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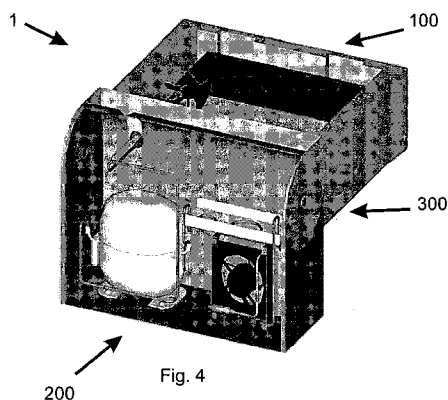


Fig. 4

(57) Abstract: The present invention relates to a self-contained, portable refrigeration unit having a construction arrangement which enables it to be compatible with several models, types and variations of refrigeratable compartments. This refrigeration unit is represented by a refrigeration module (1) capable of being removably fitted into a refrigeratable compartment, comprising a first portion (100) and a second portion (200) associated with each other. The first portion (100) is in contact with the inside of the refrigeratable compartment and the second portion (200) is in contact with the outside of the refrigeratable compartment, and in some embodiments of the present invention, the first portion (100) is capable of moving in relation to the second portion (200). The first portion (100) comprises at least a first closed box (101) interfacing the refrigeration module (1) with the inside of the refrigeratable compartment. The second portion (200) comprises at least a second closed box (201) interfacing the refrigeration module (1) with the outside of the refrigeratable compartment. In another preferred embodiment, the first box (101) fits into the refrigeratable compartment through a fitting portion (111) whose cross section is smaller than the largest cross section of the second box (201). The present invention also relates to a refrigeration system (500) comprising at least one embodiment of the portable refrigeration module (1) mentioned above.



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Title: "REFRIGERATION MODULE AND REFRIGERATION SYSTEM".

The present invention relates to a portable refrigeration module. More particularly, the invention relates to a self-contained mobile refrigeration unit having a construction arrangement which enables it to be effectively
5 compatible with several models, types and variations of refrigeratable compartments.

The present invention further relates to a refrigeration system comprising the abovementioned portable refrigeration module.

Description of the Prior Art

10 Refrigeration equipments such as refrigerators, freezers and air conditioners comprise a refrigeration circuit having at least one condenser, one evaporator, one compressor and tubes, as well as other elements that help in the refrigeration process. Normally, in this type of refrigeration equipment, the refrigeration circuit is mounted / installed in a fixed manner
15 and inside a refrigeratable compartment. In other words, the refrigerating and the refrigerated portions of a kitchen refrigerator, for instance, are associated in such a way that only a trained technician or a skilled artisan is capable of disassembling or dismounting said portions.

Thus, if a piece or a part of the refrigeration circuit has an
20 operating problem and needs maintenance, a technician is needed to repair the equipment. Furthermore, depending on the time required for repairing the equipment, the unavailability of an essential piece of equipment such as the refrigerator, the function of which is to preserve food, causes problems for users. In this sense, the preventive maintenance of household refrigerators
25 rarely is done because of the difficulties involved. Often, the only solution for the user is to buy a new refrigerator because of the impossibility / difficulty of repairing and maintaining the existing equipment and/or the lack of replacement parts from the technical support.

To avoid such problems, a solution would be to buy a backup
30 refrigerator; however, the costs and the space requirements involved are disadvantageous. Currently, there are smaller portable refrigerators that can ease the problem, but their storage capacity is considerably lower in relation

to the normal size refrigerators and it will probably not be sufficient to accommodate all refrigeration items.

In addition to the repair and maintenance issue, in this type of construction arrangement, practicality is also affected, since the dimensions of the refrigeration equipment, such as a refrigerator or air conditioner, do not enable it to be easily installed in every place. The user should adapt the site to accommodate the refrigeration equipment; thus, if there is a need to change this piece of equipment, another one with similar dimensions should be found or the site has to be readapted in order to meet the spatial needs.

Moreover, the conventional refrigeration apparatuses lack mobility, because after installation it is difficult to move and/or transport them to other areas or rooms, forcing the user to go to the site where the refrigeration equipment is installed. Even refrigeration appliances considered to be portable are difficult to move because of their fixed and limited shape, which prevent them from being adapted to different types of environments.

Document US 3,712,078 relates to a removable refrigeration unit that can be adapted for mounting on several types of refrigeration cabinets. In spite of the advantages provided by this adaptability, the proximity with the condenser, compressor and evaporator without proper insulation is a construction arrangement that facilitates undesired heat transfer through the air, adversely affecting the performance of the module. European document EP 1547492 also relates to a similar modular refrigeration unit.

Document US 5,417,081 relates to a modular refrigeration apparatus divided into two portions: a lower and an upper portion; the storage compartments/units are positioned in the upper portion and a removable refrigeration unit is positioned in the lower portion. The apparatus disclosed in this document enables the insulation of the evaporator and condenser to obtain greater energy efficiency, only when the refrigeration unit is used together with a specially adapted cabinet having a construction arrangement capable of providing said insulation. Thus, the refrigeration unit alone does not provide this insulation feature, because it depends on the shape of the cabinet or compartment in which the unit is fitted / installed.

Another prior-art document, US 5,458,407, discloses a similar apparatus, wherein the refrigeration unit is removably fitted to facilitate repair and maintenance, and in this case also the refrigeration unit's efficiency directly depends on the insulation provided by the arrangement of the adapted
5 cabinet.

Document US2007044498 describes a refrigeration apparatus comprising two evaporators capable of refrigerating a plurality of shelves of the cabinet of the refrigeration equipment, connected to each other by pipes. The air outlet ducts are directed to each shelf and said ducts enable the
10 provision of different intensity levels of refrigeration to each shelf of the cabinet. Although this US document describes a very useful configuration, it does not disclose a portable refrigeration unit, that is, an apparatus that is easily removed from the refrigeration cabinet and safely transported by an ordinary user, without special tools and technical skills in refrigeration
15 equipment.

European document EP 1691152 discloses a modular refrigeration unit usable in a refrigeration cabinet. This unit comprises the condensing assembly and the evaporating assembly operatively connected. One of the disadvantages of the invention described in this European
20 document is that the condensing assembly is open, not being safe for the transportation of the unit, because the pieces and parts are exposed and unprotected from accidental shocks and foreign objects. In addition, its construction makes handling difficult, affecting its portability. Furthermore, the vertical configuration disclosed limits its adaptability, because only certain
25 specific types of cabinets can be used together with this refrigeration unit.

Thus, the refrigeration units described in the documents cited above have the disadvantage of only working satisfactorily in specific cabinet models, which are especially configured to receive only certain types of refrigeration units (modules) and, therefore, are not flexible and easily
30 adaptable, and they have a component distribution system that facilitates the undesired heat transfer between them, adversely affecting the performance of the module. Moreover, given the construction arrangements of said units,

there is no optimization of the storage capacity of the cabinet to be refrigerated, and the portability of said units is questionable, because in addition to the apparent lack of practical transportation, the pieces and parts are not duly protected so as to prevent damage risks.

5 Brief Description and Objectives of the Invention

A first objective of the present invention is to provide a portable and self-contained refrigeration unit, being simple and easy to install and maintain as well as effectively compatible with several types, models and variations of refrigeratable compartments (optimized power consumption and
10 occupied volume).

In this context, the present invention aims at filling a gap existing in the field of refrigeration equipment through the development of a portable and self-contained refrigeration unit or module with good efficiency levels (high yield and power savings) and that can be installed in, and removed
15 from, various types and models of compartments, cabinets and/or spaces in a simple and fast way without the need for adaptations and/or modifications that are difficult to implement. In addition, it should enable flexibility in the positioning of the module as well as in the division of the refrigerated space and also the optimization of said space.

20 A first means to achieve the first objective of the present invention is by providing a refrigeration module capable of being removably fitted into a refrigeratable compartment, comprising a first portion and a second portion associated with each other, the first portion being in contact with the inside of the refrigeratable compartment, the second portion being in
25 contact with the outside of the refrigeratable compartment, the first portion being capable of moving in relation to the second portion.

A second means to achieve the first objective of the present invention is by providing a refrigeration module capable of being removably fitted into a refrigeratable compartment, comprising at least a first portion and
30 a second portion directly and firmly associated with each other, the refrigeration module comprising at least a first closed box, the first box interfacing the refrigeration module with the inside of the refrigeratable

compartment and the second portion comprising at least a second closed box, the second portion interfacing the refrigeration module with the outside of the refrigeratable compartment, the first box fitting the refrigeratable compartment through a fitting portion whose cross section is smaller than the largest cross section of the second box.

Thus, a good power efficiency is achieved due to the separation of the components (evaporator, compressor and condenser) respectively located in the first and second portions, which prevents undesired heat transfer among them. The portability and ease of transportation of the module result from the possibility of relative movement between the portions. The refrigerated space can be optimized with the use of the first portion at horizontal position (90 degrees between portions), serving as a compartment divider. This construction arrangement also enables height variation of the position of the module in the refrigerated space, consequently rendering the division of said space flexible. In addition, the volumes resulting from this division can be kept at different temperatures and said temperatures can be reverted without affecting the position of the module. Cabinets with varied refrigeration capacities can be served keeping the external dimensions of the module and changing only the internal components.

A second objective of the present invention is to provide a refrigeration system comprising the refrigeration unit mentioned above, in the first or second means indicated above.

The second objective of the present invention is achieved by a refrigeration system having at least one refrigeration cabinet to accommodate refrigeratable items, the refrigeration system comprising at least one refrigeration module, the refrigeration module according to the first or second means as mentioned above.

Brief Description of the Drawings

The present invention will be described below in more details with reference to the attached drawings, in which:

Figure 1 – represents a view in perspective of a first preferred embodiment of the refrigeration module of the present invention, in an “L”

configuration (90 degrees);

Figure 2 – represents a view in perspective of the upper part of the refrigeration module illustrated in Figure 1 in an “I” configuration (180 degrees);

5 Figure 3 – represents a view in perspective of the lower part of the refrigeration module illustrated in Figure 1 in an “I” configuration (180 degrees);

 Figure 4 – represents a view in perspective of the refrigeration module illustrated in Figure 1 in an “L” configuration (90 degrees), showing
10 the inner part of said module;

 Figure 5 – represents a view in perspective of the refrigeration module illustrated in Figure 1 in an “I” configuration (180 degrees), showing the inner part of said module;

 Figure 6 – represents a view in perspective of the refrigeration
15 circuit of the refrigeration module illustrated in Figure 1 in an “L” configuration (90 degrees);

 Figure 7 – represents an exploded view of the first box of the refrigeration module as illustrated in Figure 1;

 Figure 8 – represents an exploded view of the second box of the
20 refrigeration module as illustrated in Figure 1;

 Figure 9 – represents an upper view in perspective of the second preferred embodiment of the refrigeration module of the present invention;

 Figure 10 – represents a lower view in perspective of the refrigeration module illustrated in Figure 9;

25 Figure 11 – represents a view in perspective of the refrigeration module illustrated in Figure 9, showing the inner part of said module;

 Figure 12 – represents an exploded view of the first box of the refrigeration module as illustrated in Figure 9;

 Figure 13 – represents an exploded view of the second box of
30 the refrigeration module as illustrated in Figure 9;

 Figure 14 – represents a view in perspective of a third preferred embodiment of the refrigeration module of the present invention, in a closed

configuration (0 degree);

Figure 15 – represents a view in perspective of the refrigeration module illustrated in Figure 14 in an “L” configuration (90 degrees);

Figure 16 (16A and 16B) - represents a view in perspective of two possible modes (A and B) of a refrigeration system, comprising the refrigeration module of the present invention illustrated in Figure 14;

Figure 17 – represents a view in perspective of a forth preferred embodiment of the refrigeration module of the present invention, in a closed configuration;

Figure 18 – represents a view in perspective of the refrigeration module illustrated in Figure 17, in an open configuration;

Figure 19 – represents a view in perspective of a possible configuration of a refrigeration system, comprising the refrigeration module of the present invention illustrated in Figure 17;

Figure 20 – represents a view in perspective of a fifth preferred embodiment of the refrigeration module of the present invention, in a closed configuration;

Figure 21 – represents a view in perspective of the refrigeration module illustrated in Figure 20 showing the opening process to obtain the “L” configuration (90 degrees);

Figure 22 (22A, 22B, 22C and 22D) – represents a view in perspective of four possible modes of a refrigeration system, comprising the refrigeration module of the present invention illustrated in Figure 20.

Detailed Description of Drawings

Figures 1, 9, 14, 17 and 21 represent five types of preferred embodiments of a refrigeration module 1, which is the object of the present invention. The refrigeration module 1 can be used in any refrigeratable compartment, such as various types and models of household / commercial / industrial / transportation refrigerator and freezer cabinets, air conditioner cabinets, cupboards, rooms, boxes, spaces, among others. Thus, in order to enable the refrigeration module 1 to be removably fitted, the refrigeratable compartment needs only to have a recess, a hollow portion or any support

base. As an example of a refrigeratable compartment, figures 16, 19 and 22 show refrigeration cabinets 2 which are able to accommodate refrigeratable items used in household refrigerators. The ability to remove the refrigeration module 1 allows for easiness of repair and/or preventive maintenance, because the user needs only to remove the refrigeration module 1 from the refrigeratable compartment and take it to a technical support center. Therefore, there is no need for a technician to visit the site where the refrigeration equipment (i.e., household refrigerator) is installed. Furthermore, during the time needed for repair/maintenance, the damaged refrigeration module 1 can be replaced with another functioning module, and said functioning module can be provided by technical support itself.

The wide variety of refrigeratable compartment types that can be used represents an evident advantage in relation to refrigeration modules known in the art, wherein only some specific refrigeratable compartment models can be used so that said refrigeration modules can be fitted. In many refrigeratable compartment models, adaptations are often needed which are complex and difficult to implement, increasing production costs.

Figure 4 depicts the main elements arranged in the internal parts of said refrigeration module. Such elements form a conventional refrigeration circuit, which is well-known and normally used in household air conditioners, refrigerators and freezers. Figure 6 shows the refrigeration circuit comprising an evaporator 104, an accumulator 105, a compressor 204, a filter drier 205, a condenser 206, and an expansion device 11 associated with one another by tubes, in which a cooling fluid circulates, which cooling fluid, in turn, is responsible for heat (energy) exchange and transportation. In this case, the expansion device 11 is represented by a capillary tube, associated with a suction line 12, which in turn associates the compressor 204 with the accumulator 105. If the expansion device is a valve (which is not depicted in the drawings), it would be arranged next to the evaporator inlet 104 and connected to the filter drier 205 by a tube. Generally speaking, heat is removed from the hot air present inside the refrigeratable compartment by the evaporator 104 and is transported to the condenser 206, which releases

said heat outside the refrigeratable compartment. Therefore, the condenser 206 is known as the hot heat exchanger of a refrigeration apparatus while the evaporator 104 is known as the cold heat exchanger. These heat exchangers can assume different construction arrangements, such as microchannels, finned tube, wire wound tube, roll-bond, among others, some of which enable more compact refrigeration modules.

The evaporator 104, the accumulator 105 and the expansion device 11 (integrally in the case of a valve and partially in the case of a capillary tube) connected to one another constitute a first portion 100 that represents the "cold portion" of the refrigeration module. The compressor 204, the filter drier 205 and the condenser 206 connected to one another constitute the second portion 200 that represents the "hot portion" of the refrigeration module. Therefore, the first portion 100 ("cold portion") is in contact with the inside of the refrigeratable compartment to provide refrigeration and the second portion 200 ("hot portion") is in contact with the outside of the refrigeratable compartment to enable heat dispersion.

Preferably, the first portion 100 is totally (integrally) accommodated inside the refrigeratable compartment and the second portion 200 is totally accommodated outside the refrigeratable compartment, for maximum performance and greater energy efficiency to be obtained. However, this configuration is not mandatory, and it is possible that a first portion 100 and/or a second portion 200 is accommodated only partially inside and outside the refrigeratable compartment, respectively.

The first portion 100 and the second portion 200 are associated with each other through the suction line 12 and the expansion device 11 (or tubes, connecting the evaporator 104 and the filter drier 205, if the expansion device 11 is a valve), whose function is to enable the exchange of heat (energy) between the elements comprised by the first portion 100 and by the second portion 200, especially the condenser 206 and the evaporator 104.

The first portion 100 further comprises at least a first closed box 101 which externally involves the evaporator 104, the accumulator 105 and the expansion device 11 (integrally, in the case of a valve and partially in the

case of a capillary tube). The first box 101 comprises at least a first lid 102 removably fitted into a first base 103, and the evaporator 104, the accumulator 105 and the expansion device 11 are arranged in the first base.

The first box 101 further comprises at least one outlet 107 which
5 enables the refrigerated air to flow to the environment. This outlet can be controlled by a damper for better air distribution inside the cabinet. In order to help and facilitate the air flow, at least a first fan 106 is fixed / installed in the first box 101 next to said outlet 107. Among others, variable rotation fans and two-coil fans can be used also enabling better air flow rate control inside the
10 cabinet and even temperature reversal between compartments. This box can also comprise air filters and/or odorizers (not depicted in the drawings) to improve the quality of the refrigerated air. On the other hand, the first box 101 has inlet slots 108 which enable ambient air to flow into the first portion 100. Therefore, the first box 101 is the interface between the refrigeration module 1
15 and the inside of the refrigeratable compartment.

The second portion 200 further comprises at least a second closed box 201 which externally involves the condenser 206, the compressor 204 and the filter drier 205. The second box 201 comprises at least a second lid 202 removably fitted to a second base 203, and the condenser 206, the
20 compressor 204 and the filter drier 205 are arranged in the second base 203. The second box 201 has cooling slots 207 that enable heat dispersion to the environment with the help of at least a second fan 210. Therefore, the second box 201 is the interface between the refrigeration module 1 and the outside of the refrigeratable compartment.

25 The first box 101 and the second box 201 should be totally or partially made of thermal insulating material to minimize undesired heat transfer between the refrigeration module (especially the hot portion) and the cabinet. Insulation materials such as polyurethane, polystyrene or vacuum panels can be used, the latter enabling thinner walls and consequently a
30 slimmer refrigeration module. Other materials, such as plastic and stainless steel can be part of said structures for weight reduction or corrosion protection. In addition to these devices, sealing and vibration insulating

materials can be employed to for noise reduction purposes.

The possibility of closing the first box 101 and the second box 201 facilitates the transportation of the refrigeration module 1 and also provides the mechanical protection of all pieces and parts that form the refrigeration circuit, such as, for instance, when the user takes the refrigeration module 1 for repair/maintenance to a technical support center. Thus, the risks of damaging the pieces and parts are prevented by closing said boxes, avoiding said pieces and parts to be exposed and unprotected from accidental shocks and foreign objects.

The above described construction arrangement and the flexibility/adaptability of the refrigeration module 1 enables it to be moved along the extension of the refrigeratable compartment. For instance, if the refrigeratable compartment is a household refrigerator cabinet, the refrigeration module 1 can be positioned from its base to the top, depending on the required application. In addition, by controlling the cold air flow rate that exits the evaporator, using the first fans 106, two refrigeratable compartments, for instance, can be kept at different temperatures, regardless of the volumes of these compartments. Therefore, as previously mentioned, temperature reversal or change between refrigeratable compartments is also possible.

The distance of the first portion 100 ("cold portion") and the second portion 200 ("hot portion"), provided by the construction arrangement of the present invention, enables the reduction of the undesired heat transfer from the compressor 204 and the condenser 206 to the evaporator 104 by means other than through the cooling fluid, such as, for instance, through the air or through the structure of the refrigeration module 1 itself.

Additionally, the external dimensions of the first box 101 and the second box 201 can be kept, and different types of refrigeration modules 1 can be implemented having varied refrigeration capacities through the use of variable capacity compressors and/or only replacing the internal components. Thus, the dimensions and the shape of the refrigeratable compartment can remain unchanged.

Control, lights, electronic circuits which currently are part of the cabinet could also be coupled to the refrigeration module, as well as specific component controls, such as compressor and expansion device, enabling an increase in their efficiency.

5 The electric supply to or energization of the refrigeration module 1, which is not depicted in the drawings, is preferably provided by a conventional electric cable to be connected to an alternating current (AC) power socket. However, batteries, a DC power supply or any other type of power supply may be used, as long as it is compatible with the operation of
10 the refrigeration module 1.

 Therefore, it can be said that the refrigeration module 1 is self-contained because, in addition to comprising all of the elements, pieces and parts required to provide refrigeration, its electric supply is not provided by / dependent on the refrigeratable compartment, as is the case of a
15 conventional household refrigerator.

 Although the present invention relates to a refrigeration module, it should be understood that the construction arrangements described in this document are applicable to other types of climatization equipment, such as, for example, equipment intended for heating in general.

20 First embodiment

 Figures 1 and 8 illustrate details of a first embodiment of the refrigeration module 1 of the present invention.

 In this first embodiment, the first portion 100 is capable of angularly moving in relation to the second portion 200.

25 In Figure 1, the refrigeration module 1 is configured in "L", that is, the first box 101 is angularly positioned in a stabilized way at 90 degrees from the second box 201. In Figures 2 and 3, the refrigeration module 1 is configured in "I", that is, the first box 101 is angularly positioned in a stabilized way at 180 degrees from the second box 201. These two
30 configurations, in "L" and "I", are preferably used; however, any other angle value can be adopted depending on the construction configuration (arrangement) of the refrigeratable compartment to be used.

The angular movement between the first portion 100 and the second portion 200 enables flexibility and the simple and easy adaptation of the refrigeration module 1 to several types of compartments, including those that were not specially designed to receive the refrigeration module 1.

- 5 Therefore, this construction arrangement, which enables the freedom of angular movement between the first portion 100, comprising the evaporator 104, and the second portion 200, comprising the condenser 206, was never exploited before in self-contained modular refrigeration equipment.

- 10 Said angular movement between the first portion 100 and the second portion 200 is enabled by means of an articulation mechanism 300, which preferably comprises pivoting pins 301 mounted on first fitting holes 110 and on second fitting holes 209 comprised by the first box 101 and by the second box, respectively. Thus, the first box 101 and the second box 201 slide over the pivoting pins 201 so as to enable the angular movement
- 15 between first portion 100 and the second portion 200. The pivoting pins 301 and/or the first and second fitting holes 110, 209 should provide sufficient friction to enable angular movement and also to enable that the first portion 100 stabilizes in relation to the second portion 200 in any angular position. Another type of articulation mechanism 300 could be used provided it is
- 20 suitable for this application. For instance, a pivoting axis could be used associating the holes of said boxes instead of the pivoting pin 301, or else, some type of spring/lock mechanism.

- Preferably, in this first embodiment, the suction line 12 and the expansion device 11, which associate a first portion 100 with a second
- 25 portion 200, are flexible. A passage groove 208 from the second box 201 and a passage hole 109 from the fist box 101 aligned to each other enable the passage of the suction line 12 and the expansion device 11 from the first box 101 to the second box 201. However, depending on how the articulation mechanism 300 is implemented, the suction line 12 and the expansion
- 30 device 11 can be rigid, if they are not subject to any force that might damage them.

In Figures 2, 3 and 5, it is noted that there two first fans 106

installed in the first box 101, directed to ends (sides or faces) opposite to said first box 101. Therefore, the refrigeration module 1 is capable of dividing the refrigeratable compartment in at least two different spaces, enabling the separate refrigeration of each environment. Thus, large savings are obtained because with only one refrigeration module 1 it is possible to refrigerate two environments at the same time and, in addition, it is not necessary to implement ducts or tubes that hamper installation and/or maintenance. It is also possible to use another number of first fans 106, or add ducts to the structure, depending on the application.

10 Second embodiment

Figures 9 to 13 illustrate a second embodiment of the refrigeration module 1 of the present invention.

The second embodiment of the present invention can be understood as a particular case of the first embodiment explained above.

15 In this second embodiment, the first portion 100 does not move in relation to the second portion 200, that is to say, the first box 101 and the second box 201 are directly and fixedly associated.

The first box 101 fits into the refrigeratable compartment through a fitting portion 111 whose cross section is smaller than the largest cross section of the second box 201.

20 Preferably, the first box 101 is positioned at 90 degrees from the second box 201, characterizing the "L" configuration. In this configuration, the largest cross section of the second box 201 is the longitudinal section of the second box 201, which is larger than the cross section of the fitting portion 111 of the first box 101. This type of construction arrangement facilitates the mounting / installation of the refrigeration module 1 in a refrigeratable compartment. The "L configuration" enables the second portion 200 ("hot portion") to be totally outside the refrigeratable compartment and the first portion 100 ("cold portion") to be totally inside the refrigeratable compartment, so as to optimize the space occupied by the refrigeration module 1. Of course, the "L configuration" is not mandatory, and other angular values are acceptable, such as, 180 degrees.

This type of fixed and static arrangement is more advantageous in relation to the mobile arrangement (first embodiment) in terms of cost and ease of production, because it is a simpler configuration and involves fewer pieces and parts, thus reducing the material and manpower costs for mounting and testing in production.

Third embodiment

Figures 14 and 15 illustrate a third embodiment of the refrigeration module 1 of the present invention.

This embodiment is quite similar to the first embodiment, and the main difference lies in the articulation mechanism 300, which comprises a pivoting axis 302, instead of a pivoting pin 301. The first box 101 and the second box 201 are adapted to enable the fitting of the pivoting axis 302. Particularly, Figure 14 illustrates the closed or the 0 (zero) degree configuration, which facilitates the transportation of the refrigeration module 1, because the space occupied by it is reduced. This configuration can also be used in the functioning mode of the refrigeration module 1.

The other differences in relation to the first embodiment represent only design and shape variations of the first box 101 and the second box 201.

Forth embodiment

Figures 17 and 18 illustrate a forth embodiment of the refrigeration module 1 of the present invention.

In this forth embodiment, the first portion 100 is capable of axially moving in relation to the second portion 200 through a sliding mechanism 400.

Preferably, a first portion 100 has a slit 401 through which the edges of the second portion 200 slide.

This sliding mechanism 400 enables the first portion 100 to stabilize in relation to the second portion 200 at any axial position through a conventional mechanic lock (not depicted in the drawing) capable of fixing the first box 101 to the second box 201 so as not to allow any relative movement between them.

The closed configuration (or 0 degree) illustrated in Figure 17 is preferably used for the transportation of the refrigeration module 1.

Fifth embodiment

Figures 20 and 21 illustrate a fifth embodiment of the refrigeration module 1 of the present invention.

This embodiment is very similar to the third embodiment, and the differences represent only design and shape variations of the first box 101 and the second box 201.

The closed configuration (or 0 degree) illustrated in Figure 20 is preferably used for the transportation of the refrigeration module 1.

Refrigeration system

Figures 16, 19 and 22 show refrigeration systems 500 which respectively comprise the third, forth and fifth embodiments of the refrigeration module 1 and a refrigeration cabinet 2. This refrigeration system 500 is represented by a household refrigerator with a freezer; however, as already mentioned, other types of refrigeratable compartments can be used.

Preferably, the refrigeration module 1 is integrally accommodated on the back wall 501 of the refrigeration cabinet 2 so as not to functionally and esthetically interfere with the front part of the refrigerator-freezer.

Figures 16 and 22 depict some configurations showing how the refrigeration module 1 can be moved along the back wall 501 of the refrigeration cabinet 2.

Figure 16A illustrates a configuration in which only the freezer is refrigerated by the refrigeration module 1. On the other hand, in Figure 16B, the refrigeration module 1 (third embodiment) is positioned exactly at the division between the refrigerator and the freezer so that a specific refrigeration intensity is provided for each of these parts. Similarly, Figures 22A and 22B illustrate the same configurations shown in Figures 16A and 16B, respectively, using the fifth embodiment of the refrigeration module 1. Figures 22C and 22D illustrate alternative configurations enabled by the flexibility and adaptability of the fifth embodiment of the refrigeration module 1.

As already mentioned, preferably the first portion 100 of the refrigeration module 1 is partially or totally accommodated inside the refrigeration cabinet 2 and the second portion 200 of the refrigeration module 1 is partially or totally accommodated outside the refrigeration cabinet 2 to provide optimized performance and power efficiency. However, this configuration is not mandatory, as illustrated in Figure 22D (180 degree configuration), wherein the first portion 100 is accommodated outside the refrigeration cabinet 2.

It is possible to note that there are no ducts inside the cabinet for distributing the cold air due to its flexible positioning. Ducts can be coupled or not, according to one's needs. These ducts cause problems related to wall condensation and load loss, the latter being one of the sources of refrigeration system inefficiency.

The examples described above represent preferred embodiments; however, it should be understood that the scope of the present invention encompasses other possible variations, and is limited only by the content of the appended claims, which include all possible equivalents.

CLAIMS

1. A refrigeration module (1) capable of being removably fitted into a refrigeratable compartment, comprising a first portion (100) and a second portion (200) associated with each other, the first portion (100) being in contact with the inside of the refrigeratable compartment, the second portion (200) being in contact with the outside of the refrigeratable compartment, the refrigeration module (1) characterized in that the first portion (100) is capable of moving in relation to the second portion (200).

2. The refrigeration module (1) according to claim 1, characterized in that the first portion (100) is capable of angularly moving in relation to the second portion (200) through an articulation mechanism (300).

3. The refrigeration module (1) according to claim 1, characterized in that the first portion (100) is capable of axially moving in relation to the second portion (200) through a sliding mechanism (400).

4. The refrigeration module (1) according to claim 2, characterized in that the articulation mechanism (300) is capable of stabilizing the first portion (100) in relation to the second portion (200) in any angular position.

5. The refrigeration module (1) according to claim 3, characterized in that the sliding mechanism (400) is capable of stabilizing the first portion (100) in relation to the second portion (200) in any axial position.

6. The refrigeration module (1) according to claim 1, characterized in that the first portion (100) is partially or totally accommodated inside the refrigeratable compartment.

7. The refrigeration module (1) according to claim 1, characterized in that the second portion (200) is partially or totally accommodated outside the refrigeratable compartment.

8. The refrigeration module (1), according to claim 1, characterized in that the first portion (100) comprises at least one evaporator (104) and one accumulator (105) associated with each other.

9. The refrigeration module (1) according to claim 1, characterized in that the second portion (200) comprises at least one

condenser (206), one compressor (204) and one filter drier (205) associated with one another.

10. The refrigeration module (1) according to claim 8, characterized in that the first portion (100) comprises at least a first closed box (101) which externally involves the evaporator (104) and the accumulator (105), the first box (101) comprising at least a first lid (102) removably fitted into a first base (103).

11. The refrigeration module (1) according to claim 9, characterized in that the second portion (200) comprises a second closed box (201) which externally involves the condenser (206), the compressor (204) and the filter drier (205), the second box (201) comprising at least a second lid (202) removably fitted into a second base (203).

12. The refrigeration module (1) according to claims 10 and 11, characterized in that the first box (101) is angularly positioned at 90 degrees from the second box (201).

13. The refrigeration module (1) according to claims 10 and 11, characterized in that the first box (101) is angularly positioned at 180 degrees from the second box (201).

14. The refrigeration module (1) according to claims 10 and 11, characterized in that the first box (101) is angularly positioned at 0 degree from the second box (201).

15. The refrigeration module (1) according to claims 8 and 9, characterized in that the first portion (100) is associated with the second portion (200) through at least one suction line (12) and one expansion device (11) which enable the heat exchange between the condenser (206) and the evaporator (104).

16. The refrigeration module (1) according to claim 15, characterized in that the suction line (12) and the expansion device (11) are flexible.

17. The refrigeration module (1) according to claim 10, characterized in that the first box (101) comprises at least one outlet (107) which enables the refrigerated air to flow to the environment.

18. The refrigeration module (1) according to claim 17, characterized in that the first portion (100) comprises at least a first fan (106) associated with the outlet (107).

19. The refrigeration module (1) according to claim 10,
5 characterized in that the first box (101) comprises inlet slots (108) which enable the ambient air to flow into the first portion (100).

20. The refrigeration module (1) according to claim 11, characterized in that the second box (201) comprises cooling slots (207) which enable heat dispersion to the environment.

10 21. The refrigeration module (1) according to claim 1, characterized in that it is capable of being moved along the refrigeration compartment.

22. Refrigeration module (1) according to claim 1, characterized in that it is capable of dividing the refrigeratable compartment into at least two
15 different spaces, the refrigeration module (1) being capable of refrigerating each environment separately, keeping said compartments at different temperatures and enabling temperature reversal or change between the refrigerated volumes through the flow rate control of the first fans (106).

23. A refrigeration system (500) having at least one refrigeration
20 cabinet (2) to accommodate refrigeratable items, the refrigeration system (500) characterized by comprising at least one refrigeration module (1), the refrigeration module (1) as defined in claims 1 to 22.

24. The refrigeration system (500) according to claim 23, characterized in that the refrigeration module (1) is capable of being integrally
25 accommodated in a back wall (501) of the refrigeration cabinet (2).

25. The refrigeration system (500) according to claim 24, characterized in that the refrigeration module (1) is capable of being moved along the back wall (501) of the refrigeration cabinet (2).

26. The refrigeration system (500) according to claim 23,
30 characterized in that the first portion (100) of the refrigeration module (1) is capable of being partially or totally accommodated inside the refrigeration cabinet (2).

27. The refrigeration system (500) according to claim 23, characterized in that the second portion (200) of the refrigeration module (1) is partially or totally accommodated outside the refrigeration cabinet (2).

28. The refrigeration system (500) according to claim 23,
5 characterized in that it is a household refrigerator having a freezer.

29. A refrigeration module (1) capable of being removably fitted into a refrigeratable compartment, comprising at least a first portion (100) and a second portion (200) directly and firmly associated with each other, the refrigeration module (1) characterized in that first portion (100) comprises at
10 least a first closed box (101), the first box (101) interfacing the refrigeration module (1) with the inside of the refrigeratable compartment, and the second portion (200) comprising at least a second closed box (201), the second portion (200) interfacing the refrigeration module (1) with the outside of the refrigeratable compartment, the first box (101) fitting the refrigeratable
15 compartment through a fitting portion (111) whose cross section is smaller than the largest cross section of the second box (201).

30. The refrigeration module (1) according to claim 29, characterized in that the first portion (100) is partially or totally accommodated inside the refrigeratable compartment.

20 31. The refrigeration module (1) according to claim 29, characterized in that the second portion (200) is partially or totally accommodated outside the refrigeratable compartment.

32. The refrigeration module (1) according to claim 29, characterized in that the first portion (100) comprises at least one evaporator
25 (104) and one accumulator (105) associated with each other.

33. The refrigeration module (1) according to claim 29, characterized in that the second portion (200) comprises at least one condenser (206), one compressor (204) and one filter drier (205) associated with one another.

30 34. The refrigeration module (1) according to claim 29, characterized in that the first box (101) comprises at least a first lid (102) removably fitted into a first base (103).

35. The refrigeration module (1) according to claim 29, characterized in that the second box (201) comprises at least a second lid (202) removably fitted into a second base (203).

5 36. The refrigeration module (1) according to claim 29, characterized in that the first box (101) is angularly positioned at 90 degrees from the second box (201).

37. The refrigeration module (1) according to claim 29, characterized in that the first box (101) is angularly positioned at 180 degrees from the second box (201).

10 38. The refrigeration module (1) according to claims 32 and 33, characterized in that the first portion (100) is associated with the second portion (200) through at least one suction line (12) and one expansion device (11) which enable the heat exchange between the condenser (206) and the evaporator (104).

15 39. The refrigeration module (1) according to claim 29, characterized in that the first box (101) comprises at least one outlet (107) which enables the refrigerated air to flow to the environment.

20 40. The refrigeration module (1) according to claim 39, characterized in that the first portion (100) comprises at least a first fan (106) associated with the outlet (107).

41. The refrigeration module (1) according to claim 29, characterized in that the first box (101) comprises inlet slots (108) which enable the ambient air to flow into the first portion (100).

25 42. The refrigeration module (1) according to claim 29, characterized in that the second box (201) comprises cooling slots (207) which enable heat dispersion to the environment.

43. The refrigeration module (1) according to claim 29, characterized in that it is capable of being moved along the refrigeratable compartment.

30 44. The refrigeration module (1) according to claim 29, characterized in that it is capable of dividing the refrigeratable compartment into at least two different spaces, the refrigeration module (1) being capable

of refrigerating each environment separately, keeping said compartments at different temperatures and enabling temperature reversal or change between the refrigerated volumes through the flow rate control of the first fans (106).

45. A refrigeration system (500) having at least one refrigeration cabinet (2) to accommodate refrigeratable items, the refrigeration system (500) characterized by comprising at least one refrigeration module (1), the refrigeration module (1) as defined in claims 29 to 45.

46. The refrigeration system (500) according to claim 45, characterized in that the refrigeration module (1) is partially accommodated in a back wall (501) of the refrigeration cabinet (2).

47. The refrigeration system (500) according to claim 46, characterized in that the refrigeration module (1) is capable of being moved along the back wall (501) of the refrigeration cabinet (2).

48. The refrigeration system (500) according to claim 45, characterized in that the first portion (100) of the refrigeration module (1) is partially or totally accommodated inside the refrigeration cabinet (2).

49. The refrigeration system (500) according to claim 45, characterized in that the second portion (200) of the refrigeration module (1) is partially or totally accommodated outside the refrigeration cabinet (2).

50. The refrigeration system (500) according to claim 45, characterized by being a household refrigerator having a freezer.

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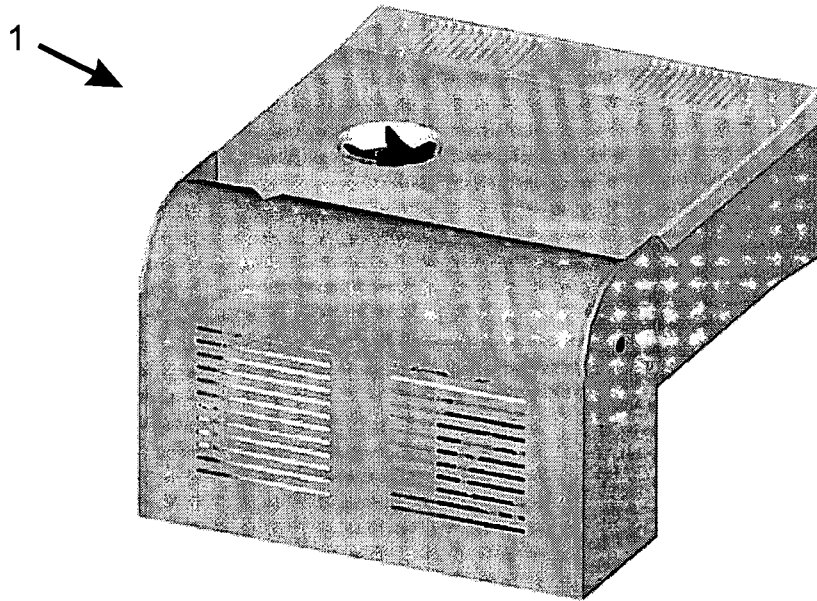


Fig. 1

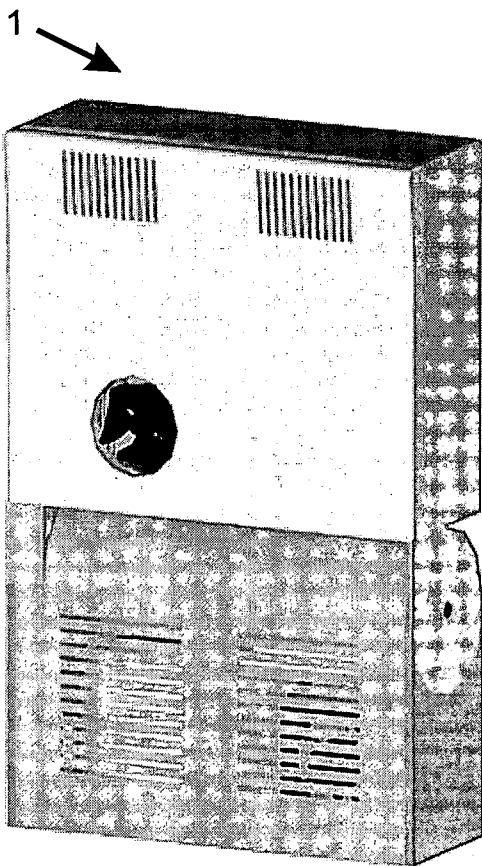


Fig. 2

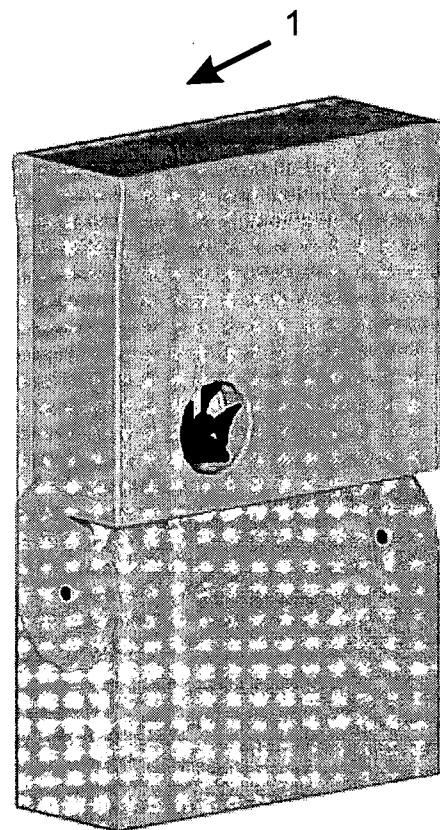


Fig. 3

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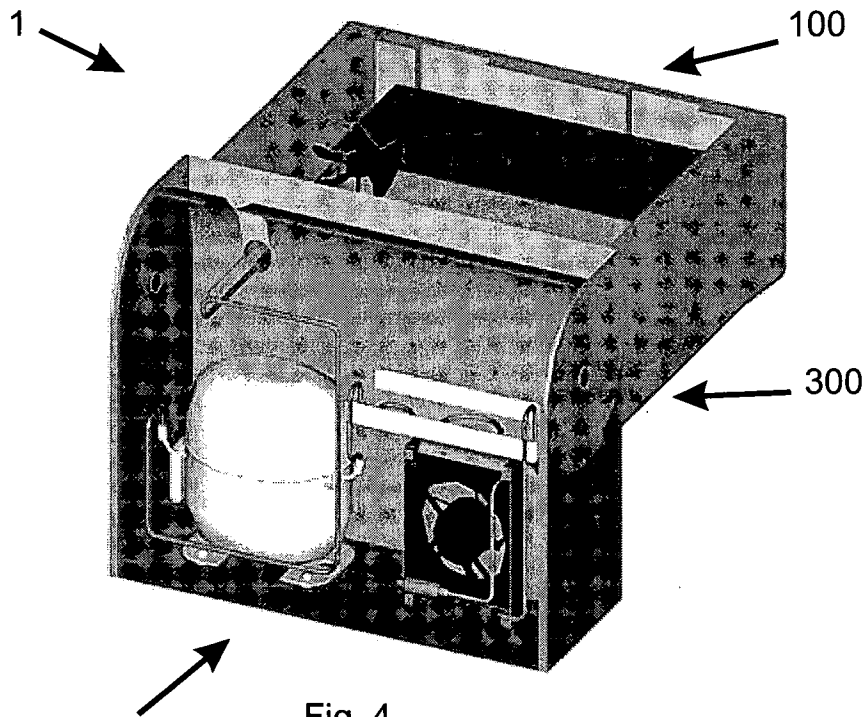


Fig. 4

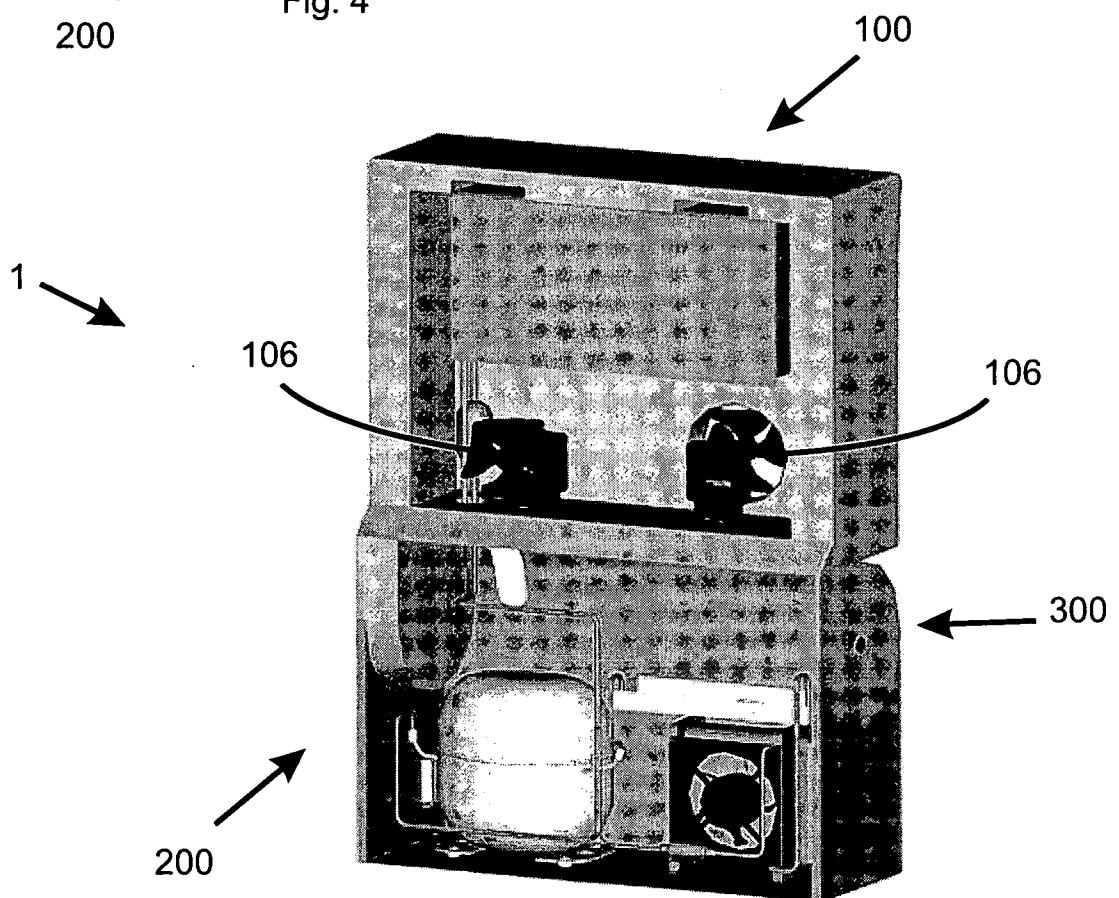


Fig. 5

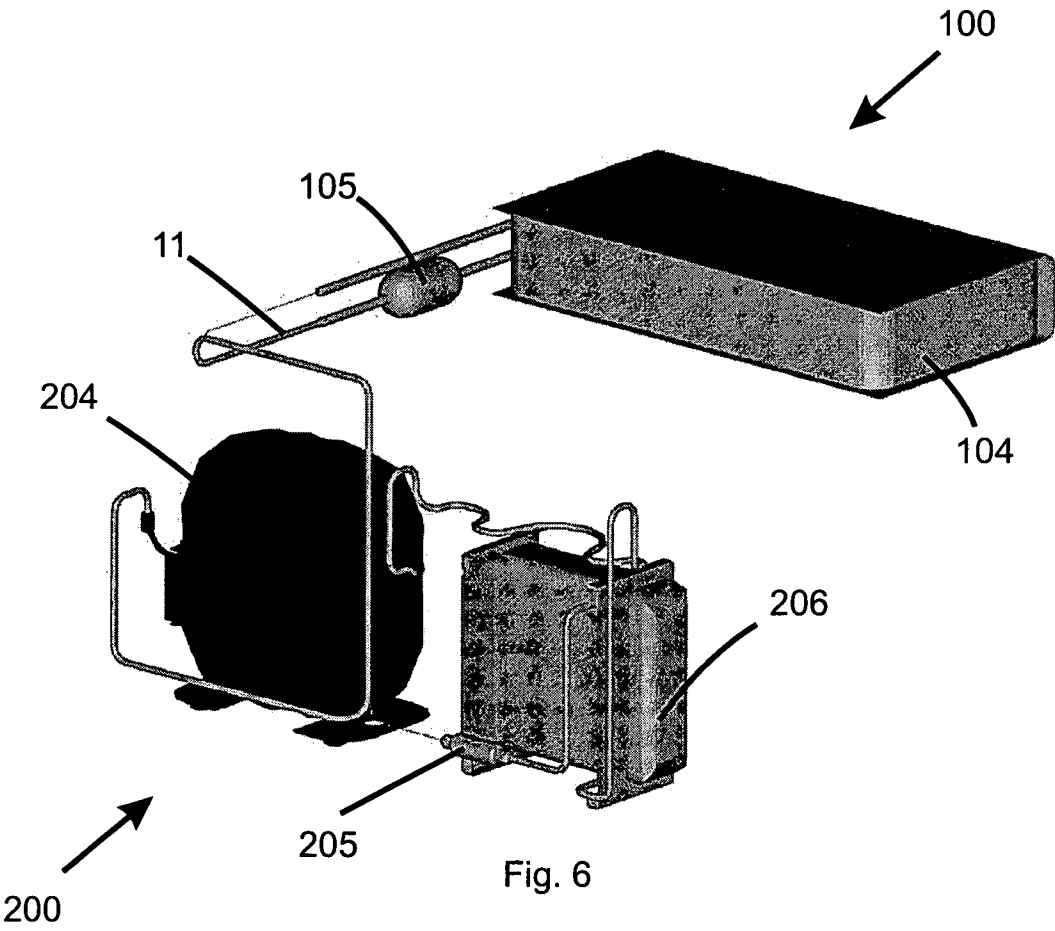


Fig. 6

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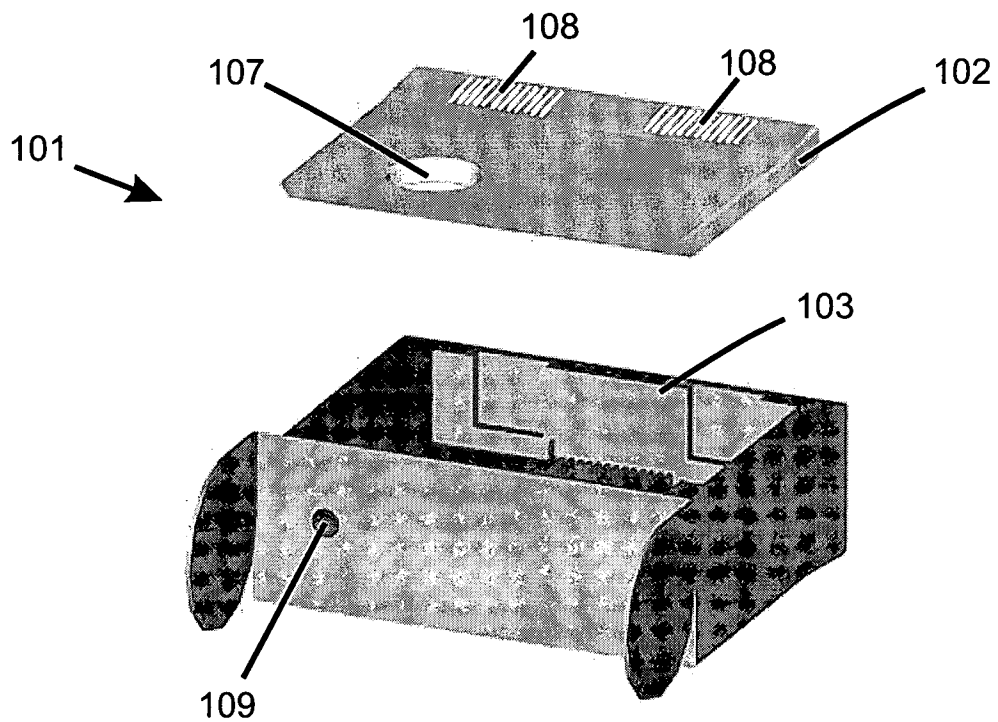


Fig. 7

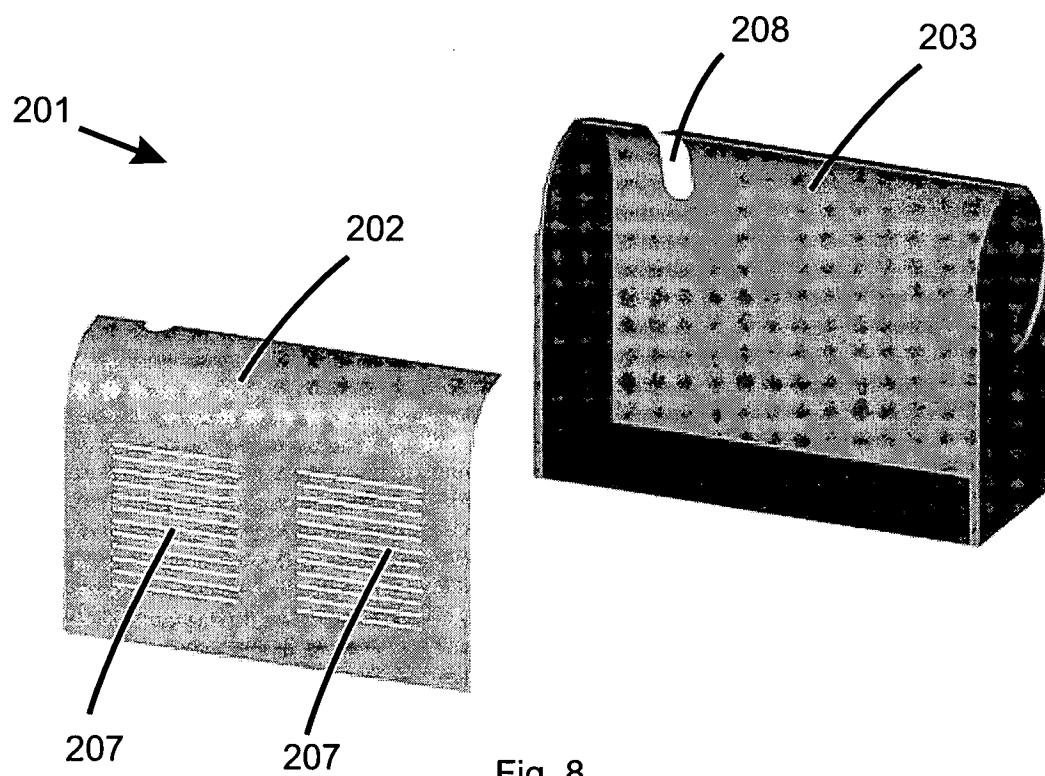


Fig. 8

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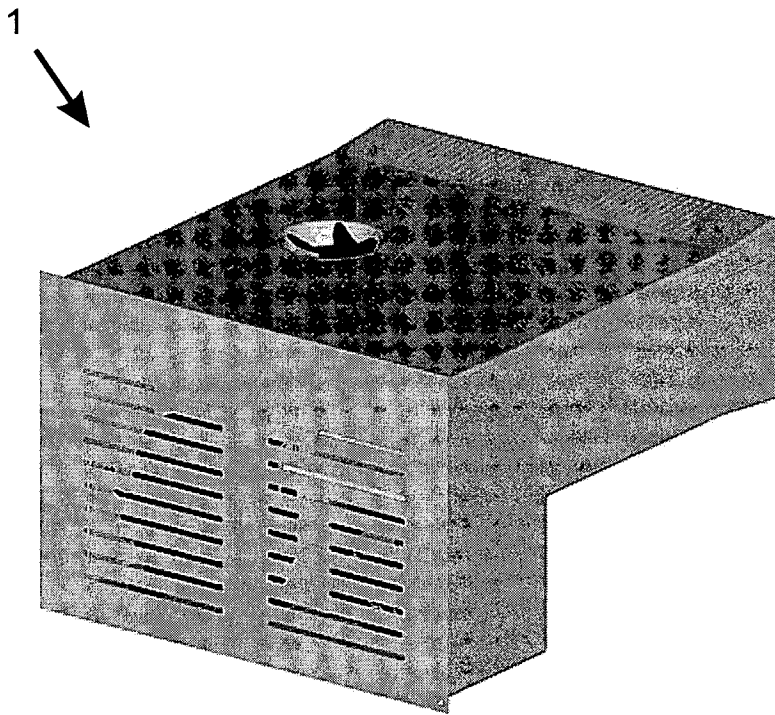


Fig. 9

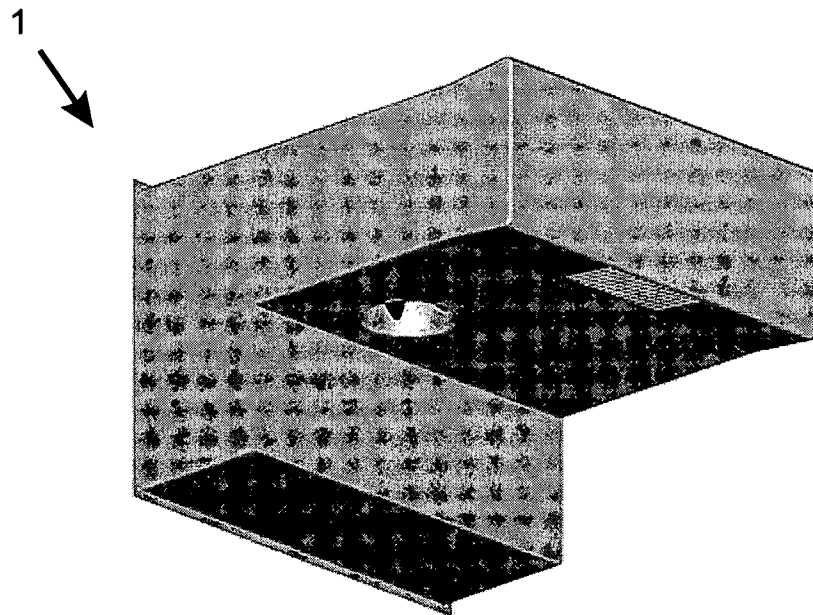
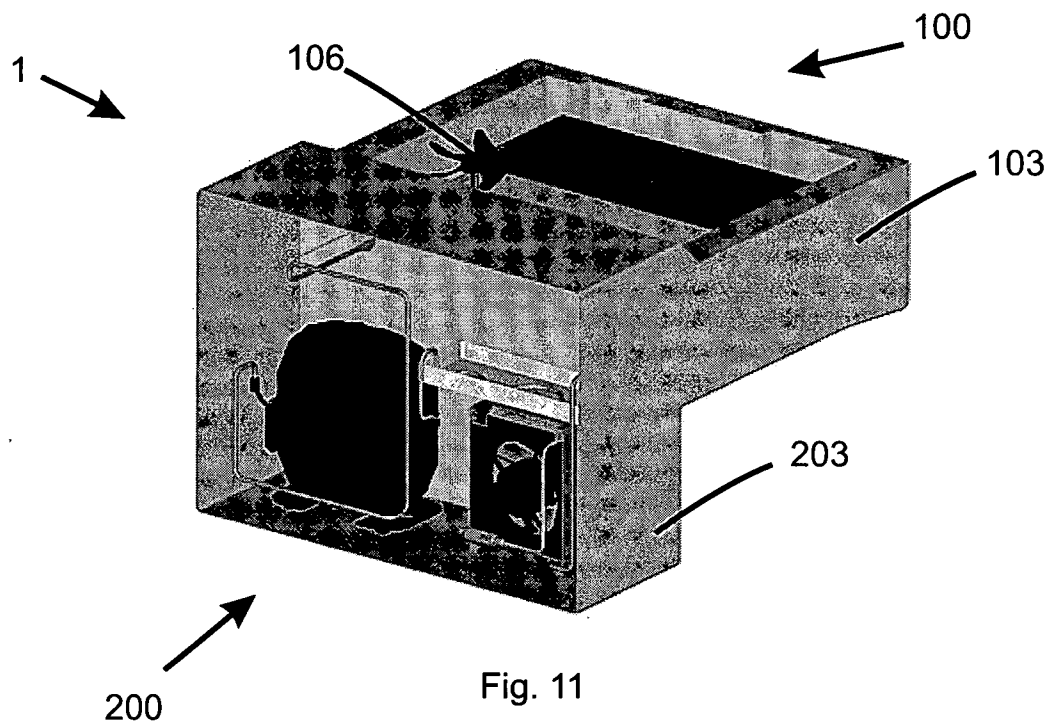


Fig. 10

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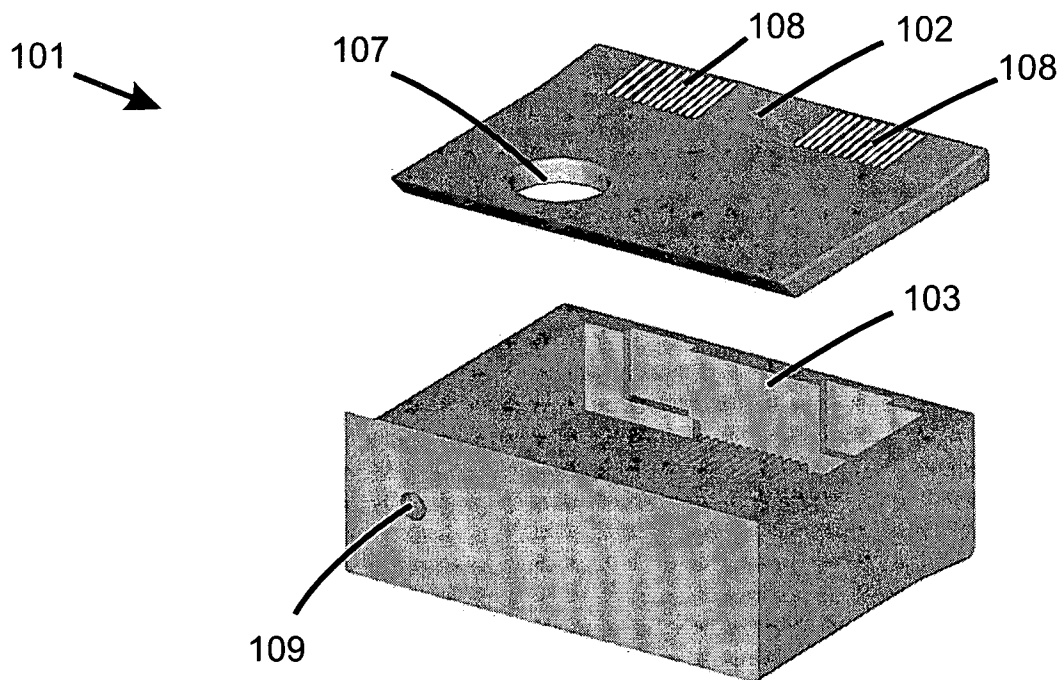


Fig. 12

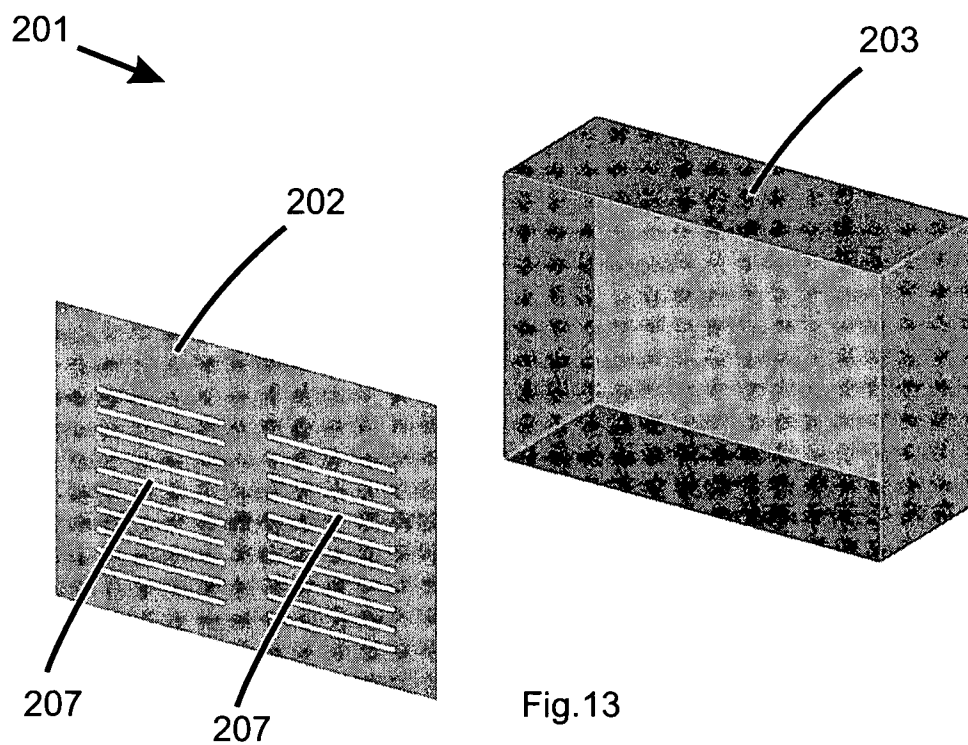


Fig. 13

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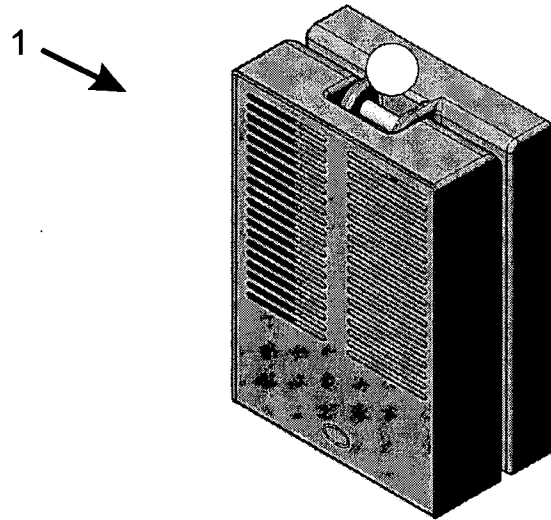


Fig. 14

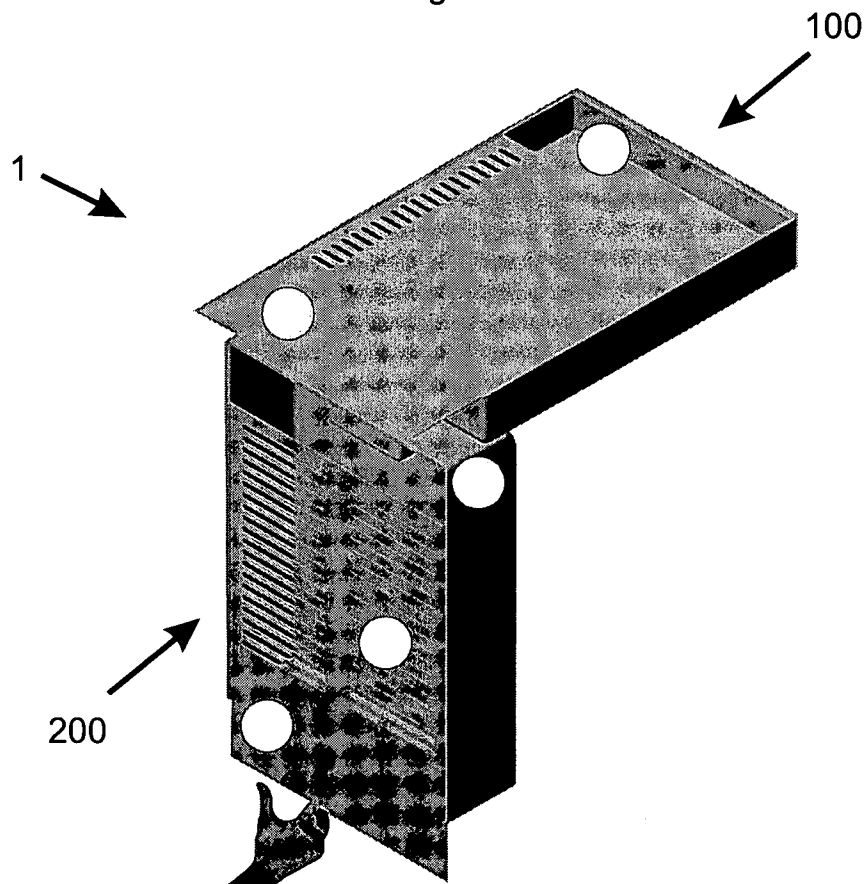


Fig. 15

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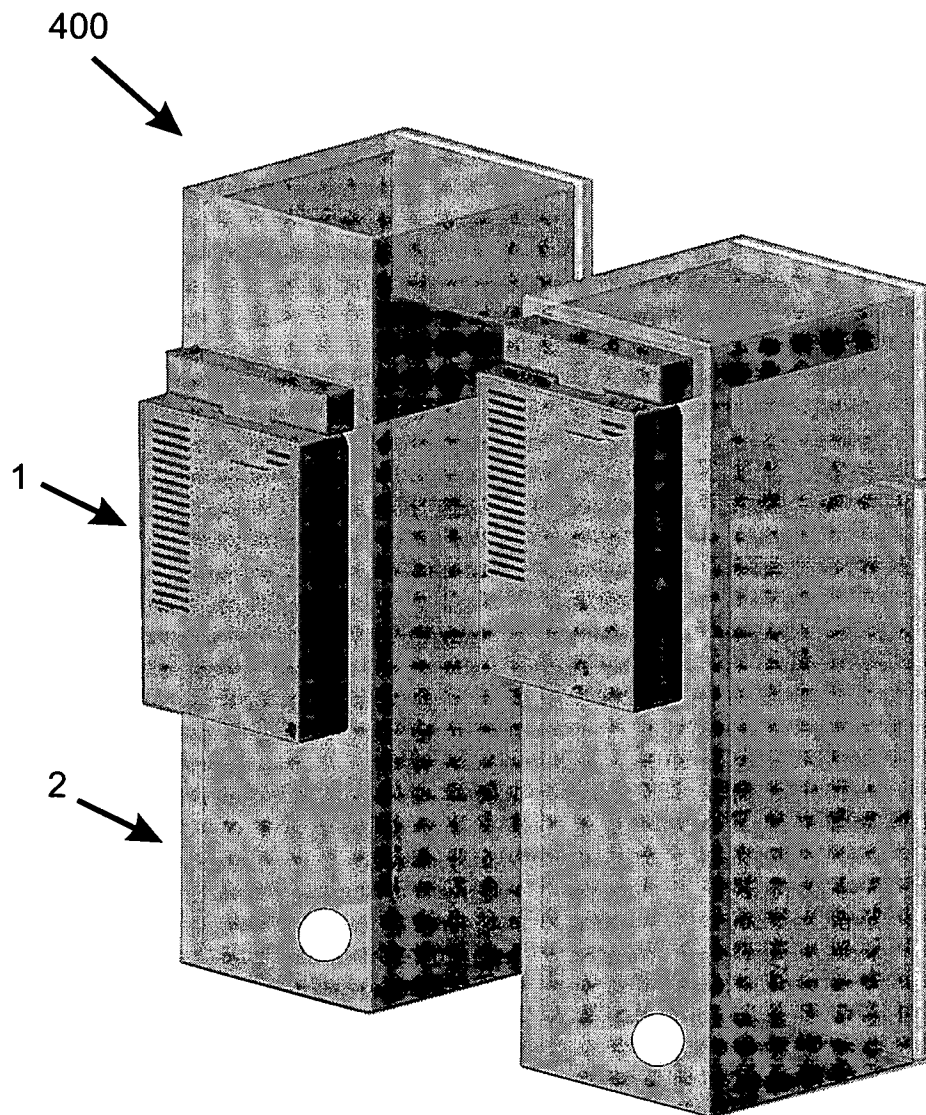


Fig. 16

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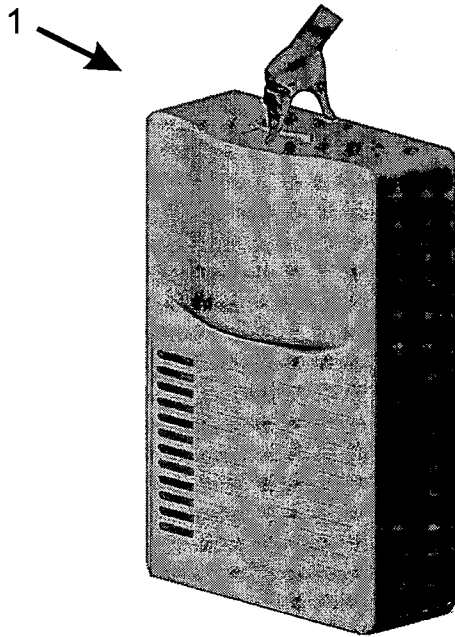


Fig. 17

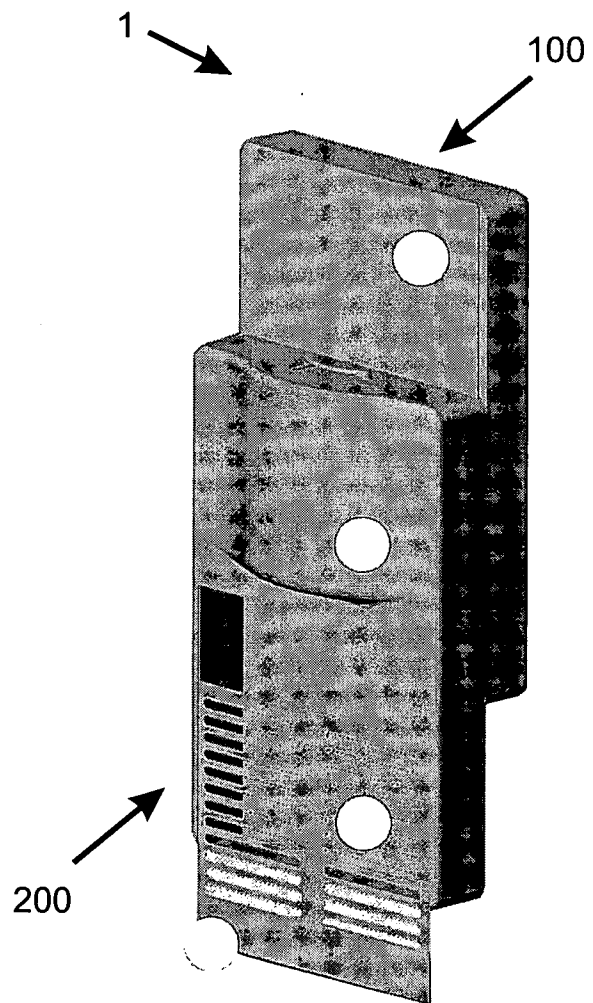


Fig. 18

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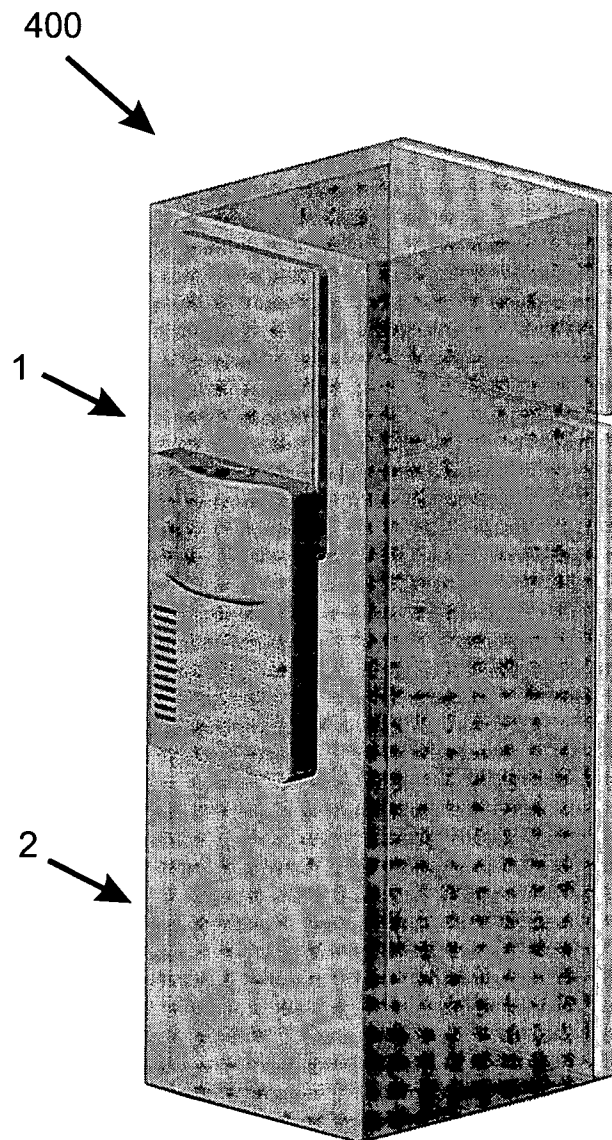


Fig. 19

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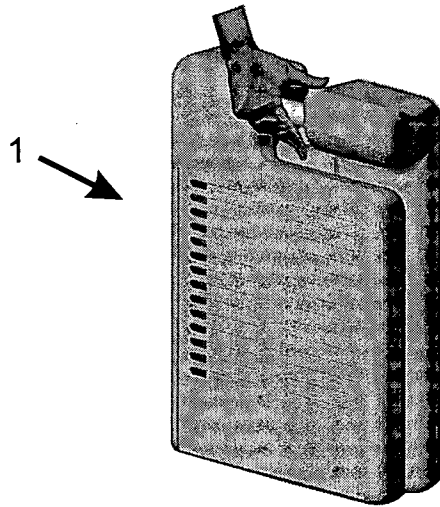


Fig. 20

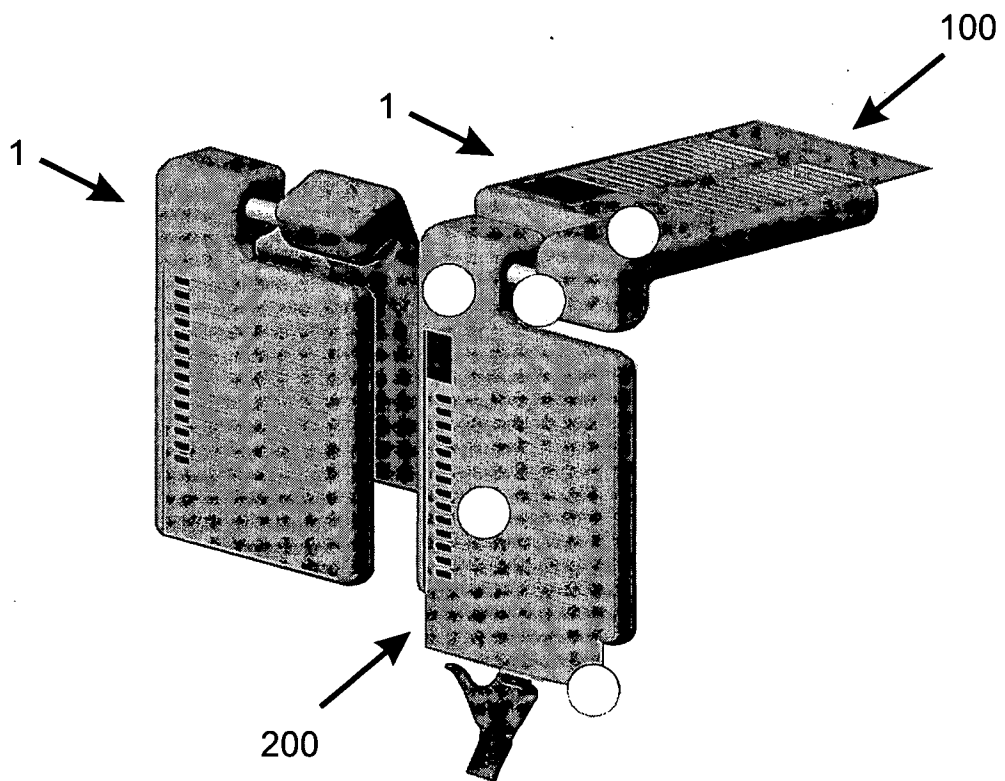


Fig. 21

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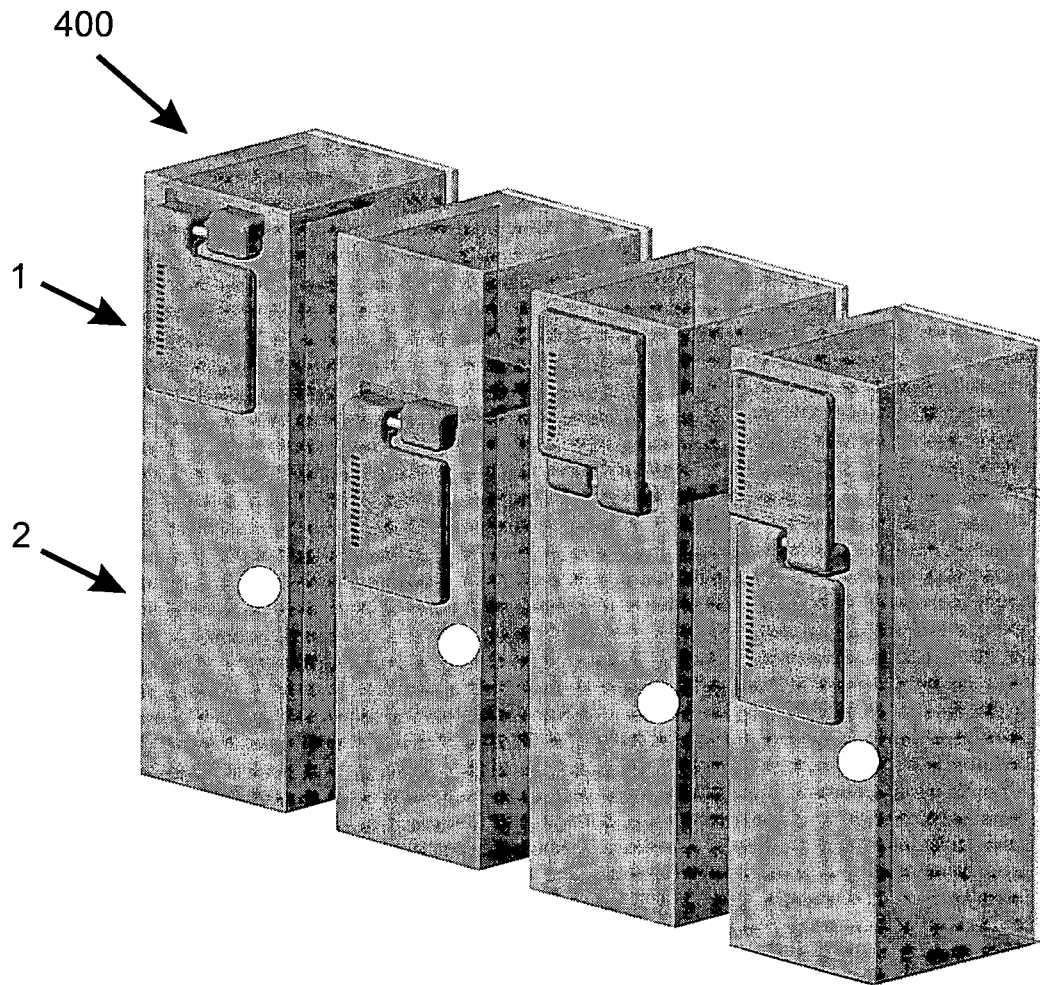


Fig. 22