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

(11) EP 1 457 748 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
15.09.2004 Bulletin 2004/38

(51) Int Cl.[7]: **F25D 11/02**, F25D 17/06

(21) Application number: **04002533.0**

(22) Date of filing: **05.02.2004**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR
Designated Extension States:
AL LT LV MK

(30) Priority: **12.03.2003 IT pn20030021**

(71) Applicant: **Electrolux Home Products Corporation N.V.**
1930 Zaventem (BE)

(72) Inventor: **Marega, Paolo**
33084 Cordenons Pordenone (IT)

(74) Representative: **Giugni, Valter**
PROPRIA S.r.l.,
Via Mazzini 13
33170 Pordenone (IT)

(54) Improvred deep-freezing apparatus with separate freezing compartment

(57) Deep-freezing apparatus comprising at least an internal storage room (1), an evaporator (2) that is preferably installed inside said storage room (1), and a first door (3) closing said storage room (1) with respect to the outside ambient, in which inside said storage room (1) there is arranged a super-cooled enclosed compartment (4), which is separate from said storage room (1) by means of at least a partition member (5) and is accessible through a second thermally insulated door (6). Such a separate compartment (4) is provided with an evaporator (8) of its own, which may be either connected functionally with the evaporator (2) of the main storage room or operate autonomously. Preferably, this separate compartment (4) may contain a fan (9), and this fan (9) may operate at the same time as the evaporator (8) of said compartment (4) in an autonomous and selectively pre-definable manner.

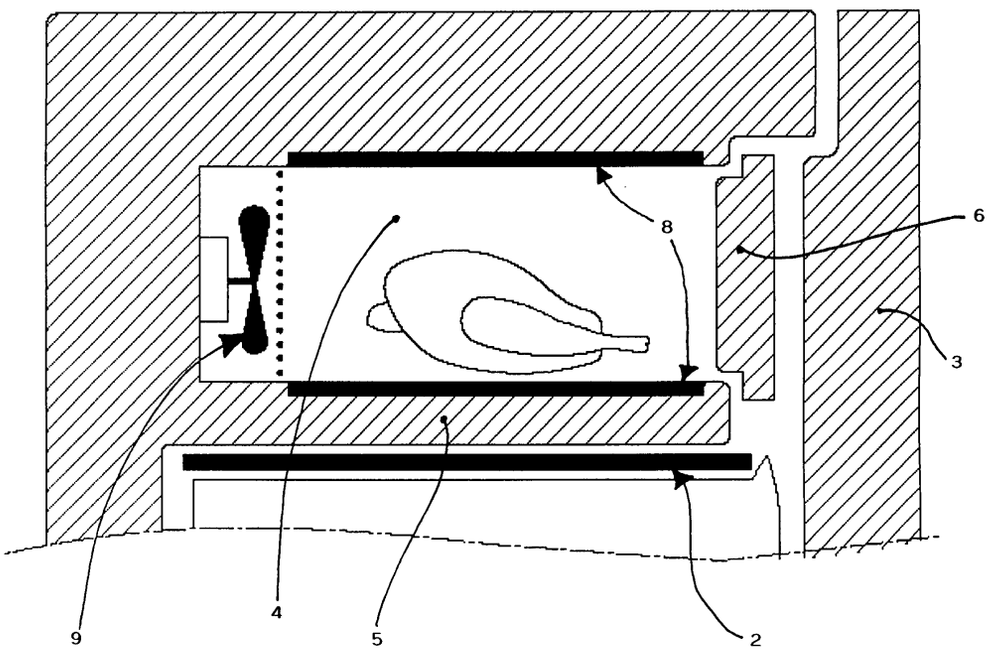

FIG. 4

EP 1 457 748 A2

Description

[0001] The present invention refers to an improved type of deep-freezing apparatus, preferably of the type for use in households, for food preservation applications.

[0002] Although an upright freezer is described and illustrated in the following description as a preferred embodiment, the present invention and the appended claims shall be understood to equally apply to and cover deep-freezing appliances of different types, such as for example the so-called chest freezers.

[0003] Deep-freezing appliances are largely known in the art to be provided with an internal storage room, which is usually subdivided into a variety of compartments or shelves arranged above each other, in which said storage room is separated from the outside ambient by means of one or more thermally insulated doors. In addition, said storage room is cooled by at least an evaporator and, owing to this room being actually subdivided into compartments that are not isolated thermally from each other, the temperature inside said storage room is essentially uniform.

[0004] Anyway, these deep-freezing appliances are largely known in the art, so that a detailed description thereof shall be omitted here for reasons of greater simplicity.

[0005] These appliances featuring a significantly simple structure are capable of performing in a generally satisfactory manner in their common utilization mode. However, in the most critical and sensitive phase of their operation, they suffer some drawbacks that derive exactly from the simplified structure thereof. In fact, in order to freeze down a fresh food item lying at ambient temperature, a user must first open the door of the deep-freezer and then introduce the fresh food item in the storage room of the appliance, and finally close again the door. These inherently simple operations give actually rise to a number of practical drawbacks, as described below.

[0006] It should first of all be stressed - although this fact is generally and widely known in the art, actually - that the effectiveness and the quality of the frozen-food preservation process are closely connected with the rapidity of the deep-freezing process, i.e. the rapidity with which the temperature in the food item to be frozen decreases to reach a predetermined value that usually lies at approximately -18°C.

[0007] If the steady-state temperature prevailing inside the storage room of the appliance is already at the value which the temperature of the fresh food item to be frozen is intended to reach, and which is desirably to be kept at a sensibly constant level, as this on the other hand actually occurs under normal conditions, it logically ensues that the temperature inside the fresh food item to be frozen tends to decrease at quite a slow rate to reach down to said steady-state temperature prevailing in the storage room following an almost asymptotic trend. Such a limitation is prejudicial to the quality of the deep-freezing process, resulting in obvious negative effects on the frozen food itself upon thawing.

[0008] If, in view of doing away with such a drawback, the option is selected of causing a steady-state temperature to prevail inside the storage room which is significantly lower than the intended final deep-freezing temperature, i.e. usually approximately -18°C, the above-described problem will certainly be solved, however at the cost of other drawbacks, such as a higher energy usage and a greater complexity and expensiveness of the deep-freezing apparatus itself.

[0009] Anyway, there remains the possibility of making use of a portion of storage room to be kept at a lower temperature than the average temperature prevailing in the storage room itself, since this would certainly prove effective in improving both the preservation life and the quality of the frozen food stored there. However, this is certainly not feasible in a storage room that does not feature any zone being particularly insulated or cooled down in a different manner with respect to the main storage room itself.

[0010] It should be furthermore be stressed that, in the normal practice, the amount of food items to be deep-frozen is generally significantly smaller than the maximum allowable batch quantity that is admitted for deep-freezing in an appliance, i.e. which the deep-freezer is designed for. This practically means that deep-freezing appliances are generally overpowered, and therefore far too expensive, with respect to the actual average deep-freezing demand.

[0011] Finally, opening the door of the deep-freezer causes ambient air to enter the storage room of the appliance, thereby bringing about a temporary increase of the temperature thereinside and causing the performance of the appliance to deteriorate, although to a slight extent.

[0012] It would therefore be desirable, and it is actually a main purpose of the present invention, to provide a deep-freezing apparatus, preferably for residential use, i.e. of the household type, that is provided with such a structure and means and operates in such a manner as to enable it to eliminate all of the afore-cited drawbacks.

[0013] This deep-freezing apparatus must furthermore be capable of being manufactured with the use of readily available, existing materials and techniques, and must also be reliable and safe in its operation.

[0014] According to the present invention, these aims, along with further ones that will become apparent from the following description, are reached in a particular type of deep-freezing apparatus incorporating the characteristics as recited in the appended claims and described below by mere way of non-limiting example with reference to the accompanying drawings, in which:

- Figure 1 is a side elevational median cross-sectional view of an upright deep-freezer according to the

prior art;

- Figure 2 is a side elevational median cross-sectional view of an upright deep-freezer according to the present invention;

- Figure 3 is a front view of the internal storage room of the deep-freezer illustrated in Figure 2, with the door closed;

- Figure 4 is an enlarged view of the top portion of the deep-freezer illustrated in Figure 2, in which two construction-related improvements have further been added;

- Figure 5 is a simplified, diagonally perspective top view of a chest freezer provided with a compartment according to the present invention.

[0015] With reference to Figure 1, a deep-freezing apparatus according to the prior art comprises an outer casing, inside which there is provided a storage room 1 for holding the frozen food items, an evaporator 2 that is usually inserted totally, i.e. fully built-in within said storage room for improved efficiency, and a first door 3 for closing the storage room itself. The storage room is usually provided with a plurality of shelves, drawers or similar supports 1A, 1B, 1C on which the food items can be placed in an orderly arrangement so as to make an optimum use of the available space.

[0016] According to the present invention, and in the example being illustrated here, inside said storage room 1 there is provided a compartment 4, which is distinct and separate from the remaining internal volume of the same storage room. The separation of this compartment from the remaining volume of the storage room is obtained, according to a preferred embodiment illustrated in Figure 2, with the help of at least a horizontal partition wall 5 that is as large as the horizontal cross-section of the storage room, and which therefore delimitates said compartment from the remaining portion of the storage room itself.

[0017] Access into said compartment is gained through a second door 6 that opens forwards, i.e. towards the user, and that, when pushed inwards, shuts the inner volume of said compartment completely, but solely that inner volume. In addition, in view of obtaining results that are consistent with the afore-cited aims and the desired object, said door is made so as to enable said compartment to be closed/opened freely and independently, without affecting any other inner volume of the main storage room.

[0018] At this point it clearly appears, but is nevertheless stressed once again, that said compartment 4, jointly with the second door 6 thereof, are to be considered in every respect as being included in the inner volume of the main storage room, and that, in order to open said compartment, it is therefore necessary for said first external door 3 to be opened first, thereby gaining access to the main storage room, and for the second door 6 to be then opened in order to gain access to the interior of said compartment.

[0019] In order to be able to ensure a specific, improved thermal insulation of said compartment 4, both the horizontal partition wall 5 and the second door 6 are appropriately insulated, although these can of course be made without providing them with any particular insulation, for instance in view of reaching different aims, such as lower costs or larger useful volumes.

[0020] In the case that the present invention is applied in an upright freezer, it has been found of particular advantage if said compartment 4 is positioned in the upper portion of the main storage room 1, as this is best illustrated in Figures 2 and 3. In fact, although this does not prove effective in improving the overall insulation of the compartment itself, such a configuration is the most ergonomic one in the normal use of the freezer, in which there is a need to frequently deep-freeze small amounts of fresh food items. Above all, however, this proves much more advantageous from a construction point of view.

[0021] The above-described insulation provisions ensure that, in this compartment, cold is held more effectively over longer periods of time. However, cold must be first produced in said compartment and, in order to be able to obtain a more intensive cool-down effect, it is highly desirable that this compartment be specifically cooled down by a second evaporator 8 of its own, which is therefore distinct from the evaporator 2 of the remaining storage volume. Such second evaporator 8 may suitably consists simply of an additional section or extension of the evaporator 2 connected in series to the latter and arranged in such a manner as to be effective almost solely within said compartment, using well-known techniques applied universally for other types of products, such as for instance the so-called two-temperature and two-door refrigerators, to this purpose.

[0022] Circumstances may however arise, in which such a kind of connection does not prove advantageous, since it is for example required that a demand of maximum deep-freezing capacity be solely directed at said compartment, whereas the remaining storage room does not have actually to meet any such peak-capacity requirement. In such a case, the above-considered solution proves fully inadequate.

[0023] In general, it is in fact desired that a temperature be held, which is constantly differentiated between said main storage room and said compartment.

[0024] In order to solve this problem, the first evaporator must therefore be made functionally independent of the second one, which, as mentioned above, works only in the separate compartment. This may be implemented in various manners, which are all well-known to those skilled in the art, and which must be selected in accordance with the other existing constraints: for example, an option might be the use of a single refrigerat-

ing unit with two evaporators in parallel, in which each branch in parallel is provided with a respective electromagnetic valve to regulate the related flow of refrigerant medium.

[0025] Another option may consist of a simplified version of the above-described arrangement, which can be obtained by simply eliminating one of said two electromagnetic valves, preferably the one associated to the storage room evaporator, so that the latter is constantly on and its operation is solely regulated by the thermostat controlling the temperature of the storage room, and possibly by further control means that shall be illustrated in greater detail further on.

[0026] A further option for controlling the temperature in the separate compartment consists in providing the latter with a complete and independent refrigerating unit of its own. Such a solution may clearly provide ideal operating conditions as far as both the storage room and the separate compartment are concerned, but has a disadvantage in terms of a significant cost increase.

[0027] The various solutions, which have briefly been hinted at above, shall not be illustrated here to any greater detail, since they are readily understood by and fully within the ability of all those skilled in the art.

[0028] Regardless of the solution that is used, the fact must anyway be constantly kept into due account is that the result to be obtained is a temperature in the separate compartment which is lower than the temperature of the main storage compartment by an extent to be properly defined. As this has already been stated above, such a lower temperature may be obtained either by appropriately increasing the insulation of said separate compartment with respect to the outside ambient (while it is clear that said compartment must anyway be provided with an evaporator of its own) or by providing an adequate amount of frigories, i.e. units of heat extraction, in said compartment, however these may also be generated and controlled, or by using a combination of these methods.

[0029] The operation of the deep-freezing apparatus described above is now fully apparent: when it is desired to deep-freeze some fresh food items, all it takes is to open the door of the storage room 1 and the second door 6 of the separate compartment, and then introduce said food items in the compartment itself. When the doors are then closed again, the appliance goes on operating, thereby achieving the twofold advantage that the previously frozen food items stored in the main storage room keep their previous temperature practically unaltered, and are not undesirably and uselessly over-refrigerated, while the fresh food items to be deep-frozen are placed in an ambient at a temperature that may even be considerably lower than the temperature which they would have been exposed to in a deep-freezing apparatus not provided with the separate compartment according to the present invention, thereby excluding a possible deterioration in the quality of the deep-freezing process for the reasons that have already been explained earlier in this description.

[0030] It can however be noticed that the present invention is effective in bringing about another clear benefit: in fact, thanks to the superinsulation thereof, the separate compartment is capable of holding a sensibly constant or, at most, minimally oscillating temperature therewithin, and this of course contributes to a sensibly improved performance of such a compartment as a storage compartment for holding the same deep-frozen food items upon conclusion of the deep-freezing process.

[0031] It has also been found that a further advantageous improvement derives from installing a small, selectively operable fan 9 in this separate compartment. As a matter of fact, providing an air circulation means inside such a compartment is effective in improving the cool-down rate of the food to be frozen by making also use of forced-convection heat transfer, which therefore adds to the existing heat-transfer process by conduction and radiation.

[0032] The solutions and the improvements that have been described hereinbefore enable a particularly improved and advantageous deep-freezing apparatus to be provided in the following way: said fan 9 and the arrangement used to cool down said second evaporator 8 (regardless of which kind of arrangement is used to such a purpose, actually, as this has been already explained earlier in this description) are both connected in parallel to a single control means situated externally (and not shown in the Figures); the overall arrangement is therefore such that, when a fresh food item to be deep-frozen is introduced in the super-refrigeration compartment 4, by operating said single control means it is possible for all of the modes and conditions of operation that are required at that point to ensure the best possible quality of the deep-freezing process, to be set and controlled automatically.

[0033] In an advantageous manner, considering that the deep-freezing process must at a certain point be also terminated, said single control means may be further provided with timing devices, or devices that are responsive to the temperature being detected inside the deep-freezing compartment, in which these devices are made capable of cutting off the operation of said fan 9 and said second evaporator 8 upon expiration of a period of time that is selectively pre-settable by the user, or as soon as a temperature threshold, that may again be predefined by the user, is reached inside said compartment during an on-going deep-freezing process.

Claims

1. Deep-freezing apparatus, in particular for residential use, comprising at least an internal storage room (1) for holding frozen food items, an evaporator (2) that is preferably installed inside said storage room, and a first door (3) closing said storage room

with respect to the outside ambient, **characterized in that** inside said storage room there is arranged a compartment (4) that is separated from said storage room by means of at least a partition member (5) and is accessible from said storage room (1) through a second door (6) adapted to selectively open/close said compartment.

2. Deep-freezing apparatus according to claim 1, **characterized in that** said second door (6) is adapted to solely open/close said compartment (4).

3. Deep-freezing apparatus according to claim 2, **characterized in that** said partition member (5) has a capacity of thermally isolating said compartment from the remaining volume of said storage room.

4. Deep-freezing apparatus according to any of the preceding claims, **characterized in that** said compartment (4) is provided with a second evaporator (8) that is physically distinct and separate from said evaporator (2) used to cool down said main storage room, but works at the same time as said first evaporator (2).

5. Deep-freezing apparatus according to at least one of the claims 1 to 4, **characterized in that** said compartment (4) is provided with a second evaporator (8) and further means adapted to operate it in a manner that is independent of said first evaporator (2).

6. Deep-freezing apparatus according to any of the preceding claims, **characterized in that** inside said compartment (4) there is provided an air circulating means (9), preferably a fan, adapted to circulate the air within said compartment.

7. Deep-freezing apparatus according to any of the preceding claims, **characterized in that** there are provided external control means adapted to selectively operate said air circulating means (9) and said second evaporator (8).

8. Deep-freezing apparatus according to claim 6, **characterized in that** there are provided automatic means adapted to simultaneously cut off the operation of said air circulating means (9) and said second evaporator (8) upon expiration of a selectively pre-settable period of time.

9. Deep-freezing apparatus according to any of the preceding claims, **characterized in that** it is an upright deep-freezer, i.e. a freezer in which said first door is vertical and capable of being opened rotating it about a vertical axis, and in which said compartment (4) is arranged in the upper portion of said storage room.

10. Deep-freezing apparatus according to any of the preceding claims, **characterized in that** said compartment (4) is adapted to reach a temperature that is lower than the temperature inside the remaining volume of said storage room.

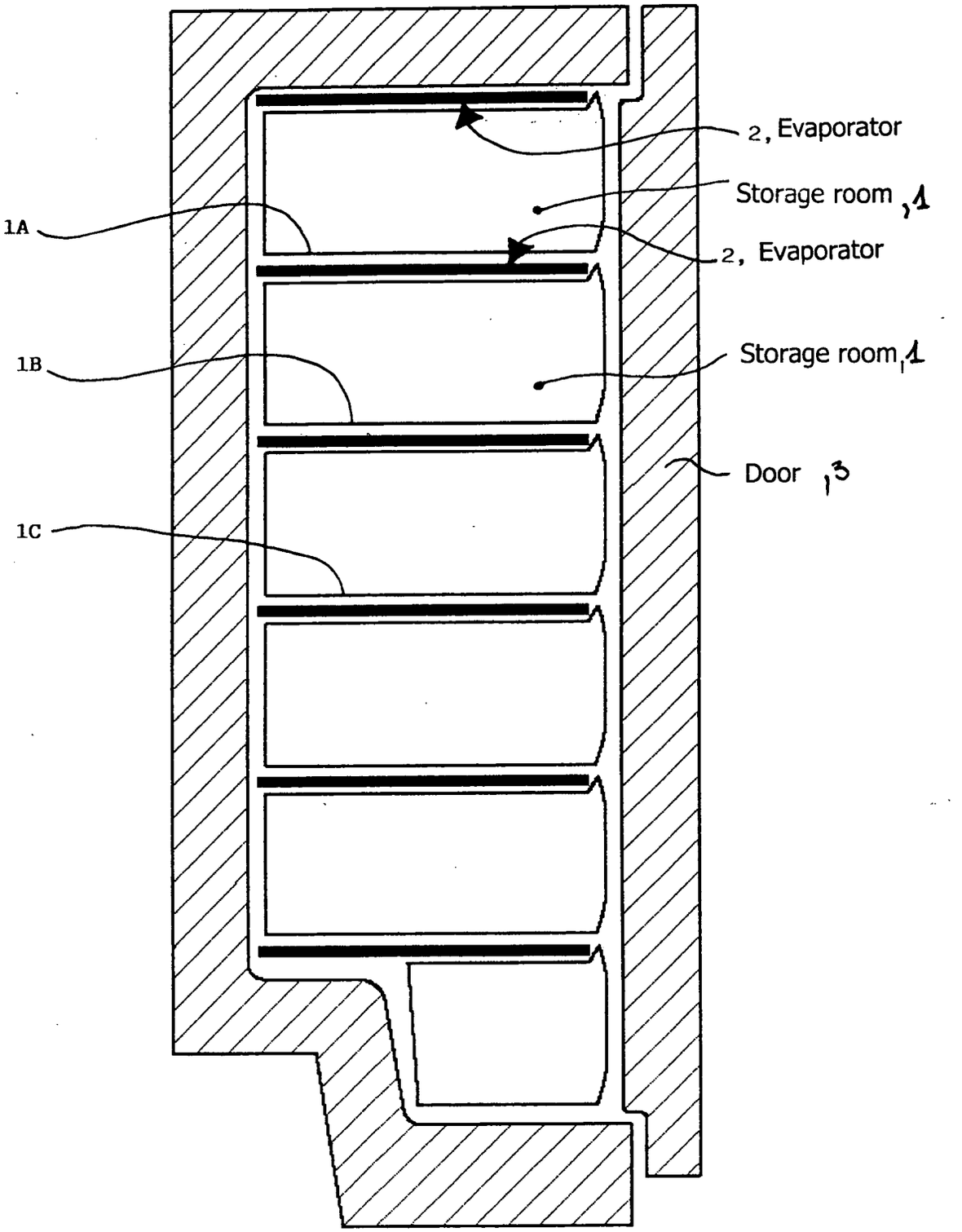
2, Evaporator
Storage room ,1
1A
2, Evaporator
1B
Storage room ,1
Door ,3
1C

FIG. 1

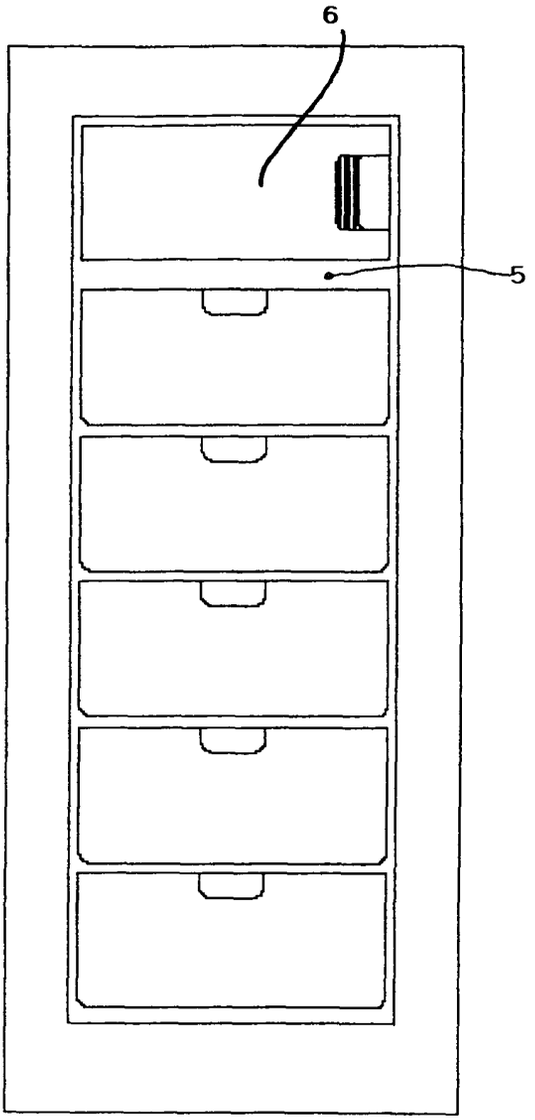

FIG. 3

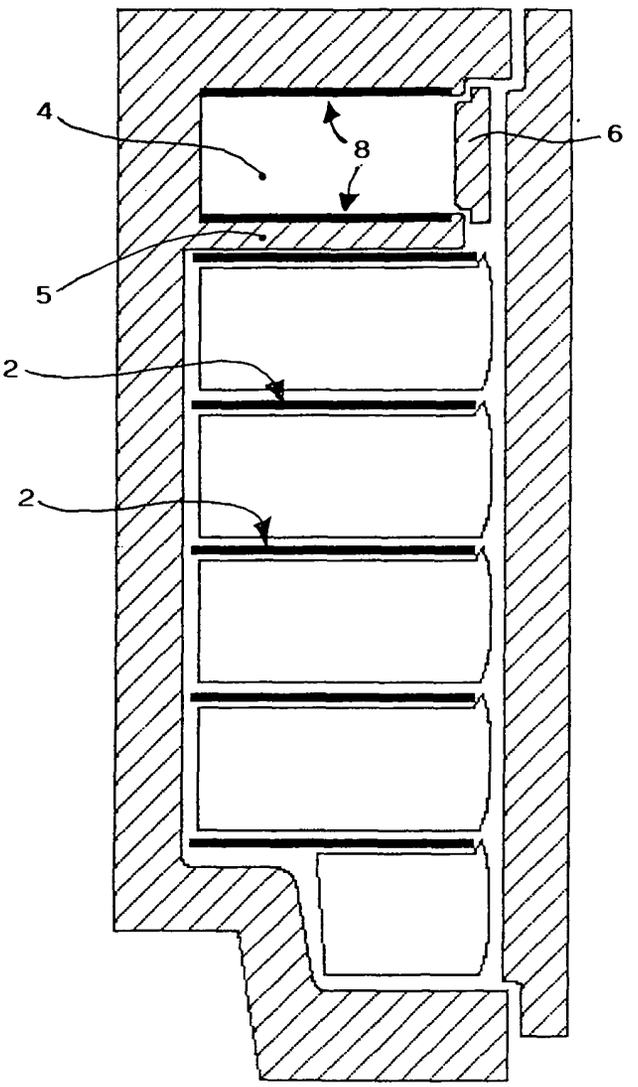

FIG. 2

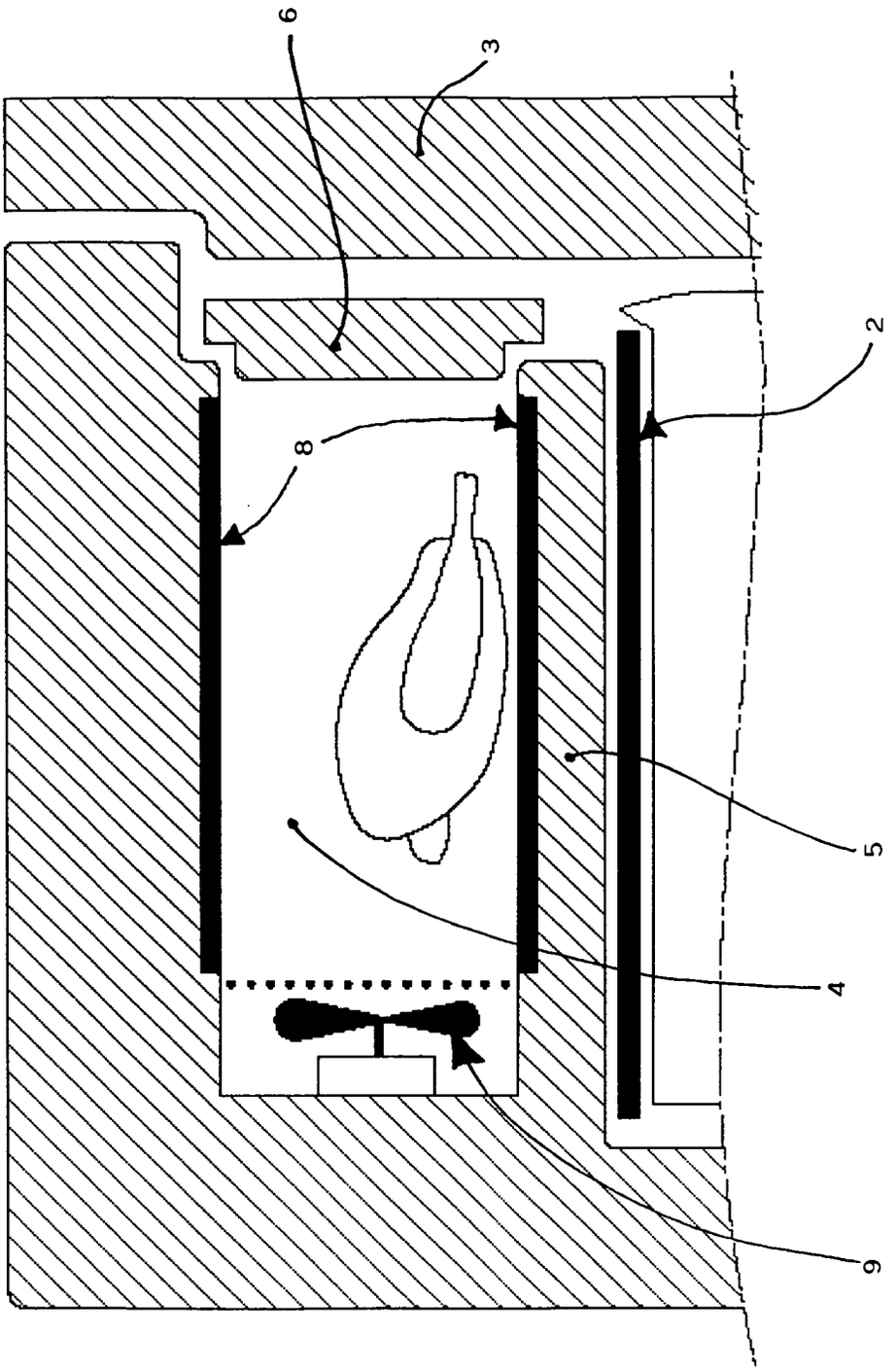

FIG. 4

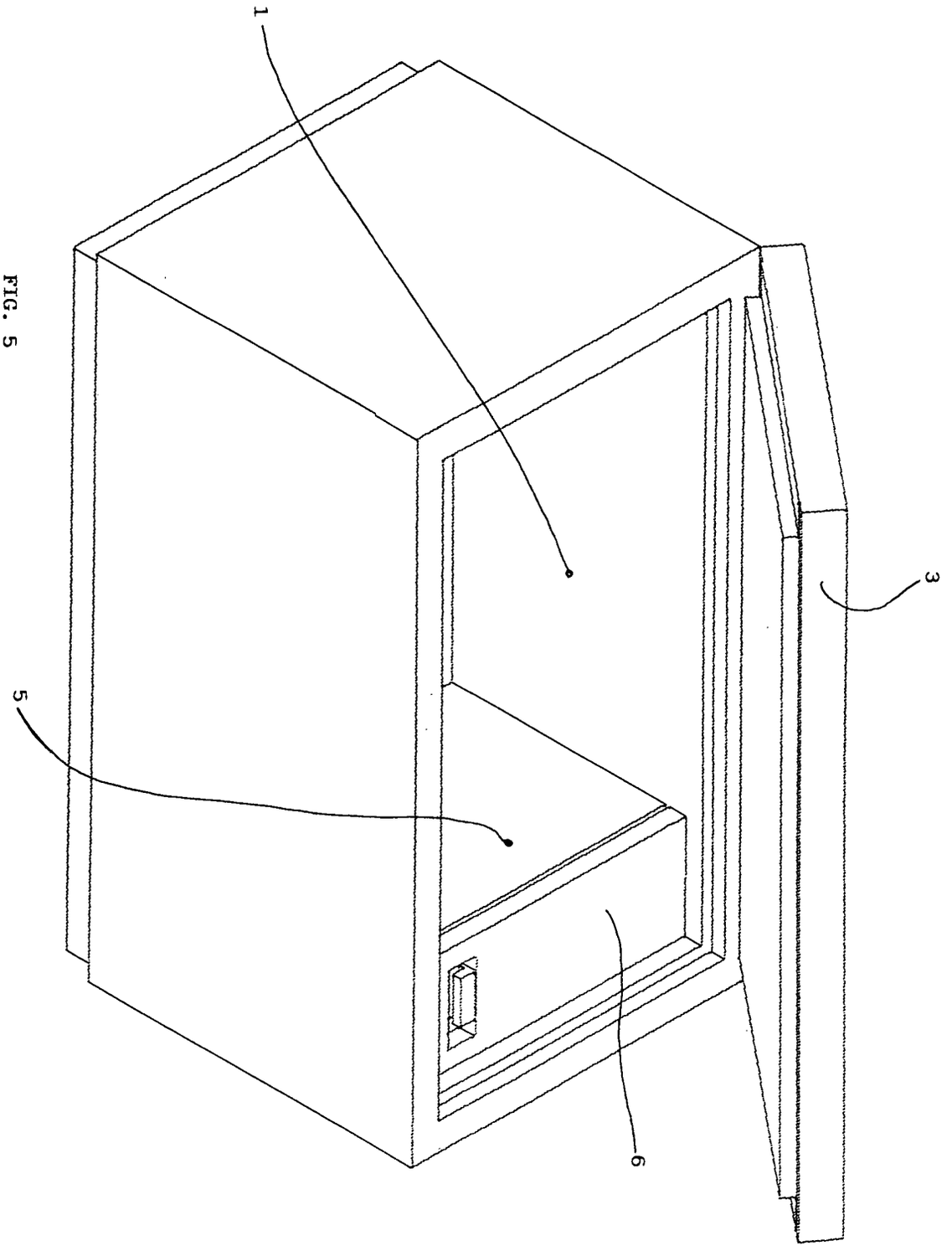

FIG. 5