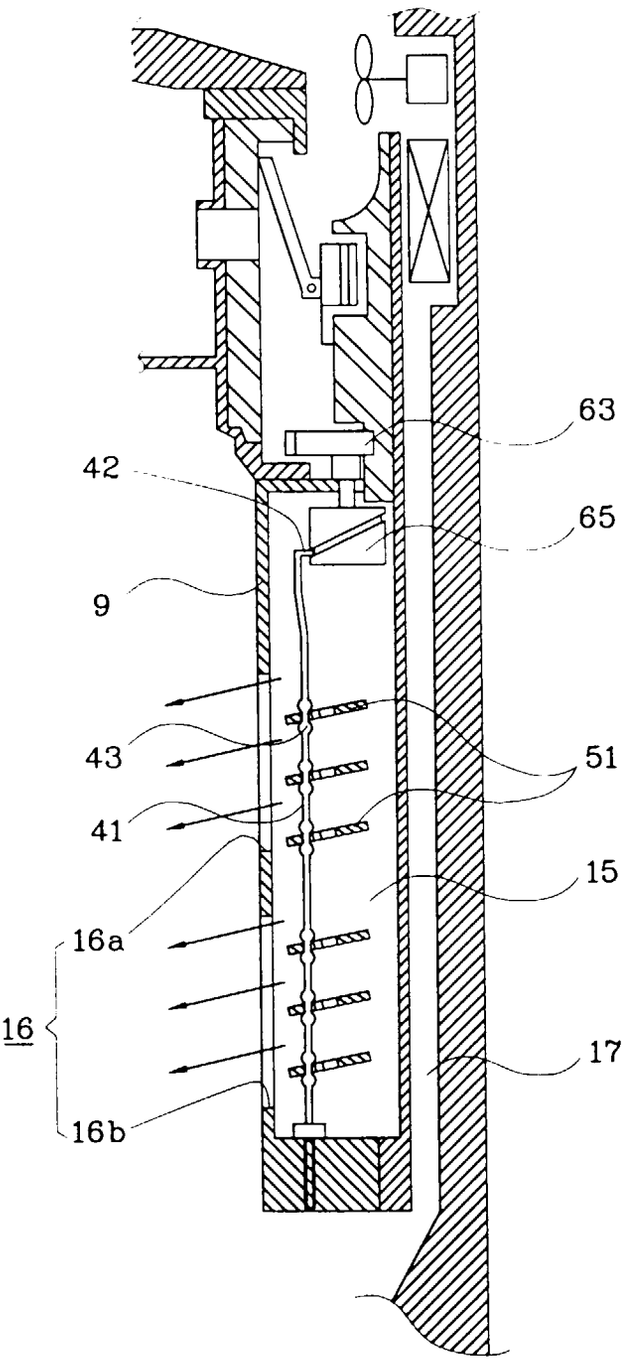

FIG.13