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(54) **Warehouse system for products storage and transport at low temperature**

(57) The present invention provides a system, a method and devices for receiving and storing cooled, chilled, refrigerated and frozen products and for loading said products into a transport container (1) for transport to an external destination, whereby the products comprise food products and at least one cooling medium product, whereby the cooling medium product is provided in a determined amount sufficient to maintain the food products stored within said transport container (1) at a desired temperature during further transport to an external destination.

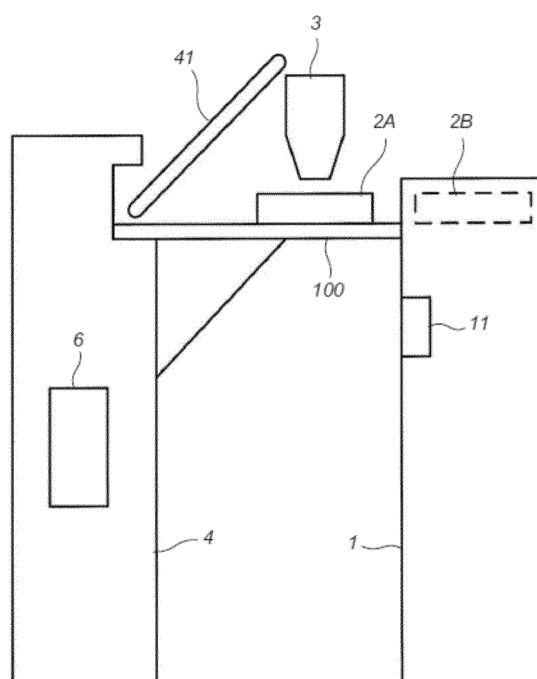


Fig. 1

Description

Field of the invention

[0001] The present invention relates to the field of filling insulated containers, in particular transport insulated cooling containers, with a cryogenic medium. More in particular, the present invention relates to a system, a method and devices for receiving and storing cooled, chilled, refrigerated and frozen products and for loading said products into a transport container for transport to an external destination

State of the art

[0002] High quality of many products, especially food products, can be only guaranteed if cold chain is uninterrupted, i.e. the temperature of the product during storage and distribution is kept within given ranges, specific for the process and the products. Dry ice or solid CO₂ is used to keep low temperatures inside containers for goods transport. Dry ice or solid CO₂ present several advantages such as a high sublimation heat, a low sublimation temperature, lack of any residues and a bacteriostatic effect of CO₂ gas released during sublimation.

[0003] EP 1 408 295 discloses a system wherein the amount of heat absorbed by the solid carbon dioxide is being controlled by the amount and size of pellets of solid CO₂ brought into the cassette. The dosing system uses a buffer tank, from which solid CO₂ falls gravitationally to a cassette in isothermal container through a hole in the container roof. During this process, the particles of solid CO₂ are comminuted in order to achieve a predefined specific surface. This solution would require the user to exchange the whole container fleet and to use a specialized type of container. Moreover, making an additional hole in the container roof requires additional closing device, which, in case of probable failure, could significantly increase heat losses of the container.

[0004] In EP 0 745 816 solid CO₂ is produced in a special vessel, separate from isothermal container. The cassette for CO₂ is brought into this special vessel. Then decompression of liquid CO₂ takes place in the vessel and the snow produced in the cassette is compressed. A drawback of this system is the manual workload for the user, who has to load the cassettes with compressed snow manually. This operation can take a long time if several cassettes have to be filled which is dangerous for the user.

[0005] The aim of the present invention is to provide a solution to overcome at least part of the above mentioned disadvantages by providing an improved system, devices and methods for the introduction of a cooling medium in a container which is used for goods, such as foodstuff storage and/or transport.

Summary of the invention

[0006] In a first aspect, the present invention provides a cold storage warehouse system for receiving and storing cooled, chilled, refrigerated and frozen products and for loading said products into a transport container for transport to an external destination, whereby the products comprise food products and at least one cooling medium product, whereby the cooling medium product is provided in a determined amount sufficient to maintain the food products stored within said transport container at a desired temperature during further transport to an external destination. In a preferred embodiment of the system, the cooling medium product comprises solid CO₂.

[0007] In a preferred embodiment, the system comprises at least one device to calculate and/or to provide said determined amount of cooling medium product. This allows avoiding losses of important amounts of cooling medium and avoids the use of an insufficient amount of cooling medium during transport, which leads to a partial or even a complete loss of the transported products.

[0008] In a second aspect, the present invention provides a method for optimizing the transport of cooled, chilled, refrigerated and frozen products loaded in a transport container, whereby the products comprise food products and at least one cooling medium product, whereby the cooling medium product is provided in a determined amount sufficient to maintain the food products stored within said transport container at a desired temperature during transport from a warehouse to an external destination. In a preferred embodiment, the cooling medium product is assembled outside and/or prior to its loading in the transport container.

[0009] In a preferred embodiment, said amount of cooling medium product is determined taking into account parameters comprising the nature of the food products, the amount of food products loaded in the transport container, the temperature inside the transport container, the density of the solid CO₂, the time required for the transport of said food products to the external destination, the average expected external temperature during the transport or any combination thereof.

[0010] In a third aspect, the present invention provides a transport container comprising a roof, a floor, at least three upstanding walls and at least one upstanding door, thereby defining an internal compartment, said internal compartment is provided with at least one engagement means for holding at least one cooling medium product, said engagement means have a variable height within the internal compartment of the transport container.

[0011] In a fourth aspect, the present invention provides for the use of the cold storage warehouse system and/or the method and/or the transport container of the invention for transporting cooled, chilled, refrigerated and frozen products from the warehouse to an external destination.

[0012] The system, devices and method of the present

invention present several advantages such as offering to the user the possibility to use small, light and cheap support devices. The latter could be easily fitted into several types of containers. The system does not require a modification of the container, which leads to a cost saving and higher flexibility with respect to the container type that can be used.

[0013] The system is safe as it does not involve a step wherein the user has to handle a pressurized media. The system allows a precise dosage of the solid CO₂ based on its mass or volume. This is more precise than other dosing systems such as time based dosing systems.

[0014] The system of the present invention presents several advantages as it allows taking into account the solid CO₂ left from a transport for optimizing the amount of solid CO₂ for a next transport of the same products in similar conditions. This is advantageous as it ensures the safety of the transported products and simultaneously reduces the solid CO₂ waste. This present invention also allows lowering of operational cost, increasing worker safety and improving food quality.

[0015] The system also provides for the reliquefaction of gaseous CO₂ produced together with solid CO₂. Thus the system is suitable to be combined with CO₂ reliquefaction process. Moreover, the system is equipped with a solid CO₂ production device, thus providing the user an access to solid CO₂ for maintaining cold chain in other facilities for food storage and/or transport. The solid CO₂ production device can also be used for different purposes, for example, solid CO₂ blasting.

[0016] The system according to the present invention is easily and quickly backed up, by manual loading of solid CO₂ into cassettes and/or by supply of solid CO₂ from the market. The backup will be required if the dosing station and/or the solid CO₂ production device fails to work.

Short description of the figures

[0017]

Fig. 1 illustrates a side view of a 1st embodiment of the system according to the present invention.

Fig. 2 illustrates a side view of an embodiment of a buffer tank being part of the system of the present invention.

Fig. 3 illustrates a side view of another embodiment of a buffer tank being part of the system of the present invention.

Fig. 4 is a top view of an embodiment of a distribution centre according to the present invention

Fig. 5 illustrates a side view of a second embodiment of the system according to the present invention.

Fig. 6 illustrates a side view of a third embodiment of the system according to the present invention.

Fig. 7 illustrates a side view of a fourth embodiment of the system according to the present invention.

Fig. 8 is a top view of another embodiment of a dis-

tribution centre according to the present invention.

Fig. 9 illustrates a side view of a first embodiment of the cassette removal system.

Fig. 10 illustrates a side view of second embodiment of the cassette removal system.

Fig. 11 illustrates a side view of third embodiment of the cassette removal system.

Fig. 12 illustrates a side view of a fifth embodiment of the system wherein the tank is fixed to a roof framework.

Fig. 13 is a top view of another embodiment of a distribution centre according to the present invention.

Fig. 14 is an illustration of an embodiment of the container according to the present invention.

Fig. 15A is an illustration of a solid CO₂ slab suitable to be placed in the container **B** is an illustration of a solid CO₂ slab supported by a grid suitable to be placed in the container **C** is an illustration of a solid CO₂ slab provided with fixation means suitable to be placed in the container.

Fig. 16 is an illustration of the different shapes of the solid cooling medium, namely the solid CO₂.

Fig. 17 is an illustration of a first embodiment of a support device suitable to be placed in the container.

Fig. 18 is an illustration of an embodiment of wrapped solid CO₂.

Fig. 19A is an illustration of a second embodiment of a support device suitable to be placed in the container **B** a vertical cross sectional view of the embodiment shown in **Fig. 19A**.

Fig. 20 is an illustration of a third embodiment of a support device suitable to be placed in the container.

Fig. 21 is an illustration of a fourth embodiment of a support device suitable to be placed in the container.

Fig. 22 is an illustration of an embodiment of a support device when placed inside the container.

Fig. 23 is an illustration of a fifth embodiment of a support device suitable to be placed in the container.

Fig. 24 is an illustration of a sixth embodiment of a support device suitable to be placed in the container.

Fig. 25 is an illustration of a container according to the present invention, the container door is closed.

Fig. 26 is an illustration of a container according to the present invention, the container door is open and the support device is inside said container.

Fig. 27 is an illustration of a container according to the present invention, showing the support device partially inside said container.

Fig. 28 is an illustration of a container having orifice at the upper side.

Fig. 29 is an illustration of a container having at least one orifice at one vertical wall.

Fig. 30 illustrates a side view of a sixth embodiment of the system according to the present invention.

Fig. 31 illustrates a side view of a seventh embodiment of the system according to the present invention.

Fig. 32 is an illustration of a container according to the present invention, the container have two different compartments.

Fig. 33 illustrates a side view of a eighth embodiment of the system according to the present invention.

Fig. 34 illustrates a side view of a ninth embodiment of the system according to the present invention.

Fig. 35 illustrates a side view of a tenth embodiment of the system according to the present invention.

Fig. 36 illustrates a side view of a eleventh embodiment of the system according to the present invention.

Fig. 37 illustrates a side view of a twelfth embodiment of the system according to the present invention.

Fig. 38 illustrates a side view of a thirteenth embodiment of the system according to the present invention.

Fig. 39 shows a mobile solid CO₂ production device according to the present invention

Fig. 40 illustrates a side view of a fourteenth embodiment of the system according to the present invention.

Fig. 41 is an illustration of a preferred embodiment of a container according to the present invention, the container have is provided with springs.

Fig. 42 illustrates a side view of a fifteenth embodiment of the system according to the present invention.

Fig. 43 illustrates a side view of the buffer tank in connection with a cassette according to the present invention.

Fig. 44 illustrates a side view of a sixteenth embodiment of the system according to the present invention.

Fig. 45 illustrates a side view of a seventeenth embodiment of the system according to the present invention.

Fig. 46 illustrates a side view of a eighteenth embodiment of the system according to the present invention.

Fig. 47 illustrates a side view of a nineteenth embodiment of the system according to the present invention.

Fig. 48 a illustrates another embodiment of the support device being a cassette having a sloped bottom **b** illustrates another embodiment of the support device being a cassette, having a bottom capable of changing shape under a certain weight.

Detailed description of the invention

[0018] The present invention relates to a system, a method and devices for cooling products during transport.

[0019] Unless otherwise defined, all terms used in disclosing the invention, including technical and scientific terms, have the meaning as commonly understood by one of ordinary skill in the art to which this invention be-

longs. By means of further guidance, term definitions are included to better appreciate the teaching of the present invention.

[0020] As used herein, the following terms have the following meanings:

"A", "an", and "the" as used herein refers to both singular and plural referents unless the context clearly dictates otherwise. By way of example, "a compartment" refers to one or more than one compartment.

"About" as used herein referring to a measurable value such as a parameter, an amount, a temporal duration, and the like, is meant to encompass variations of +/-20% or less, preferably +/-10% or less, more preferably +/-5% or less, even more preferably +/-1% or less, and still more preferably +/-0.1% or less of and from the specified value, in so far such variations are appropriate to perform in the disclosed invention. However, it is to be understood that the value to which the modifier "about" refers is itself also specifically disclosed.

"Comprise," "comprising," and "comprises" and "comprised of" as used herein are synonymous with "include", "including", "includes" or "contain", "containing", "contains" and are inclusive or open-ended terms that specifies the presence of what follows e.g. component and do not exclude or preclude the presence of additional, non-recited components, features, element, members, steps, known in the art or disclosed therein.

[0021] The recitation of numerical ranges by endpoints includes all numbers and fractions subsumed within that range, as well as the recited endpoints.

[0022] The expression "% by weight" (weight percent), here and throughout the description unless otherwise defined, refers to the relative weight of the respective component based on the overall weight of the formulation.

[0023] By "solid CO₂" we hereby refer to any solid cooling medium obtained from liquid CO₂. This includes solid CO₂ and dry ice.

[0024] In a first aspect, the present invention provides a cold storage warehouse system for receiving and storing cooled, chilled, refrigerated and frozen products and for loading said products into a transport container for transport to an external destination, whereby the products comprise food products and at least one cooling medium product. The cooling medium product is provided in a determined amount sufficient to maintain the food products stored within said transport container at a desired temperature during further transport to an external destination. In a preferred embodiment, the cooling medium product comprises solid CO₂.

[0025] In a preferred embodiment, the warehouse system comprises at least one device to calculate and/or to

provide said determined amount of cooling medium product.

[0026] In a preferred embodiment, the cooling medium product comprises a support device selected from the group comprising a tray, a cassette, a plate, a grid or any combination thereof. In a further preferred embodiment, the support device comprises an upper insulating lid and a lower support surface. In a preferred embodiment, the upper lid and the lower support surface of the support device have different heat transfer capacity and/or have different thickness.

[0027] In a preferred embodiment, the system comprises a transport unit suitable to move the support device from a position inside the container to a position wherein the support device is at least partly outside the container. In a preferred embodiment, the transport unit is provided with weighting means for determining the weight of the solid CO₂ provided to the support device. In a preferred embodiment, the transport unit comprises at least one horizontally movable guiding rail provided with clamps for temporarily fixing the device on the guiding rails thereby moving said support device between the position inside the container and the position outside the container.

[0028] In a preferred embodiment, the system further comprises a solid CO₂ production device having at least one outlet from which solid CO₂ is provided to the support device after being produced.

[0029] In a preferred embodiment, the system comprises a tank having at least one inlet through which solid CO₂ is provided and one outlet suitable to directly deliver solid CO₂ to the support device. The solid CO₂ can be provided to the tank directly or indirectly from the solid CO₂ production device. The tank is optionally provided with a dispensing device suitable to volumetrically measure the solid CO₂ prior to the delivery of solid CO₂ to the support device.

[0030] In the system of the present invention, the solid CO₂ can be automatically provided to the support device. The predetermined quantity of solid CO₂ to be provided to the support device and/or to the container is defined by its volumetric and/or gravimetric weight.

[0031] The system of the present invention will now be described in more details with reference to the accompanying figures. The description of the system hereunder refers to a system wherein the cooling medium product comprises a cassette 2 as a support device. It is to be understood that any embodiment of the support device described hereafter and/or known to the person skilled in the art can be used instead of the cassette.

[0032] Fig. 1 illustrates the system according to an embodiment of the invention. The system comprises an isothermal container 1, a solid CO₂ production device 4, a buffer tank 3 and a cassette removal system 100. The dosing process starts when an isothermal container 1 is placed in front of the cassette removal system 100. Once this task is performed, the control box 6 sends the signal to the cassette removal system 100 and the dosing process can be initiated. The control box 6 can send the signal

based on the manual action of an operator. Preferably, a fully automatic system is applied. In the fully automated system, the presence of the isothermal container 1 is detected automatically and this detection is a signal to start the procedure of solid CO₂ dosing. Preferably the isothermal container 1 is equipped with an electronic device 11 which communicates with the control box 6 and contains information about the isothermal container 1, its destination, its transport conditions and the goods contained within. Based on that information, the electronic device 11 controls the amount of dosed solid CO₂ by emitting signal to the dispensing device (not shown in Fig. 1).

[0033] In the most preferred embodiment the cassette removal system 100 is equipped with detection means, which would detect the presence of the cassette 2 placed in the isothermal container 1. The detection means would also control a process of matching the cassette removal system 100 to the cassette 2 in case that the initial alignment of the cassette removal system 100 and the cassette 2 does not allow to perform the loading process properly.

[0034] After proper alignment of the cassette removal system 100 and the cassette 2, the cassette removal system 100 moves the cassette 2 from a position (2B, Fig. 1) within the container 1 to a retracted position (2A, Fig. 1).

[0035] The cassette 2 can be filled when it is fully retracted from the isothermal container 1. The cassette can also be filled while being only partially retracted or inside the isothermal container. Fig. 26 and Fig. 27 respectively show the cassette when completely inside the container and when partially retracted from the container. In the example shown in Fig. 27, a cassette having two inlets 237 at the front side is shown.

[0036] The solid CO₂ is produced by the solid CO₂ production device 4 and is further conveyed by an additional conveying system 41 to the buffer tank 3. Preferably, the buffer tank 3 contains enough solid CO₂ to perform dosing to several cassettes. In the solid CO₂ production devices 4, solid CO₂ is produced by decompression of liquid CO₂. However, any other type of solid CO₂ production device can be used in the system of the present invention. For example, solid CO₂ can be produced by subcooling and subsequent solidification of liquid CO₂. The mechanical conveying system 41 is here given as an example. The solid CO₂ can be transported to the buffer tank by any another method obvious to a person skilled in the art. It is also possible to fill the buffer tank 3 directly from the solid CO₂ production device 4.

[0037] Once the buffer tank 3 is in position, the dosing of solid CO₂ can follow. In a most preferable embodiment of the invention, the proper position of the cassette 2 under the buffer tank 3 is being detected by the cassette removal system 100. Once the signal of proper alignment is sent to the control box 6, buffer tank 3 is being given a signal from the control box 6, which releases a predefined amount of solid CO₂ from the buffer tank. The in-

formation about the amount of solid CO₂ to be dosed from the buffer tank **3** is preferably sent to the control box **6** from the electronic device **11**.

[0038] In another embodiment, after detection of the position of the cassette **2**, the signal for the release of solid CO₂ from buffer tank **3** can be done manually by pushing a button provided in the control box.

[0039] In the system of the present invention, the predetermined quantity of solid CO₂ is determined taking into account parameters comprising the shape of the produced solid CO₂, the initial container temperature, the amount of solid CO₂ left in the support device, the amount of goods to be stored in the container, the nature of the goods in the container, the weather conditions, the necessary temperature in the container, the length of the transport road and the time of storage before and/or after transport.

[0040] Any form of solid CO₂ can be used to fill the cassette **2**. The choice of the form and the amount of solid CO₂ is to be made based on the required transport and is based on several parameters comprising (i) the initial container temperature, (ii) the amount of solid CO₂ left in the cassette from the previous transport, (iii) the amount of goods in the container (iv) the weather conditions expected during the transport and/or the storage period, (v) the necessary temperature within the container, (vi) the length of the road, (vii) the time of storage after transport and (viii) the type of transported goods.

[0041] The position of the control box **6** is given here as an example. The information technology nowadays enables signal transmission on significant distances; therefore the control box **6** can be placed wherever the user sees it comfortable.

[0042] According to the present invention, the cassette **2** does not to withstand mechanical shocks, and its only role is to carry and/or store the solid CO₂. Therefore the cassette **2** can be smaller, lighter and cheaper than in systems wherein the cassette must fulfil additional functions. This is very advantageous for the user.

[0043] Fig. 2 illustrates an embodiment of the buffer tank **3**. The buffer tank **3** is suitable to be filled with solid CO₂ from above through an opening (continuous arrow) in the upper side **30** of the buffer tank. Through the upper side **30** of the buffer tank, a gas suction channel **31** is provided. Said gas suction channel **31** is suitable to be connected to the local gas removal system. Solid CO₂ emits only small amounts of gaseous CO₂ due to sublimation. In big and well ventilated spaces, the local gas suction channel **31** will not be necessary. However, if the dosing system should be used in small spaces, the local gas suction channel **31** is required in order to avoid having high CO₂ concentration in said spaces. The CO₂ gas is evacuated via the suction channel (discontinuous arrow).

[0044] In Fig. 2 a vibrating arm **32** is shown. The arm creates vibration in the buffer tank **3**, thereby preventing lumping of solid CO₂ and ensuring proper functioning of the dosing system. The vibration also helps to spread

evenly the solid CO₂ within the buffer tank **3**.

[0045] In a preferred embodiment, the buffer tank **3** is provided with a dispensing device **33** which measures solid CO₂ volumetrically. Each turn of the wheel doses one predetermined quantity of solid CO₂ into the cassette **2**. Said quantity can be selected by the user and depends on the size of the dispensing device. The amount of dosed solid CO₂ is being measured by the amount of the turns of the wheel. The dispensing device **33** is described as an example and a person skilled in the art can envisage other solid dispensing systems suitable to be used as a dispensing device for the buffer tank **3**.

[0046] Fig. 3 shows another embodiment of the buffer tank **3** in combination with another embodiment of the cassette **2**. The buffer tank **3** is suitable to be filled with solid CO₂ from at least one opening (continuous arrow). The cassette **2** is divided into three separate zones **21**. Each zone has different heat transfer properties. In Fig. 3 this is exemplified by different thicknesses of the bottoms of the zones **21**. Thus, different temperatures ranges can be maintained within the isothermal container **1**, depending on the nature the transported products. It is to be understood that said different heat transfer properties can be due to different material of the different cassette zones **21** and/or to different shapes of the different cassette zones **21**. The solid CO₂ leaves the buffer tank **3** by gravity. Depending on the user's choice, one, two or three zones **21** are filled. The amount of solid CO₂ dosed is being controlled by opening and closing of the outlets **35** provided in the buffer tank and by the action of a scale **106**, which is part of the cassette removal system **100**. Fig. 3 illustrates another example of a device which prevents the lumping of solid CO₂ and enhances the dosing precision of the system. The device has a form of a mechanical stirrer **34**, preferably a slow rotating helical stirrer.

[0047] The buffer tank **3** can be connected to the other devices of the system in several modes, depending on the needs of the user. In a preferred embodiment, the buffer tank **3** and the solid CO₂ production device **4** are assigned to a common framework. In another preferred embodiment, the buffer tank **3** can be fixed to a roof framework **RF** and shifted between different dosing points **DP** in the user's facilities. Such arrangement is presented in Fig. 4. The latter arrangement provides for solid CO₂ dosing in different locations within a distribution centre **DC**.

[0048] The cassette **2**, which is retracted from the isothermal container **1**, can be also filled with solid CO₂ directly from the solid CO₂ production device **4**, which is provided with an outlet **42**. Such system does not require any additional elements for solid CO₂ transfer. The control of the amount of the dosed solid CO₂ can be made, for example, with a weighing element installed in the cassette removal system **100**. This embodiment is illustrated in Fig. 5.

[0049] Another embodiment of the invention is presented in Fig. 6. The solid CO₂ is transported by a me-

chanical conveyer **51** after being released from the outlet **42** of the solid CO₂ production device **4** to the retracted cassette **2A**. The mechanical conveyer **51** can be positioned horizontally or at an angle β from the horizontal. The angle is comprised between 0 and 85°, preferably between 5 and 70°, more preferably between 10 and 60°, most preferably between 15 and 50°. The solid CO₂ falls under gravity from the conveyer into the cassette **2A**. The control of the amount of the dosed solid CO₂ can be made, for example, with a weighing element installed in the cassette removal system **100**, but can be also made based on the speed and loading of the mechanical conveyer **51**. Although, solid CO₂ emits only small amounts of gaseous CO₂, a local gas removal system **53** might be provided as shown in **Fig. 6** (discontinuous arrow). This will help to prevent the accumulation of high gaseous CO₂ concentration, if the dosing system should be used in small spaces and/or unventilated working places.

[0050] **Fig. 7** illustrates another embodiment of the invention wherein the solid CO₂ is transported, from the outlet **42** of the solid CO₂ production device **4** to the retracted cassette **2A**, by a pneumatic conveyer **52**. The solid CO₂ is being driven by gas under pressure through an elastic hose **54** or through a fixed pipe. Preferably, the gas transporting the solid CO₂ is a compressed CO₂ gas originating from the solid CO₂ production device **4** and supplied by a supply line **55**.

[0051] It is to be understood that any type of mechanical or pneumatic conveyer, obvious to the person skilled in the art, can be used in the system of the invention. A bucket conveyer, supplying well defined portions of solid CO₂ or a pneumatic transfer system **52** based on dense phase conveying may be used.

[0052] In a preferred embodiment, systems using mechanical and/or pneumatic conveyers can be used to simultaneously supply several cassettes **2** with solid CO₂. **Fig. 8** illustrates an example wherein a main conveyer **MC** is supplying solid CO₂, originating from the solid CO₂ production device **4**, to several dosing points **DP**.

[0053] **Fig. 9** illustrates a first embodiment of the cassette removal system **100** wherein the cassette **2** is placed on at least a pair of guiding rails **101**, fixed with clamps **102**. In **Fig. 9**, only one of the guiding rail **101** pair is shown. The cassette **2** is removed from the isothermal container **1**. The system can use mechanical, electromagnetic or any other known type of clamps in order to reinforce the connection of the guiding rails **101** to the cassette **2**. Preferably the action of clamps is initiated automatically from the control box **6**, but can be also controlled manually. Furthermore, while the clamps **102** are shown to act on the sides of the cassette **2**, it is possible to use the front and rear sides of the cassette **2** as fixation points to the clamps **102**. The retracted position of the cassette, the guiding rails and the clamps is referred to with the letter "A" in **Fig. 9**, while the non-retracted position is referred to with the letter "B". Preferably the guiding rails **101** are telescopic; however other technical solution obvious to a person skilled in the art

can be used.

[0054] The cassette removal system **100** can be fixed to the solid CO₂ production device **4** or have a common framework with the solid CO₂ dosing device. The cassette removal system **100** can also function independently from the other elements of the system of the invention.

[0055] Sensors and a position control system **105** of the cassette and/or the container position can be provided to the guiding rails **101** (**Fig. 9**). The sensors are used to detect whether the cassette **2**, inside the container, is aligned with the cassette removal system **100**. Thus the cassette **2** can be retracted from the container **1**. The sensors can be of any type, preferably of optical type. The position control system **105** can be used for the detection of the position of the solid CO₂ dosing device and/or the buffer tank **3** and/or the solid CO₂ production device **4** and/or a conveyer **51**, **52**.

[0056] **Fig. 10** illustrates a second embodiment of the cassette removal system **100** wherein a belt conveyer **107** is used instead of guiding rails. The cassette **2**, after being detected by position control system **105** is being moved by the action of the belt conveyer **107**, until it reaches the position for solid CO₂ dosing. In a most preferred embodiment, the friction between the belt conveyer and the cassette **2** is sufficient to remove the cassette from the container. However, additional elements, obvious to a person skilled in the art, can be foreseen, which would temporarily enhance the connection between the cassette **2** and the belt conveyer **107**.

[0057] **Fig. 11** illustrates a third embodiment of the cassette removal system. The cassette is sliding along the guiding rails **101** under the action of a draw arm **108** fixed to the cassette by electromagnetic clamps **103**. In **Fig. 11**, the elements in the retracted position are referred to with letter **A**, while elements in the non-retracted position are referred to with letter **B**. The draw arm **108** and the electromagnetic clamps are preferably controlled automatically from the control box **6**, but can be also controlled by the user. Any other type of connection obvious to the person skilled in the art and suitable to replace the electromagnetic clamps can be applied. Preferably the draw arm **108** is telescopic, however other technical solution obvious to a person skilled in the art can be used.

[0058] In a preferred embodiment, all metal elements of the cassette removal system **100** that enters in contact with the cassette are heat traced in order to prevent freezing of the surfaces and immobilization of the cassette removal system **100**.

[0059] The above described embodiments of the cassette removal system **100** are exemplary and can be connected to any type of solid CO₂ dosing device presented above.

[0060] Isothermal containers can have different sizes and/or be subject to significant wear which leads to a size change during their lifetime. Therefore, the cassette removal system **100** must be constructed in such a way, that it can be aligned to the actual position of the cassette

2 inside the isothermal container 1. In a preferred embodiment, the cassette removal system 100 is placed on a distance control system which comprises spacers 109 and a support framework 110. The spacers 109 height can be adapted such as to bring the cassette removal system 100 at a height allowing the removal of the cassette 2 from the isothermal container 1. The support framework 110 can be shifted to the left or to the right, compensating the improper positioning of the isothermal container 1 and/or the cassette 2. The movement of the distance control system can be controlled manually by the user. In a most preferred embodiment, the movement of the distance control system is automatically controlled by information originating from the position control system 105. The spacers 109 (Fig. 11) can be telescopes, compressed gas bellows or any other height control devices known to a person skilled in the art.

[0061] In Fig. 10 another embodiment of the system is illustrated wherein the alignment between the cassette removal system 100 and the cassette 2 is performed by a platform 7 positioned under the container. The platform 7 has a rectangular shape, an upper side 7' and a lower side 7". The upper side surface of the platform is at least equal to the surface of the container lower side. The upper side surface of the platform 7' is vertically movable such as to align the height of the cassette removal system to the cassette in the isothermal container. The platform 7 can comprise a weighing device for controlling the mass of the container, the mass of the goods placed in the container and the dosed solid CO₂.

[0062] In case the system uses a mobile buffer tank as presented in Fig. 4, a preferred embodiment of the alignment system for the cassette removal system 100 is presented in Fig. 12. In this embodiment the cassette removal system 100 is fixed under the buffer tank 3 with beams 110. The continuous arrow shows the opening through which the tank is filled with solid CO₂. The discontinuous arrow shows the suction channel through which the CO₂ gas is evacuated. The buffer tank 3 is fixed with steel ropes 36 to the trolley 37, which can move along the roof framework beams RF. The trolley 37 is equipped with a system of counterbalances which enable the user to move the buffer tank 3 and the cassette removal system 100 without effort. The alignment of the cassette removal system 100 with the cassette and/or the isothermal container can be performed manually. Preferably, the alignment is automatically accomplished, based on information gathered by the sensors of the cassette and the position control system 105. Fig. 13 shows a preferred embodiment of the invention wherein the user only brings the isothermal container to a docking point 8. The container 1 is brought by the user to a docking point 8 and temporarily placed in a transfer system (exemplified in Fig. 13 as a rail 81). The front door of the container is opened and latched. All the following steps: container movement, container and cassette alignment, retraction of the cassette, dosing of solid CO₂ and pushing the cassette back are automatically initiated and ter-

minated. At the end of the process, the user needs only to recuperate the container wherein the cassette filled with solid CO₂ is placed. The arrow in Fig. 13 shows the container movement direction in the transfer system.

[0063] Fig. 30 shows another embodiment, of the system. The container 1 is provided with a hinged door D, three vertical walls, a horizontal lower side and a horizontal upper side US. The upper side is removable and is meant to provide the temperature control. The solid CO₂ is placed in a pocket 56 placed and fixed to the container upper side US. The solid CO₂ can be placed in the pocket 56 directly from the solid CO₂ production device 4 through a special die. An additional buffer could be engaged for that purpose.

[0064] The amount of solid CO₂ can be measured volumetrically or gravimetrically during the loading of the solid CO₂ into the pocket 56. The amount of CO₂ can be matched to the parameters of the container at the time of products loading inside the container. The amount of CO₂ can also be pre-loaded in the pocket 56 of the upper side US. Several pockets of different upper sides can be pre-loaded with different solid CO₂ quantities. The upper sides can be stored in a storage closet 57. When a container 1 is loaded with products, the upper side having the appropriate solid CO₂ amount in its pocket 56 is placed on top to close the container 1. The upper side can be placed on the container manually or in an automated way. The storage closet 57 is insulated and ventilated. The process of bringing the upper sides with filled pockets 56 in the storage closet 57 can also be automated or manual. In this embodiment, a large internal space is provided for loading products inside the container in comparison to a container wherein a voluminous support device is used.

[0065] Fig. 31 shows another embodiment of the system. The container 1 is provided with a hinged door D, three vertical walls, a horizontal lower side and a horizontal upper side US. Said upper side is movable and can be horizontally slid. The operator pushes the container towards the solid CO₂ production device 4. During this movement the upper side US is horizontally slid by a solid CO₂ dosing die 58 provided to the solid CO₂ production device 4. Solid CO₂ is then dispensed to a support device - a tray 238 in Fig. 31. Solid CO₂ can be automatically dispensed from the dosing die 58. In this embodiment, the support device is not handled by the user which is safe but also provides a fast solid CO₂ loading process.

[0066] Fig. 42 illustrates another embodiment of the system. The dosing process starts when buffer tank 3 is connected to the cassette 2. Once this task is performed, the control box 6 sends the signal to the dispensing device 33 and the dosing process can be started. The control box 6 can send the signal based on manual action of an operator, but a fully automatic system should preferably be applied. In a fully automatic system the connection of the cassette 2 with the buffer tank 3 is detected automatically and this detection is a signal to start the

procedure of solid CO₂ dosing. Preferably the buffer tank **3** is equipped with a connection sensor **38** which communicates with the control box **6**. Preferably the isothermal container **1** is equipped with an electronic device **11** which communicates with the control box **6** and contains information about the isothermal container **1**, its destination, its transport conditions and the goods contained within. Based on that information, the electronic device **11** controls the amount of dosed solid CO₂ by emitting signal to the dispensing device **33**.

[0067] The buffer tank **3** can be operated manually, i. e. it can be moved and aligned by an operator with the help of appropriate fixation and counterbalance system (not shown on the **Fig. 42** for clarity). In the preferred embodiment however, the buffer tank **3** is moved and aligned with the cassette **2** automatically. In the most preferred embodiment a connection sensor **38** is provided to the buffer tank. Said connection sensor would stipulate the presence of the cassette **2** placed in a proper position in the isothermal container **1**. The sensor **38** would also control a process of matching the cassette **2** and the buffer tank **3**.

[0068] **Fig. 42** illustrates also an exemplary embodiment of a system for filling of the buffer tank **3** with solid CO₂. The solid CO₂ is produced in the solid CO₂ production device **4** and is further conveyed by the additional conveying system **41** to the buffer tank **3**. The buffer tank **3** preferably contains enough solid CO₂ to perform dosing to several cassettes. Typically in the solid CO₂ production devices **4**, solid CO₂ is produced by decompression of liquid CO₂. However, any other type of solid CO₂ production device can be used in the system, being the subject of the invention. For example, solid CO₂ can be produced by subcooling and subsequent solidification of the liquid CO₂.

[0069] It is to be understood that the mechanical conveying system **41** is here given as an example. The solid CO₂ can be transported to the buffer tank by another method obvious to a person skilled in the art. Moreover, it is also possible to fill the buffer tank **3** directly from the solid CO₂ production device **4**.

[0070] It is to be understood that any form of solid CO₂ can be used to fill the cassette **2**. The choice of the form and the amount of CO₂ is to be made based on the required transport parameters and can be based, among others, on the (i) initial container temperature, (ii) amount of solid CO₂ left in the cassette from the previous transport, (iii) amount of goods in the container (iv) weather conditions, (v) the necessary temperature within the container, (vi) the length of the road, (vii) the time of storage after transport and (viii) the type of transported goods.

[0071] The position of the control box **6** is given here as an example. Modern information technology enables signal transmission on significant distances; therefore the control box **6** can be placed wherever the user sees it comfortable.

[0072] As can be seen from the **Fig. 42**, the cassette **2** does not have to withstand mechanical shocks, and

its only role is to store the solid CO₂. Therefore the cassette **2** can be smaller, lighter and cheaper than in systems based on liquid CO₂ dosing.

[0073] **Fig. 43** illustrates an exemplary embodiment of the buffer tank **3** and the cassette **2** connected to each other. The buffer tank **3** is filled with solid CO₂ from above through the buffer tank upper side **30**. At the top of the tank a suction channel **31** is shown. Solid CO₂ emits only small amounts of gaseous CO₂ due to sublimation and in large, well ventilated spaces the suction channel **31** will not be necessary. However, if the dosing system should be used in small spaces, there is a danger of a locally high CO₂ concentration, which the suction channel **31** helps to prevent.

[0074] In the **Fig. 43** a vibrating arm **32** is shown. The arm creates vibration in the buffer tank **3**, thereby preventing lumping of the solid CO₂ and ensuring proper functioning of the dosing system. The vibration also helps to spread evenly the solid CO₂ within the buffer tank **3**.

[0075] In this embodiment the buffer tank **3** is equipped with a dispensing device **33** which measures solid CO₂ volumetrically. Each turn of the wheel doses one small portion of CO₂ into the cassette **2**. The amount of dosed CO₂ is being measured by the amount of the turns of the wheel.

[0076] The above example of a dispensing device **33** is a non-limiting one. A person skilled in the art can envisage other solid dispensing systems that can be used as a dispensing device **33** for the buffer tank **3**.

[0077] The cassette **2** is shown here with an exemplary shape of its bottom **22**. In this particular embodiment the cassette bottom **22** is shaped like a pyramid. This shape has several functions:

- It facilitates gravitational movement of solid CO₂ into the cassette **2**
- It causes the solid CO₂ to spread more evenly within the cassette **2**, which makes the thermal properties of the cassettes **2** more predictable.
- As the solid CO₂ is spread evenly on the bottom, it is feasible to equip the buffer tank **3** with a temperature sensing element **39** in order to detect any residue of solid CO₂ and to account for it in the calculations of necessary amount of solid CO₂ to be dosed.
- It decreases the possibility of solid CO₂ removal from the cassettes **2** due to mechanical shocks caused by transport of container or similar events
- It increases the heat exchange area of the cassette **2**, improving its heat transfer properties

[0078] The cassette **2** as well as its bottom **22** can be produced from any material of appropriate thermal and mechanical resistance. As example polyethylene and stainless steel can be given, but any other material known to the person skilled in the art can be used. The cassette **2** as well as its bottom **22** can be produced from the same material, but if there are reasons to do otherwise, they

can be produced from two different materials, or from the same material of different thickness.

[0079] The pyramidal shape of the cassette bottom **22** is an example. Any other shape not parallel to the roof of container **1** and giving the same advantages can be used, for example sloped, conical, truncated conical or truncated pyramidal.

[0080] The cassette **2** can be also filled directly from the solid CO₂ production device **4**, through an outlet **42**. Such system, while requiring additional modifications in the solid CO₂ production device, advantageously does not require any additional elements for solid CO₂ transfer. This embodiment is illustrated in the **Fig. 44**. The alignment of the cassette **2** and the outlet **42** can be done automatically, but can also be done manually. In order to achieve proper alignment, both the outlet **42** and the container **1** can be operated.

[0081] While the system presented in **Fig. 44** requires alignment of the container **1** and the solid CO₂ production device **4**, it is possible to dose the solid CO₂ into the cassette **2** with help of elongating elements **43**. Such system is presented in **Fig. 45**. In this embodiment the alignment is still made with the help of outlet **42**, but the outlet **42** is decoupled from the solid CO₂ production device **4**. In the preferred embodiment the solid CO₂ is transported to the cassette **2** by the force of gravity. The necessary height difference is created by a support structure **45**. The height and the construction details of such structure can vary greatly depending on needs of the user.

[0082] In another embodiment of the system presented in **Fig. 45**, the solid CO₂ is transferred to the cassette **2** with the use of additional mechanical force, here presented as the piston **44**. Preferably, when elongation elements **43** and additional mechanical energy for transfer of solid CO₂ are used, the solid CO₂ is produced in single pieces. These pieces have mass appropriate to the conditions of food transport for the given isothermal container **1**. It is to be expected that these pieces will weigh not less than 0,25 kg. Such single blocks of solid CO₂ move faster through elongation elements **43** than solid CO₂ in form of small grains or sticks. The blocks of solid CO₂ can be produced in form of sphere, cylinder, cube, rectangular cube or any other known to a person skilled in the art.

[0083] A user of a CO₂ loading system being the subject of the invention has access to compressed CO₂. This compressed CO₂ can be used as a source of mechanical energy to propel solid CO₂ from the solid CO₂ production device **4** into the cassette **2**. An example of such arrangement is presented in **Fig. 46** wherein a pneumatic transport system preferably moves single pieces of solid CO₂, which are produced by the solid CO₂ production device in the weight necessary to maintain proper temperature within the container. Such single large pieces are less prone to sticking to the walls, which increases precision of dosing. However, in another embodiment of the invention the solid CO₂ in form of pellets, grains, rice, sticks or similar can be transported pneumatically, preferably

through the process of dense phase conveying. At one end of the elongation element **43** or in the outlet **42** there is mounted a line (discontinuous arrow) which removes the gaseous CO₂. In this way any leakage of the gaseous CO₂ into cassette and environment should be prevented.

[0084] In a preferred embodiment, all the elements that are used for transport and storage of solid CO₂ are thermally insulated. Such insulations protect the workers from the influence of low temperatures, increasing safety. This insulation decreases also losses of solid CO₂ in the system. Preferably some of the elements used for transport of solid CO₂ are heat traced. This ensures proper, fluid flow of solid material, as it prevents sticking of solid CO₂ to the walls of heat traced elements.

[0085] Another embodiment of the invention is presented in **Fig. 47**. The solid CO₂ from the solid CO₂ production device **4** is transported by a mechanical conveyer **51** from the outlet **42** to the cassette **2**. The alignment of the mechanical conveyer **51** and of the cassette **2** can be made manually or automatically. The control of the alignment is performed with the help of connection sensor **38**. The control of the dosed CO₂ amount can be made, for example, with a weighing element installed in the mechanical conveyer **51**, but can be also made based on the speed and loading of the mechanical conveyer **51**. It is to be understood that any type of mechanical conveyer, obvious to the person skilled in the art, can be used in the system being the subject of invention. In some embodiments it might be advantageous to use a bucket conveyer, supplying well defined portions of solid CO₂. In some embodiments a vibrating table may be advantageously used as the mechanical conveyer **51**.

[0086] In **Fig. 47** a local gas removal system **53** is also shown. Solid CO₂ emits only small amounts of gaseous CO₂ due to sublimation and in large, well ventilated spaces the local gas removal system **53** will not be necessary. However, if the dosing system should be used in small spaces, there is a danger of a locally high CO₂ concentration, which the local gas removal system **53** helps to prevent.

[0087] While the system being the subject of the invention is designed to be fully automatic, one of its advantages is the easy backup. The cassettes can be removed from the container and fed manually. Also, should the solid CO₂ production device fail the user is still able to maintain the cold chain by usage of solid CO₂ purchased on the market.

[0088] **Fig. 32** shows an embodiment of a container according to the present invention. The container **1** is suitable to receive at least two support devices **59**, **60** in which solid CO₂ can be placed. The inner space of the container is then divided in at least two sub-spaces **61**, **62**. Different temperatures are maintained in each container sub-spaces **61**, **62** by virtue of different heat exchange properties of the support device **59**, **60**. In **Fig. 32**, the different temperatures are maintained by having two support devices of different thickness. In this embodiment, a simple logistic is provided by enabling a simul-

taneous multi-temperature transport of products in one container. In addition, the inner space of the container is efficiently used for products loading and transport. It is to be understood that more than two support devices can be introduced in a single container. Said support devices could be introduced at different heights within the container.

[0089] Fig. 33 shows another embodiment, of the system. The cassette 2 is loaded with solid CO₂ from the solid CO₂ production device 4 and then transported into a cassette storage closet 63. The transport can be performed manually or automatically. The cassette storage closet 63 is adapted for storage of a number of cassettes containing given amounts of solid CO₂. Preferably the weight of the cooling medium product (CO₂ + cassette) is constantly monitored by a logistic system. The proper amount of solid CO₂ is already predetermined and known by the logistics system. When a container 1 is to be loaded with a cooling medium product, the appropriate CO₂+cassette arrangement is being transferred from the cassette storage closet 63 to the container 1. The cassette storage closet 63 can be equipped with a ventilation system.

[0090] Fig. 34 shows another embodiment, of the system. The container 1 is provided with a support device made of a flexible material which is resistant to low temperature. The support device can be a bag, a pouch a pocket or any equivalent. The support device can be blown with compressed gas from an initial state 2C to a second state 2D and subsequently filled with solid CO₂, after loading the products to be transported inside the container. The user is provided with a flexibility of logistics and a possibility to accurately match the cassette size and shape to the transport needs which offers additional space within the container 1.

[0091] Fig. 35 shows another embodiment, of the system. Solid CO₂, produced in the solid CO₂ production device 4, is packed within the packing device 69 in bags 70, preferably plastic bags. The bags 70 are then transferred (manually or automatically) to a storage closet 67 and hanged on one or more rails 68. The storage closet 67 can be equipped with weighing devices, monitoring the real mass of CO₂ in the bags 70. The storage closet 67 is equipped with ventilation.

[0092] For filling the container 1 with a determined amount of solid CO₂, the appropriate amount of bags 70 is taken out of the storage closet 67 and placed into the container. The bags can be fixed to engagement means provided in the container. The engagement means can be one or more rails 66 as presented in Fig. 35. The transfer of the bags from the storage closet to the container can be made automatically or manually. In this embodiment, a small space is used for the solid CO₂. The latter can be easily compiled such as to have an optimized amount - explained hereafter.

[0093] Fig. 36 shows another embodiment, of the system. The cold gas, produced by the solid CO₂ production device 4 as a byproduct of the solid CO₂ production proc-

ess, is used within the warehouse system of the invention. The container 1 is connected to the CO₂ production device 4 by a cold gas feed line 72 which pumps the produced gas into a bag 71 placed inside the container 1. The bag 71 is left in the inflated state for a certain period of time in order to cool down and lower the temperature of the container internal compartment. While in the presented embodiment the bag 71 is placed inside the container 1, it can also be placed outside it, or even function as an envelope for the container. Once the container 1 is needed for product transport, the bag is deflated and the container can be further used. The advantage here is to use a byproduct for stabilizing and lowering the initial temperature of the container.

[0094] Fig. 37 shows another embodiment, of the system in which the solid CO₂ is produced in the solid CO₂ production device 4 and deposited onto a bayonet 74. Said bayonet is fixed to a transport device 73. Once the solid CO₂ is deposited on the bayonet 74 and compressed, the transport device 73 moves the bayonet into the container 1. A heat impulse is then sent to the bayonet 74 and a small mechanical push is produced by the transport device 73 leading to the deposit of one or more solid CO₂ block on the support device 238. In this embodiment, the support device is not handled by the user which is safe but also provides a fast solid CO₂ loading process.

[0095] Fig. 38 shows another embodiment of the system wherein the container 1 is not transported to a solid CO₂ production device 4 for solid CO₂ loading. Instead, a fork lift 75, or any similar device, which is equipped with an operator cabin and a solid CO₂ storage tank 78 is provided. Said fork lift 75 provides solid CO₂ to the cassette 2 of the container 1 through a solid CO₂ applicator 77. Solid CO₂ loading is performed when the container is lifted by the fork lift. Said solid CO₂ loading can be performed before or after loading the products inside the container. The logistical operation of the distribution centre is hence accelerated.

[0096] Fig. 39 shows a mobile solid CO₂ production device suitable to be used in the system of the present invention. The mobile solid CO₂ production device comprises an insulated chamber 79 separated from an outlet 80 by a separation device 86. The solid CO₂ production process is performed in the insulated chamber 79. CO₂ gas is sucked off during the production process via the outlet 80. The solid CO₂ fills the chamber 79. In use, the operator actuates the snow pressing piston 83 and presses the snow into the cassette through a snow outlet die 84. The mobile solid CO₂ production device also comprises a liquid CO₂ injection inlet 82 and a mounting frame 85 which can be used to fix the device to a stable support during use thereby providing safety to the user.

[0097] Fig. 40 shows another embodiment of the system, wherein the container door D comprises a compartment 87 suitable to be filled with solid CO₂. The filling is ensured by a solid CO₂ applicator 88 provided to the solid CO₂ production device 4. Said applicator 88 is suitable to be temporarily introduced through the container door

D. This offers the possibility to load the solid CO₂ when the door of the container is closed. The applicator **88** can also connect the compartment **87** when the door is opened.

[0098] **Fig. 41** shows an embodiment of the container wherein the support device **238** for solid CO₂ is attached inside the container **1** using at least one spring **89**. Preferably, one end of the spring is attached end to the upper horizontal side of the container and the other end is attached to the support device. Preferably, two springs are used to attach the support device inside the container. The position of the support device **238** inside the container depends on the amount of solid CO₂ loaded and the elongation of the spring. In **Fig. 40**, shows the position **89A** of an unloaded support device inside the container and the position **89B** of the same support device inside the same container when the device is loaded with solid CO₂. This embodiment of the container, allows adapting the space of the cooling medium to the quantity of cooling medium used during each transport. Simultaneously, it allows maximizing the free space for loading the products to be transported.

[0099] In a second aspect, the present invention provides a method for optimizing the transport of cooled, chilled, refrigerated and frozen products loaded in a transport container, whereby the products comprise food products and at least one cooling medium product, whereby the cooling medium product is provided in a determined amount sufficient to maintain the food products stored within said transport container at a desired temperature during transport from a warehouse to an external destination. Said temperature is comprised from -24 to -18°C for frozen products, from 0 to 8°C for cooled products and from 8 to 15°C for fresh products.

[0100] In a preferred embodiment, the cooling medium product is assembled outside and/or prior to its loading in the transport container.

[0101] In a preferred embodiment, said amount of cooling medium product is determined taking into account parameters comprising the nature of the food products, the amount of food products loaded in the transport container, the temperature inside the transport container, the density of the solid CO₂, the time required for the transport of said food products to the external destination, the average expected external temperature during the transport or any combination thereof.

[0102] In a preferred embodiment, loading of the transport container with cooled, chilled, refrigerated and frozen products is performed within the cold warehouse system of the present invention.

[0103] In a third aspect, the present invention provides an isothermal transport container as shown in **Fig. 25**. Preferably said container has a rectangular shape. The transport container comprises a roof also called horizontal upper side, a floor also called horizontal lower side, at least three upstanding walls and at least one hinged upstanding door, thereby defining an internal compartment, said internal compartment is provided with at least

one engagement means for holding at least one cooling medium product, said engagement means have a variable height within the internal compartment of the transport container. The container is optionally provided with wheels **236**.

[0104] In a preferred embodiment, the container comprises multiple engagement means positioned at different heights within the internal compartment of the transport container.

[0105] In a preferred embodiment, a cooling medium product is horizontally loadable in the container via said engagement means.

[0106] In a preferred embodiment, the container comprises at least two engagement means (**200'**, **Fig. 14**) provided on at least two vertical walls **VW**, said engagement means (**200'**, **Fig. 14**) are contained in the same horizontal plane. The engagement means can be ledges and/or guiding rails and/or horizontal flaps and/or recesses. **Fig. 22** shows an example of a container comprising recesses **237** for the introduction of a support device **238**.

[0107] In another embodiment, the engagement means have a hook shape. An example of such structure is presented in **Fig. 14** wherein the container comprises several hooks **200** and several guiding rails **200'**. In **Fig. 14** the door of the container is not represented.

[0108] The engagement means are used for the introduction of a support device inside the container. In a preferred embodiment, the support device is slidably engageable in the container using the engagement means, thereby defining a space (**B**, **Fig. 26 to Fig. 29**) in the internal compartment of the container.

[0109] The support device is selected from the group comprising a tray, a cassette, a plate, a grid or any combination thereof. If the chosen support device is a cassette, said cassette comprises at least one chamber suitable to be filled with solid CO₂ and at least one inlet through which solid CO₂ is suitable to be introduced in the cassette.

[0110] A first embodiment of the support device is illustrated in **Fig. 17**. The support device is a tray having a square shape and is open at the upper side. The tray can also have a rectangular shape. The depth of the tray can be adapted the quantity of solid CO₂ that will be provided to it. For its introduction in the container, the tray can be provided with flaps **206** that cooperate with the engagement means (**200'**, **Fig. 14**) of the container. The tray illustrated in **Fig. 17**, is provided at the top with at least two substantially horizontal flaps **206** extending outwardly. These flaps **206** are placed on top of the engagement means **200'** shown in **Fig. 14**. The tray can also be introduced in the container by placing the lower side of the tray **207** on top of the engagement means (**200'**, **Fig. 14**) of the container. Solid CO₂ is provided to the support device of this embodiment through its open upper side.

[0111] **Fig. 19 A** shows a second embodiment of a support device suitable to be placed in the container. The support device is a tray defining a space **C** which is closed on the top by a grid **212** which prevents solid CO₂ from

falling out of the tray during the transport of the container. The grid **212** can be removable or permanently fixed to the top of the tray. The tray can also be provided with at least two substantially horizontal flaps **215** extending outwardly for the introduction of the tray in the container. The flaps **215** can be provided at the upper side **214** or at the lower side **213** of the tray. The tray can also be devoid of flaps and is introduced in the container by placing its lower side **213** on top of the engagement means (**200'**, **Fig. 14**) of the container. In this embodiment, the user have the choice to introduce solid CO₂ in the support device through opening **216** provided at the side of the support device, through the upper side **214** of the support device after removing the grid **212** or through the upper side **214** of the support device without removing the grid **212**. In the latter case, the solid CO₂ should have a size which is smaller than the size of the openings of the grid **212**.

[0112] The space **C** of the support device according to this embodiment can be less high and less wide than the compartment **B** of the container. Even if CO₂ gas is produced during the filling in small amounts, the withdrawal of said gas is possible by the presence of a space **D** in the support device. Together with the container upper side **US** and vertical sides **VW**, the support device creates a space (**D**, **Fig. 19B**) in which any produced gas can be collected and withdrawn through the opening **217** on the front side of the support device. Said opening **217** is fluid connection with the space **D** and can be provided with retractable closure.

[0113] A third embodiment of the support device is illustrated in **Fig. 20**. The support device is provided with at least one opening **218** for the introduction of solid CO₂ into said support device. The support device is also provided with a second opening **219** which can be used either for the introduction of solid CO₂, thereby accelerating the filling operation. The second opening **219** can also be used for the withdrawal of the gas produced by the solid CO₂ during the filling operation, even if said gas is produced in a small amounts. The walls, the bottom and the top of the support device of this embodiment have a glass fibre reinforced plastic. The support device is optionally provided with holding grips **220** for its easy transport by a user.

[0114] A fourth embodiment of the support device is presented in **Fig. 21**. The support device is shaped as a box open towards the upper side and divided internally by a longitudinal insulating wall **221** into two chambers **CH1**, **CH2** for storage of solid CO₂. The chamber **CH1** is provided with an insulated bottom for maintaining the temperature of fresh products and the chamber **CH2** is provided with a bottom in heat-conducting and diffusing material for maintaining the temperature of frozen products. Each chamber is provided with a channel having an opening **222**. Said opening is located in the front wall **223** of the support device. The openings **222** might be provided with retractable closures and can be used for the introduction of solid CO₂ into the support device. The

solid CO₂ can also be introduced through the upper side of the support device, when this side is left open. The bottom (**224a**, **224b**, **225a**, **225b**) of both rooms **CH1**, **CH2** of the support device is divided along its length into two zones, respectively an anterior **Z1** and posterior **Z2**. The anterior zone **Z1** has superior characteristics of thermal diffusion to those of the posterior zone **Z2**. Under the bottom part of the support device, a component (not shown) is arranged, extending in width at least under the two rooms **CH1**, **CH2** and with a length shorter than that of the support device, but enough to cover the anterior zones **Z1** of both chambers. This component being slidably mounted between two extreme positions, namely, a posterior position of high diffusion, in which it releases the previous zones **Z1** from the bottom of both chambers **CH1**, **CH2** and a previous position of small diffusion, in which it is under the anterior areas **Z1** of the bottom of the chambers.

[0115] A fifth embodiment of the support device is presented in **Fig. 23**. The support device comprises an upper wall **226** provided with at least one opening **227** and a front lateral face **228** traversed by an end piece **229** connected to at least one injector **230** disposed in the support device. The opening **227** might consist of a grid. Said end piece **229** is designed to connect the injector **230** to a circuit and/or a pistol (not shown) for leading in solid CO₂. The support device has a parallelepiped shaped configuration, the injector **230** being disposed in the vicinity of one lateral face **231** of the support device. The injector **230** might be provided with at least one ejection orifice **232** oriented so as to direct the solid CO₂ towards the inside of the support device. In a preferred embodiment, the ejection orifice comprises a deflector **233** associated with the injector **230**, the ejection orifice **232** being oriented so as to direct the jet of dry ice towards the deflector **233**. It is to be understood that the shape and the size of the solid CO₂ are adapted to the size and the shape of the ejection orifice.

[0116] A sixth embodiment of the support device is presented in **Fig. 24**. The support device has a box shape and is provided with at least one inlet **234** which can be connected to an orifice provided in the container. The inlet **234** can be provided with a retractable closure. The walls of the container surrounding the space **B** are provided with at least one orifice provided with a retractable closure, through said orifice solid CO₂ is suitable to be provided to the support device. If the inlet is provided at the upper side of the support device (**234**, **Fig. 24**) then the orifice of the container is also provided at its upper side (**US**, **Fig. 28**). If the inlet is in one of the support device side walls, then the container orifice **239** is provided at its vertical wall (**VW**, **Fig. 29**) that is in front of the support device side having the inlet when the support device is inside the container. In either configuration, an easy connection between the inlet of the support device and the container's orifice is provided. Through said connection a solid CO₂ insertion means can be introduced for providing solid CO₂ into the support device. The solid

CO₂ can thus be provided when the support device is placed inside or outside the container. The solid CO₂ insertion means can be a tube, a pistol or any other means known by the person skilled in the art. The support device can be also provided with an opening **235** through which gas can escape out of the support device.

[0117] Fig. 48a shows another embodiment of the support device being a cassette **2**. The cassette **2** has a sloped bottom **22**. When placed in the container, the slope is directed down, towards the back of the container. To insert the cassette in a contained, the, the side **2'** in Fig. 48a should be inserted first. This facilitates the flow of solid CO₂ into cassette.

[0118] In another embodiment of the cassette bottom **22**, presented at the Fig. 48b, the cassette bottom **22** is made from a material which is able to change its shape under the weight of solid CO₂. Such material would react to the process of filling by lowering down, as exemplified by the position **22B** on the Fig. 48b. Such arrangement lowers the amount of air and goods which will be conditioned by the action of solid CO₂, thereby lessening the consumption of solid CO₂.

[0119] In another embodiment, the support device is a plate or a grid on which solid CO₂ is provided. The solid CO₂ can be of any shape and can be provided to the support device and/or the container as slabs, pellets, granules, sticks or any combination thereof. Fig. 16 shows examples of solid CO₂ shapes. The solid CO₂ can be produced in a rectangular three dimensional shape (a), square three dimensional shape (b), cylindrical (c), cubical (d), sticks (e), pyramidal shape (not shown) or spherical shape (not shown).

[0120] In a preferred embodiment, the solid CO₂ is produced in different sizes. This allows to make different combination of solid CO₂ thereby having the total desired mass. For instance, 10258 gr of solid CO₂ is required for a product transport. The user can use 10 solid CO₂ pieces of 1000 gr, 2 solid CO₂ pieces of 100 gr and 3 solid CO₂ pieces of 20 gr or 2 solid CO₂ pieces of 5000 gr and 2 solid CO₂ pieces of 150 gr or any other suitable combination. This allows adapting the solid CO₂ amount to the transported products and the transport conditions. It also allows adapting the shape of the solid CO₂ to the shape and nature of the support device and of the container.

[0121] In another embodiment, the solid CO₂ can be produced as slabs as shown in Fig. 15A. The slabs are suitable to be directly introduced in the container. The solid CO₂ can also be produced as a slab (**204**, Fig. 15C) provided with outwardly extending arms **205** for the introduction of the solid CO₂ slab in the container. The extending arms **205** are provided in at least two opposite sides of the slab as presented in Fig. 15C.

[0122] In another embodiment, the solid CO₂ **202** covers at least partially a grid (**203**, Fig. 15B) such as at least two opposite extreme outer edges of the grid are not covered by the solid CO₂ as shown in Fig. 15B. The non-covered areas of the grid are used to introduce the solid CO₂ in the container. Said non covered areas can

be outwardly extending parts of the grid **203** as presented in Fig 15B.

[0123] In another embodiment, the solid CO₂ can be provided to the container in a packed form as shown in Fig. 18 A and B. The bags **210** are filled with solid CO₂ and are provided with at least one opening (**208** and **209**) for attaching the packed solid CO₂ in the hooks (**200**, Fig. 14) of the container.

[0124] In a fourth aspect, the present invention provides for the use of a cold storage warehouse system as described and/or the method and/or the transport container as described above for transporting cooled, chilled, refrigerated and frozen products from the warehouse to an external destination.

[0125] It is to be understood that each component of the system, container and support device embodiments described above can be interchanged and/or replaced by any equivalent known to the person skilled in the art.

[0126] The embodiments of the invention presented above are not limiting to the invention. Although the present invention has been described with reference to preferred embodiments thereof, many modifications and alternations may be made by a person having ordinary skill in the art without departing from the scope of this invention which is defined by the appended claims.

Claims

1. A cold storage warehouse system for receiving and storing cooled, chilled, refrigerated and frozen products and for loading said products into a transport container for transport to an external destination, whereby the products comprise food products and at least one cooling medium product, whereby the cooling medium product is provided in a determined amount sufficient to maintain the food products stored within said transport container at a desired temperature during further transport to an external destination.
2. The cold storage warehouse system according to claim 1, wherein the cooling medium product comprises solid CO₂.
3. The cold storage warehouse system according to claims 1 or 2, comprising at least one device to calculate and/or to provide said determined amount of cooling medium product.
4. The cold storage warehouse system according to any of claims 1-3, wherein the cooling medium product comprises a support device selected from the group comprising a tray, a cassette, a plate, a grid or any combination thereof.
5. The cold storage warehouse system according to claim 4, wherein the support device comprises an

upper insulating lid and a lower support surface.

6. The cold storage warehouse system according to any of claims 4-5, wherein the upper lid and the lower support surface of the support device have different heat transfer capacity and/or have different thickness. 5
7. A method for optimizing the transport of cooled, chilled, refrigerated and frozen products loaded in a transport container, whereby the products comprise food products and at least one cooling medium product, whereby the cooling medium product is provided in a determined amount sufficient to maintain the food products stored within said transport container at a desired temperature during transport from a warehouse to an external destination. 10
15
8. The method according to claim 7, wherein the cooling medium product is assembled outside and/or prior to its loading in the transport container. 20
9. The method according to claims 7 or 8, wherein said amount of cooling medium product is determined taking into account parameters comprising the nature of the food products, the amount of food products loaded in the transport container, the temperature inside the transport container, the density of the solid CO₂, the time required for the transport of said food products to the external destination, the average expected external temperature during the transport or any combination thereof. 25
30
10. the method according to claims 7-9, wherein loading of the transport container with cooled, chilled, refrigerated and frozen products is performed within the cold warehouse system described in any of claims 1-6. 35
11. A transport container comprising a roof, a floor, at least three upstanding walls and at least one upstanding door, thereby defining an internal compartment, said internal compartment is provided with at least one engagement means for holding at least one cooling medium product, said engagement means have a variable height within the internal compartment of the transport container. 40
45
12. The transport container according to claim 11, comprising multiple engagement means positioned at different heights within the internal compartment of the transport container. 50
13. The transport container according to claims 11-12, wherein a cooling medium product 55
14. duct is horizontally loadable.

15. Use of the cold storage warehouse system as described in any of claims 1-6 and/or the method as described in claims 7-10 and/or the transport container as described in claims 11-13 for transporting cooled, chilled, refrigerated and frozen products from the warehouse to an external destination.

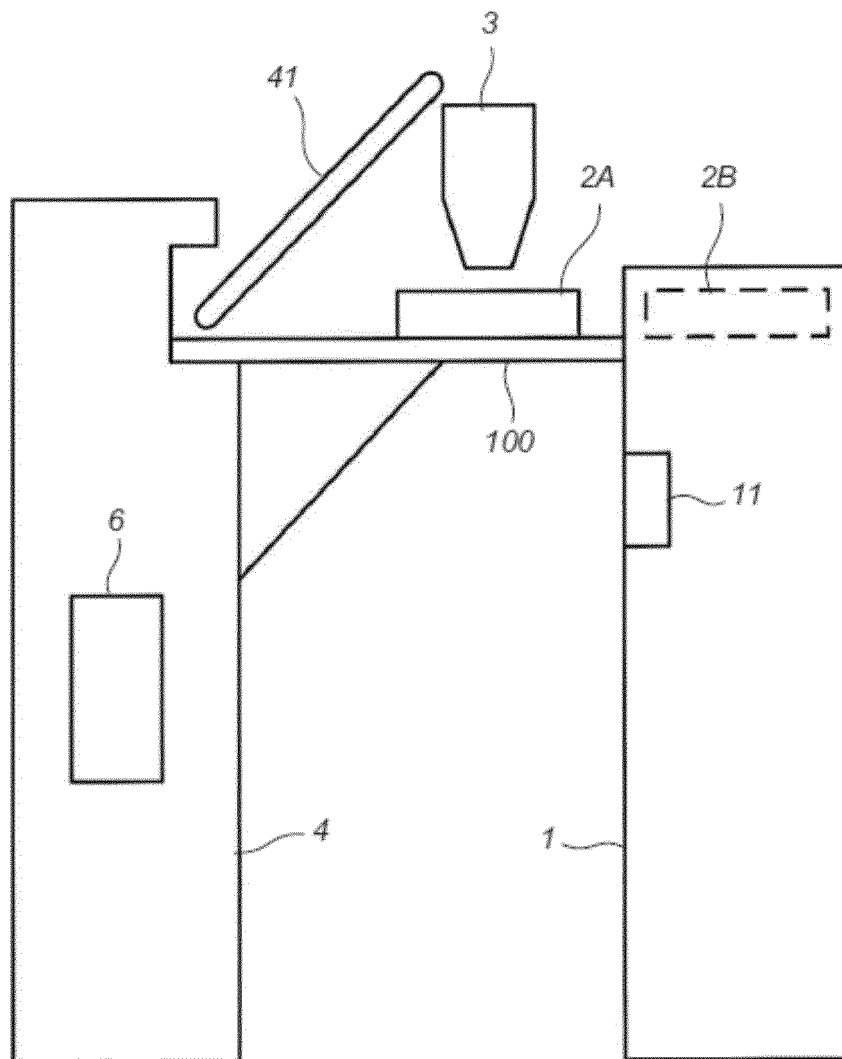


Fig. 1

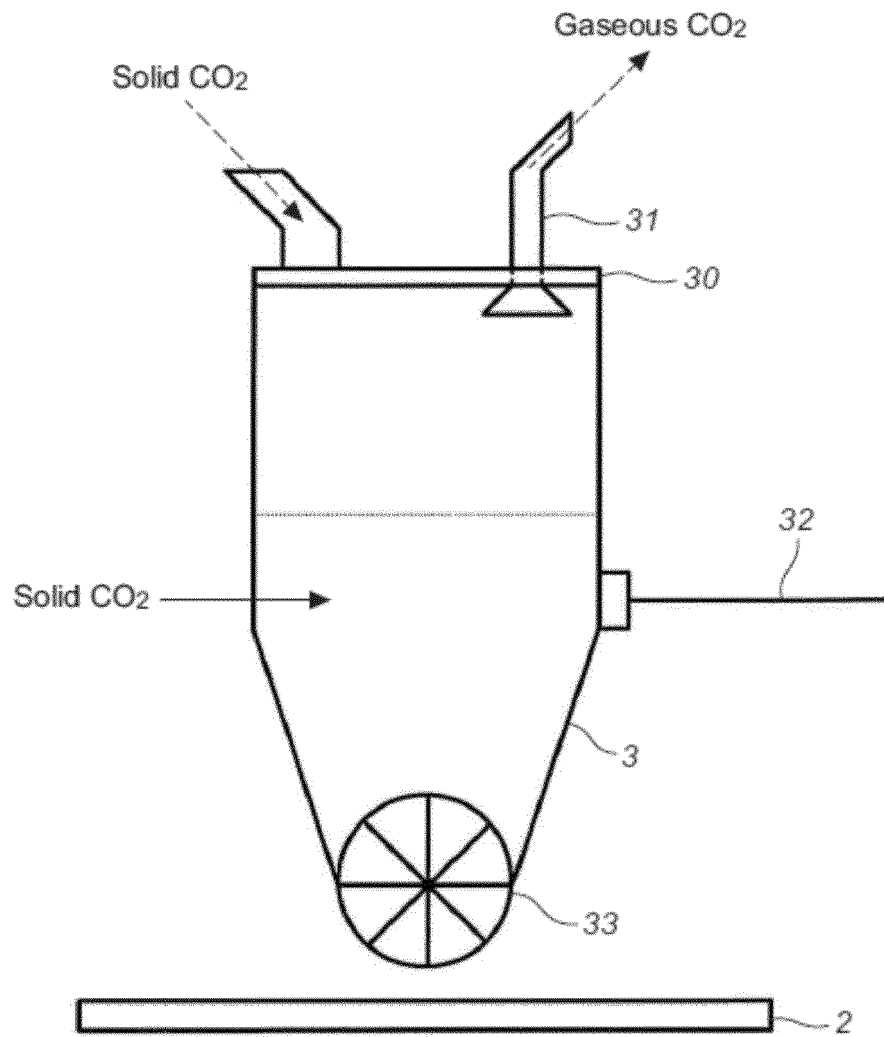


Fig. 2

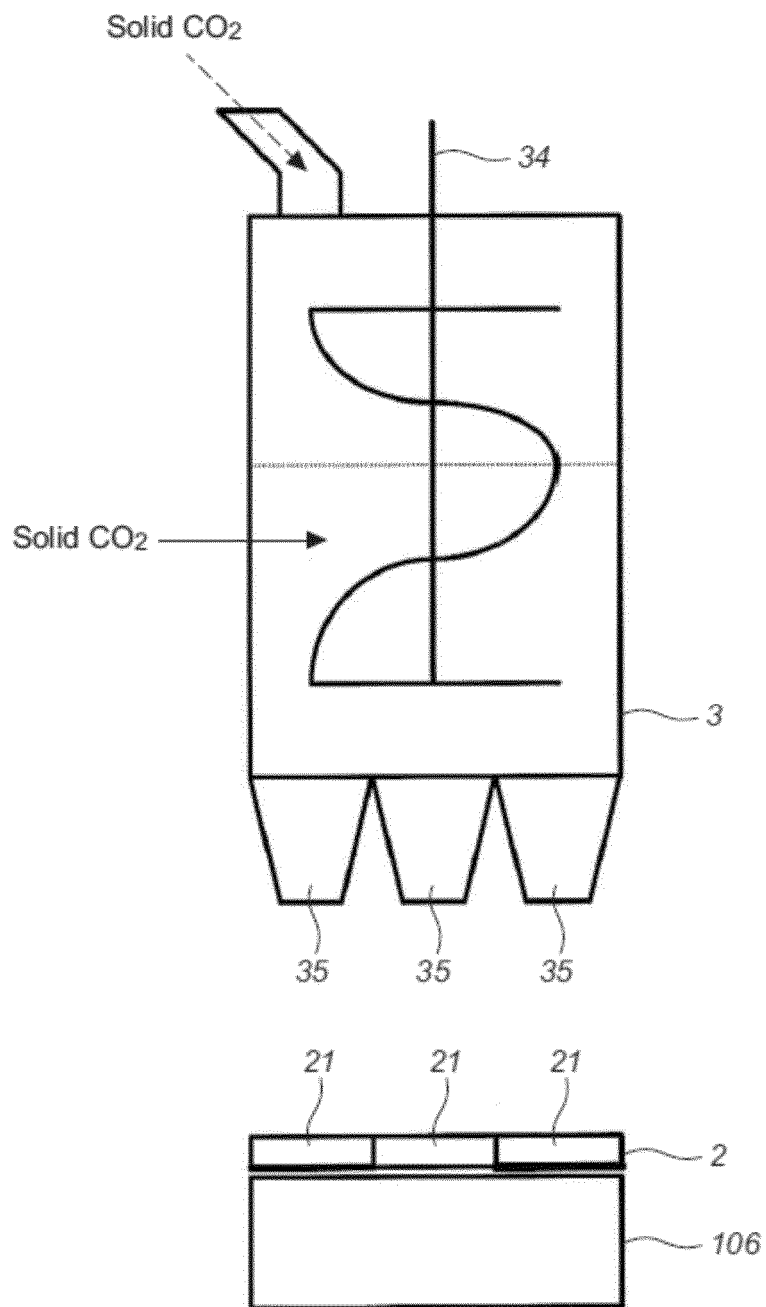


Fig. 3

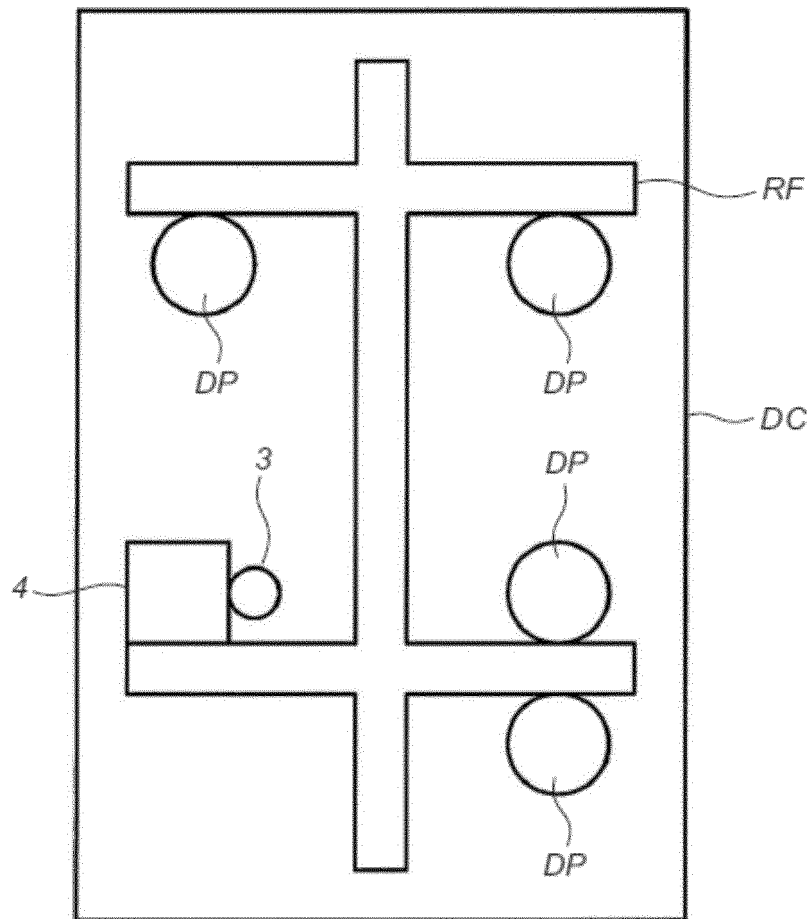


Fig. 4

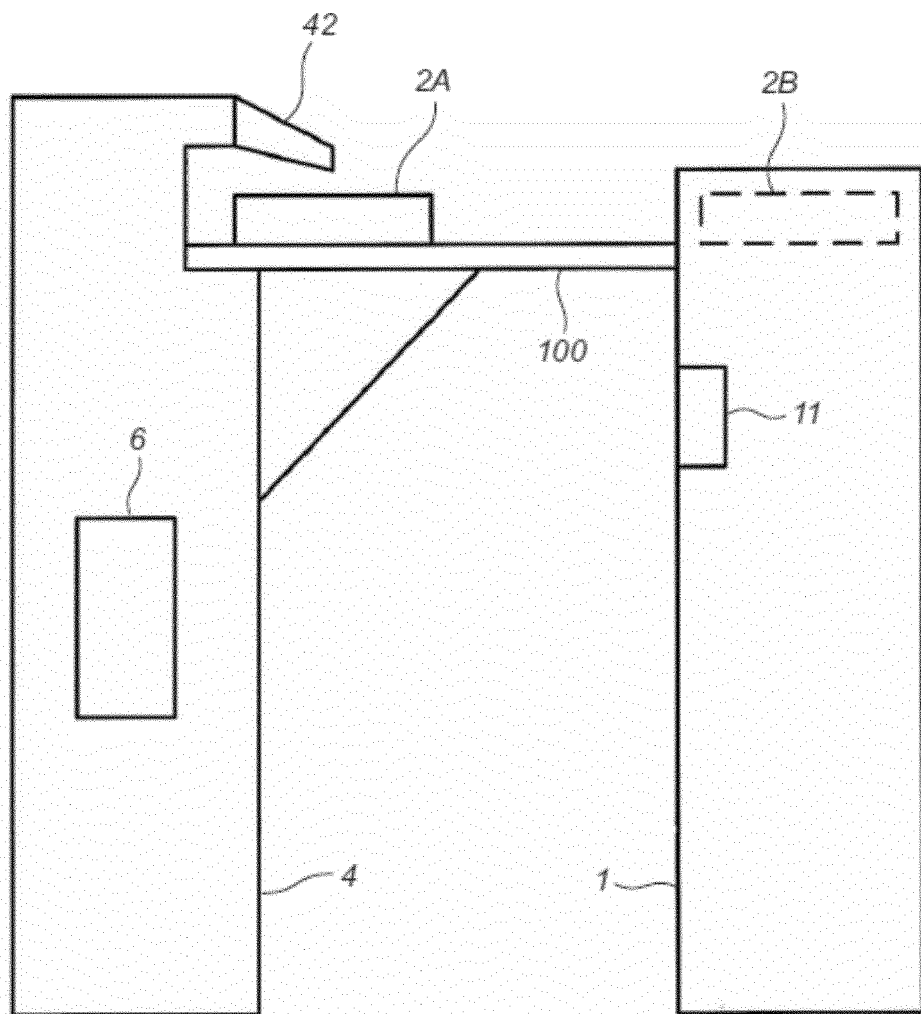


Fig. 5

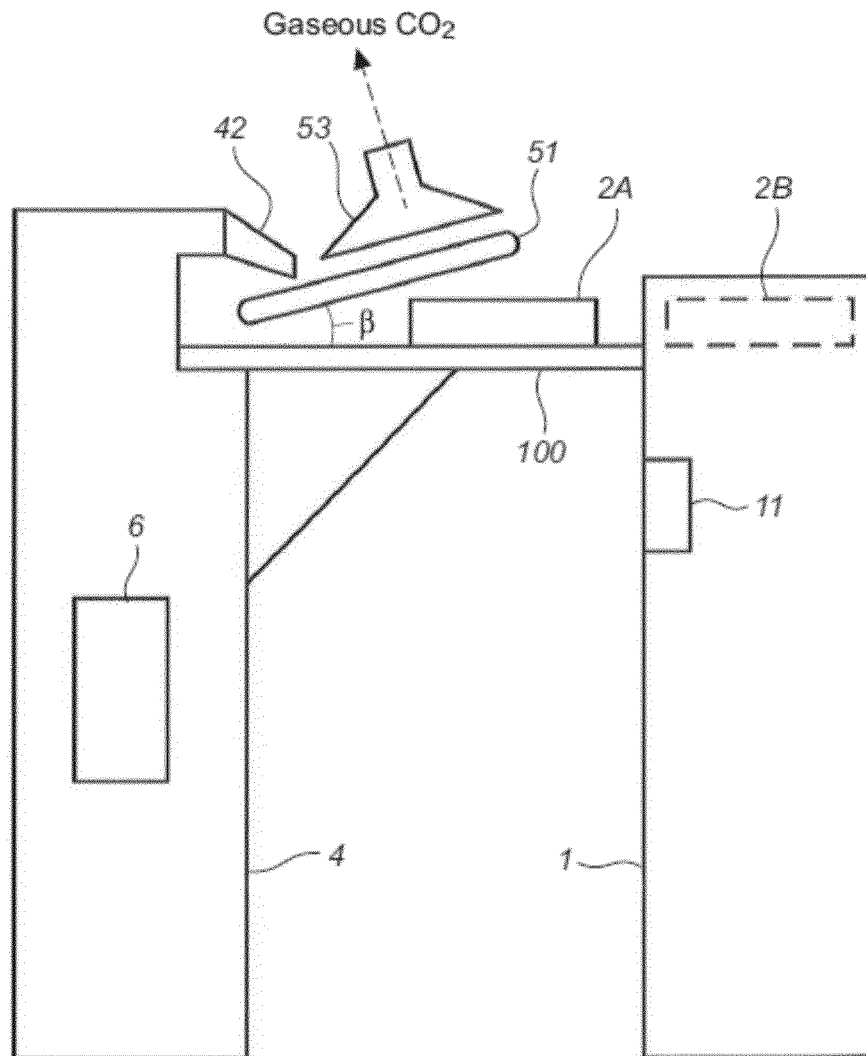


Fig. 6

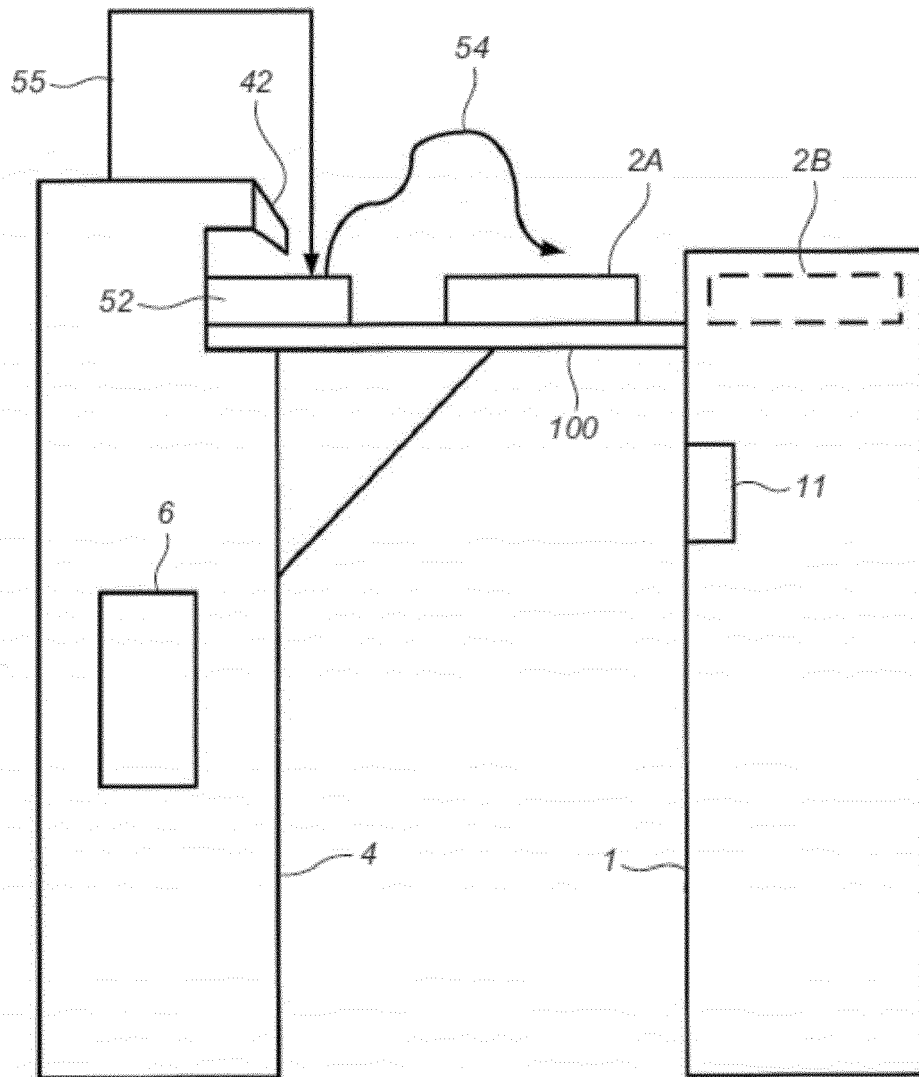


Fig. 7

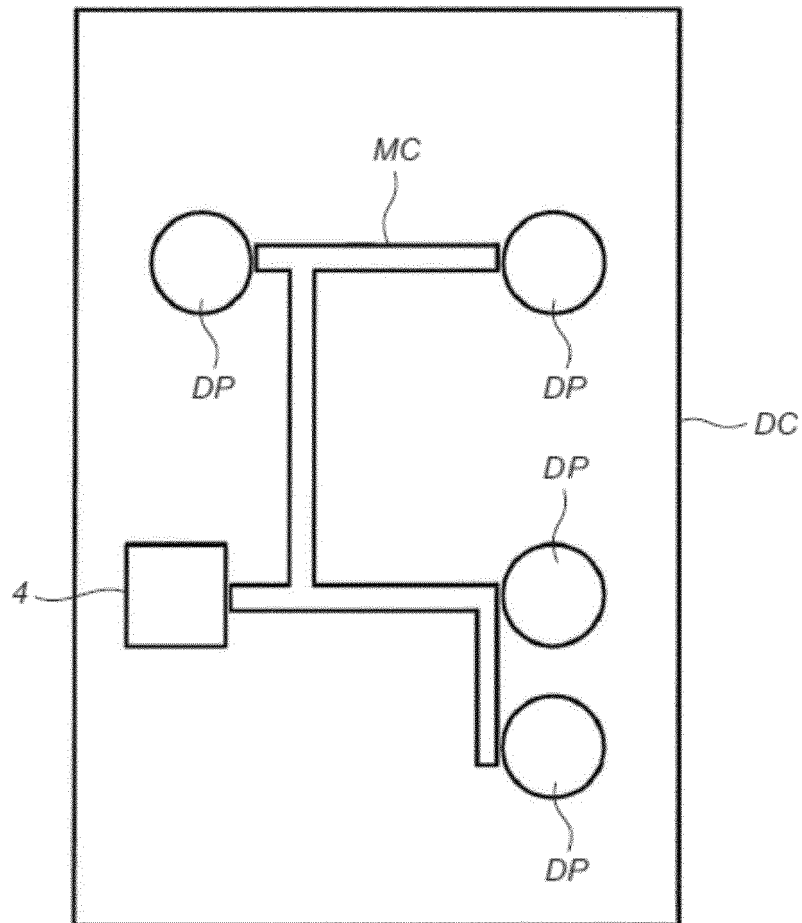


Fig. 8

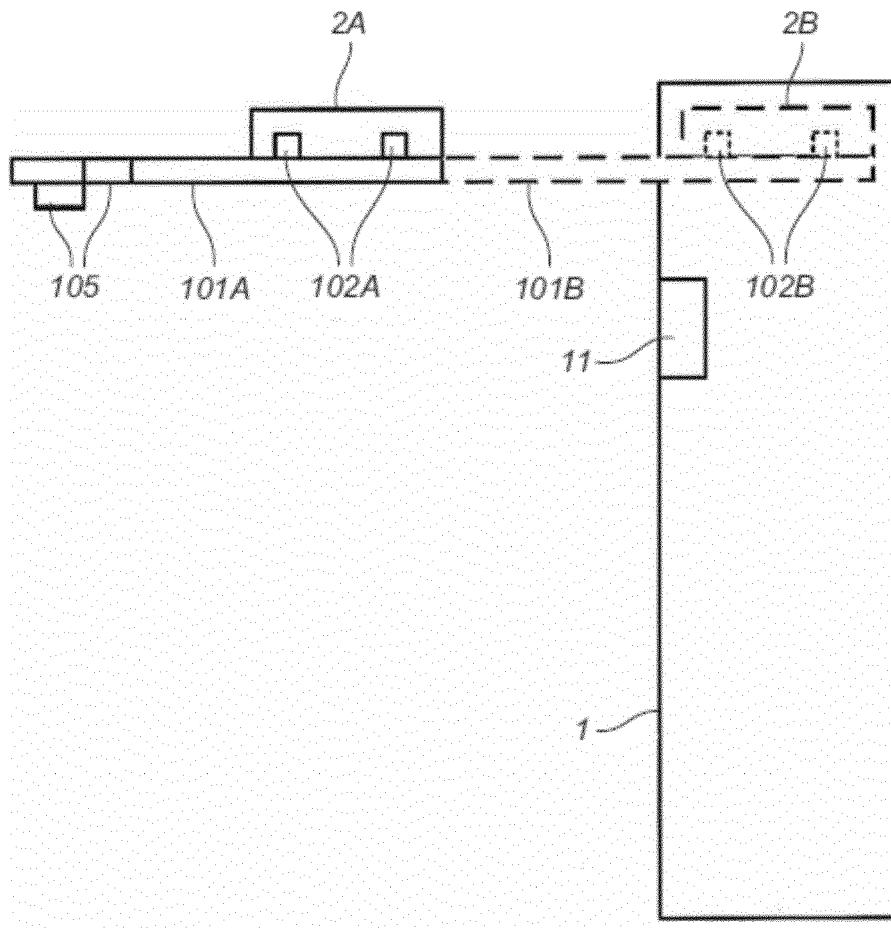


Fig. 9

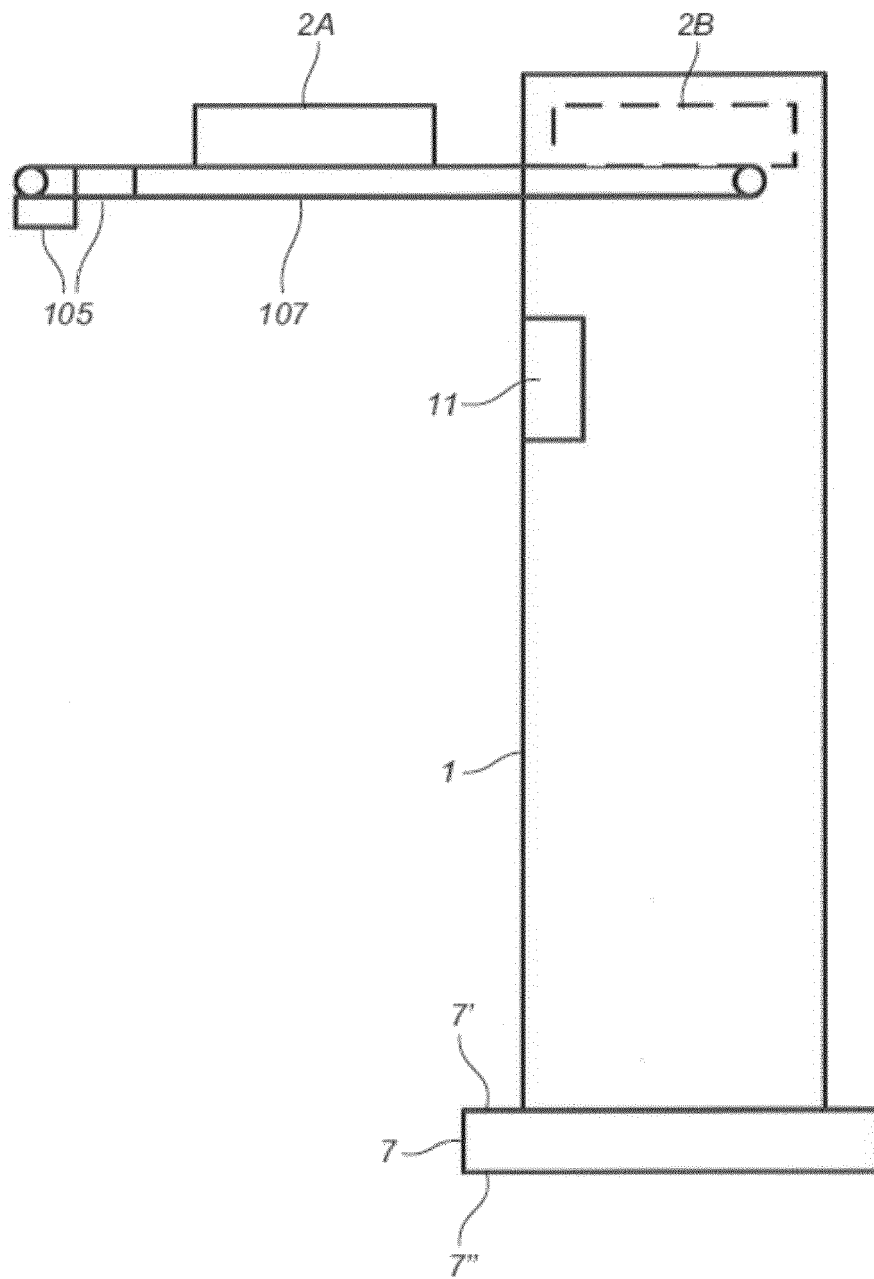


Fig. 10

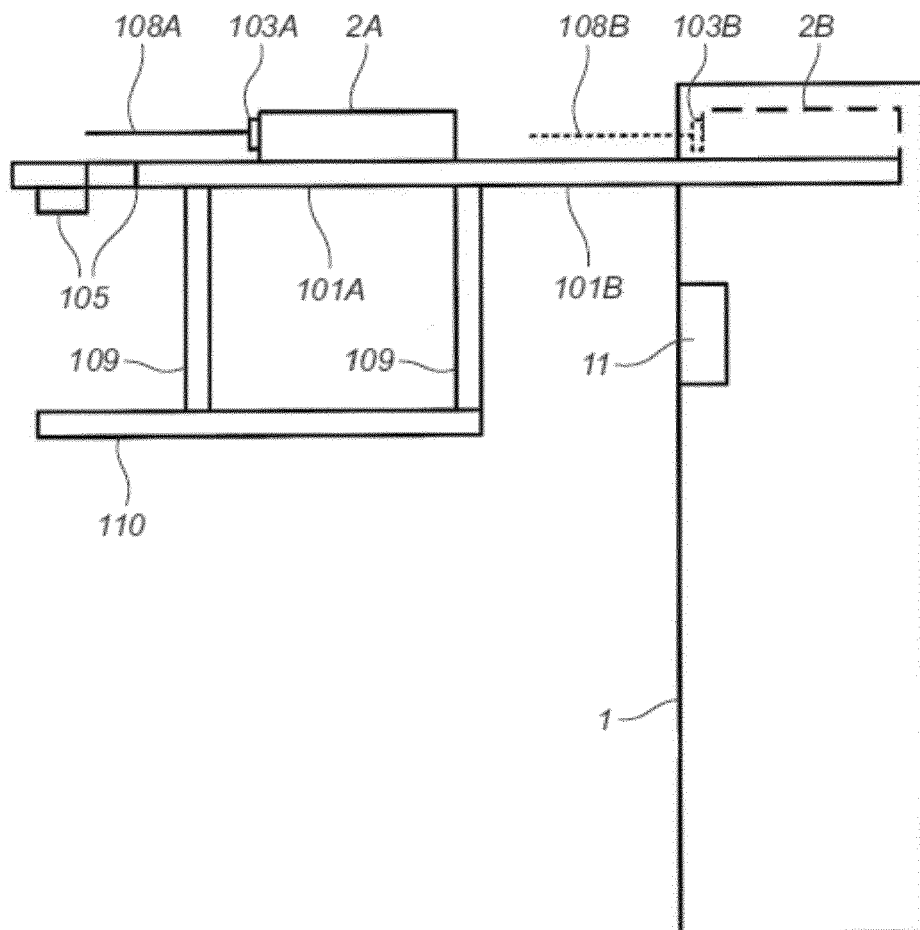


Fig. 11

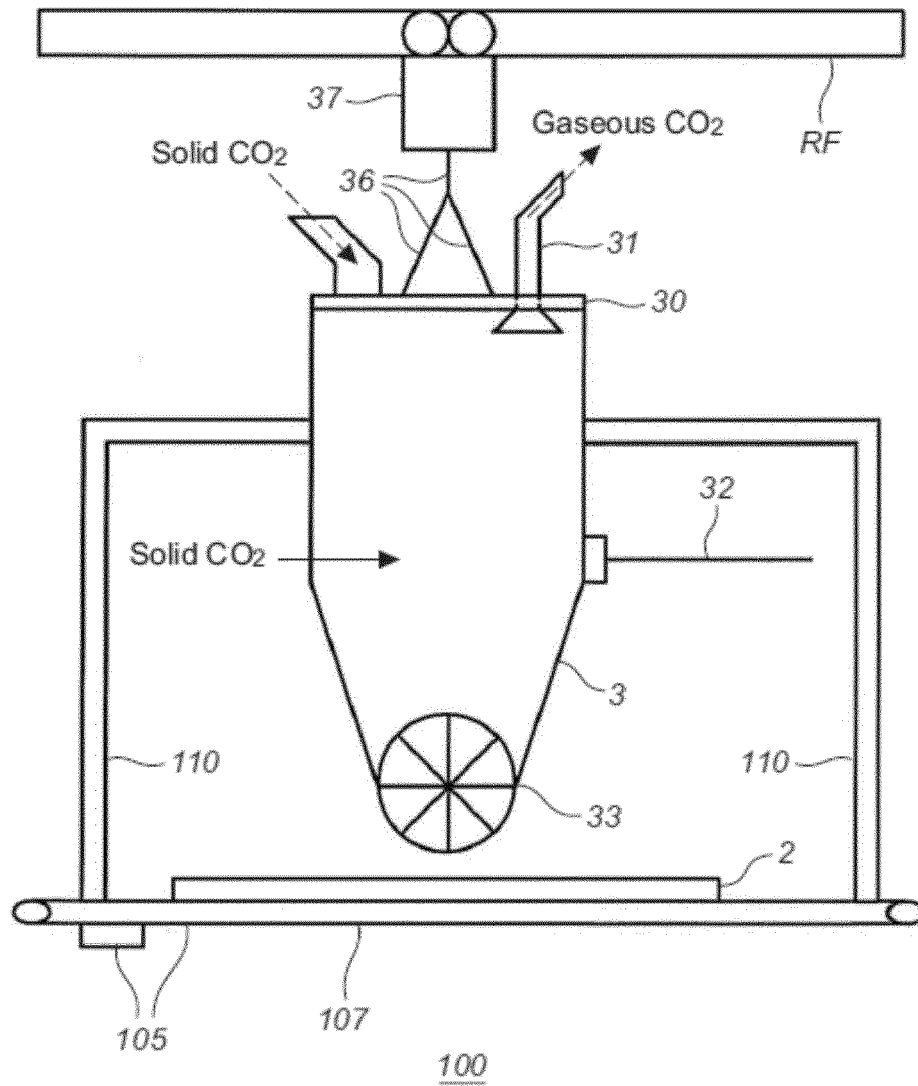


Fig. 12

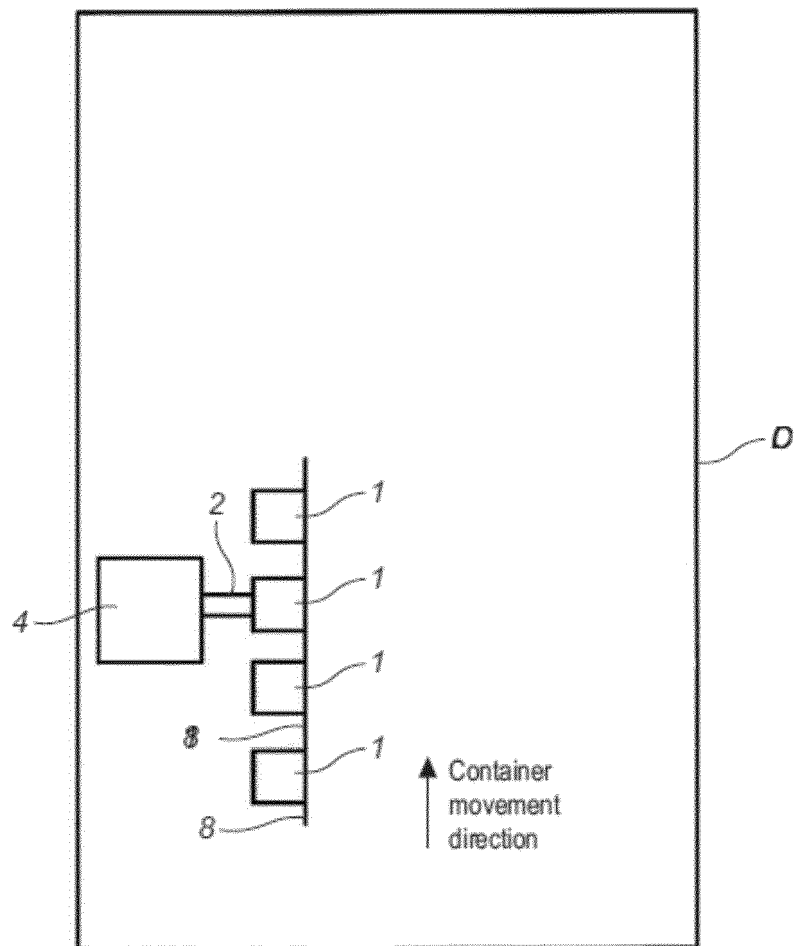
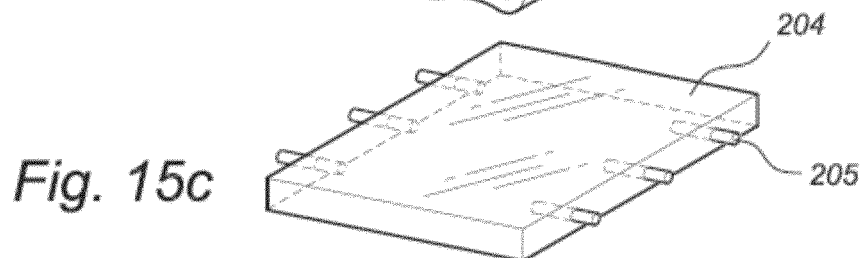
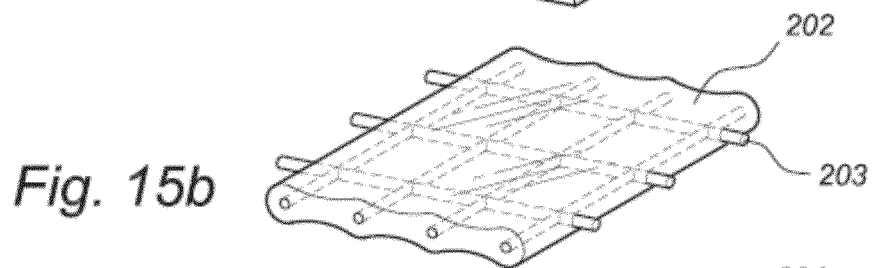
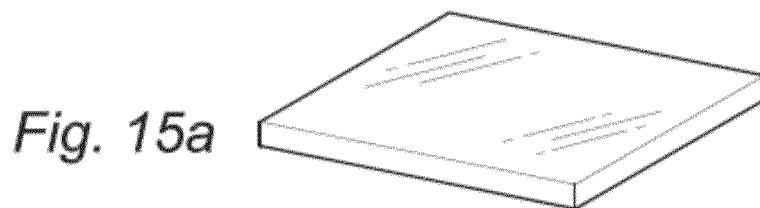
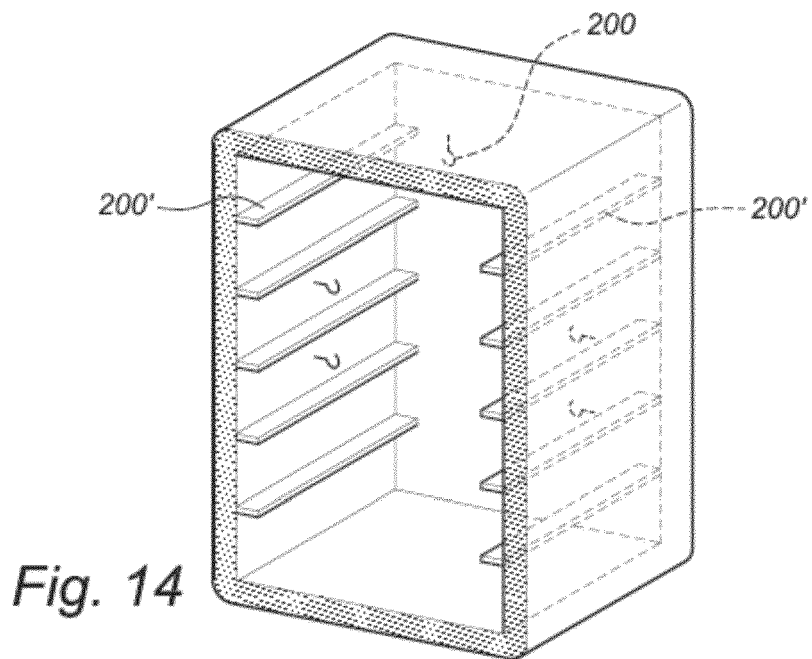


Fig. 13



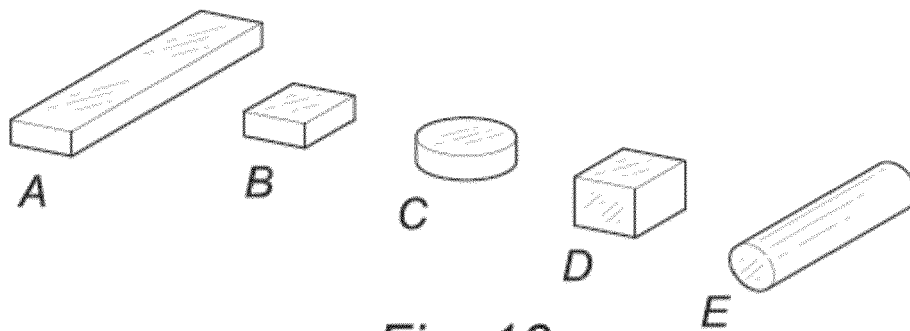


Fig. 16

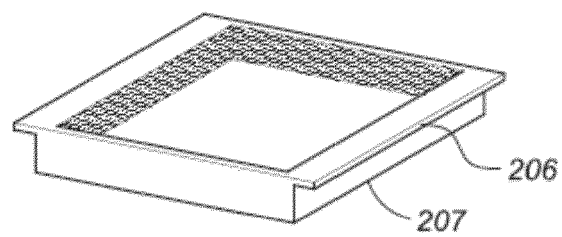


Fig. 17

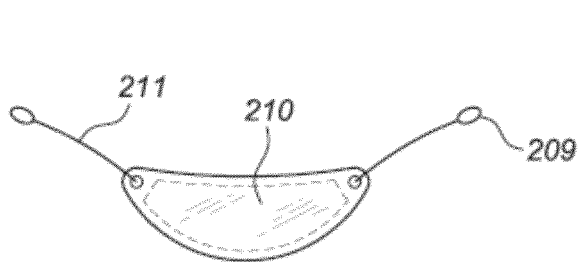


Fig. 18a

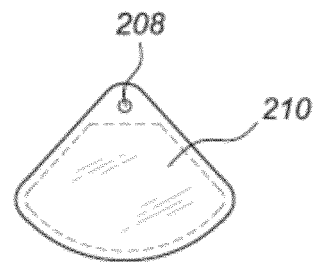


Fig. 18b

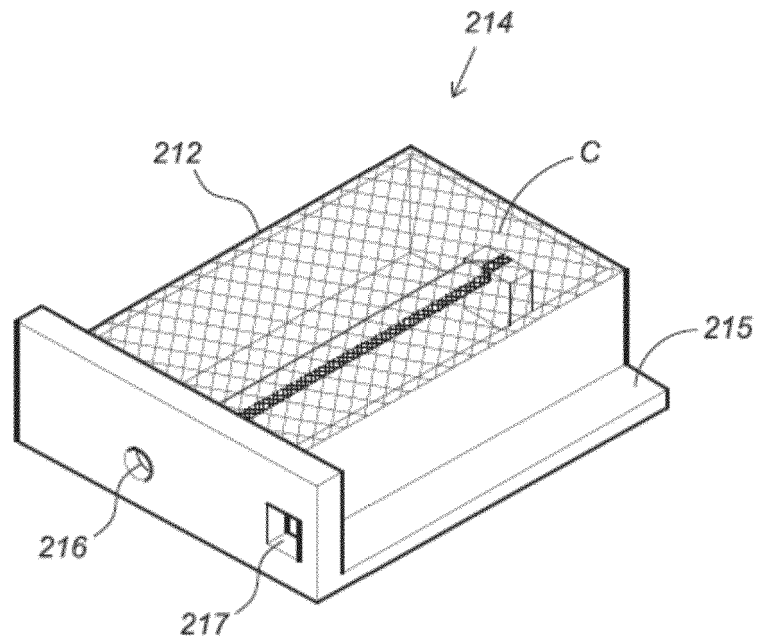


Fig. 19a

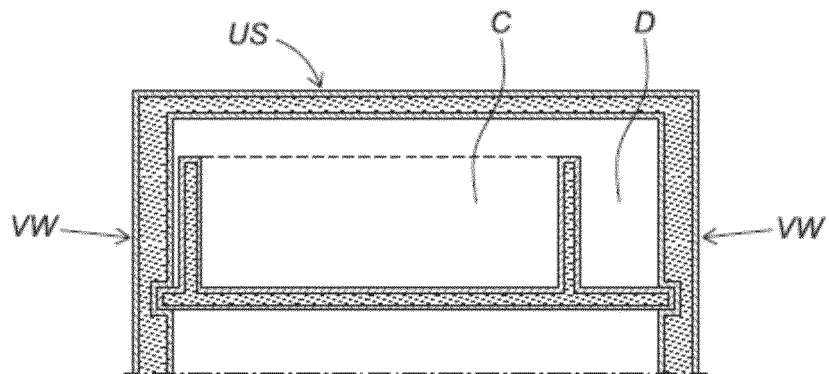


Fig. 19b

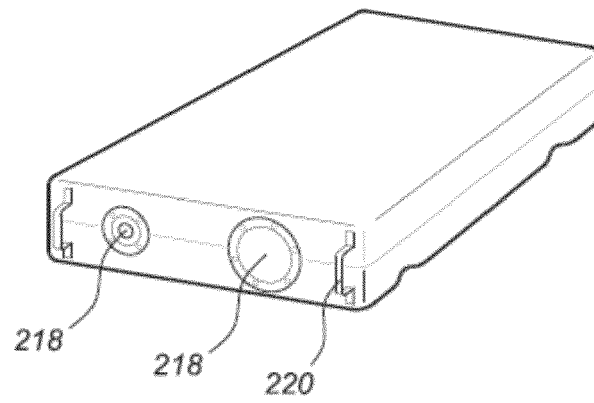


Fig. 20

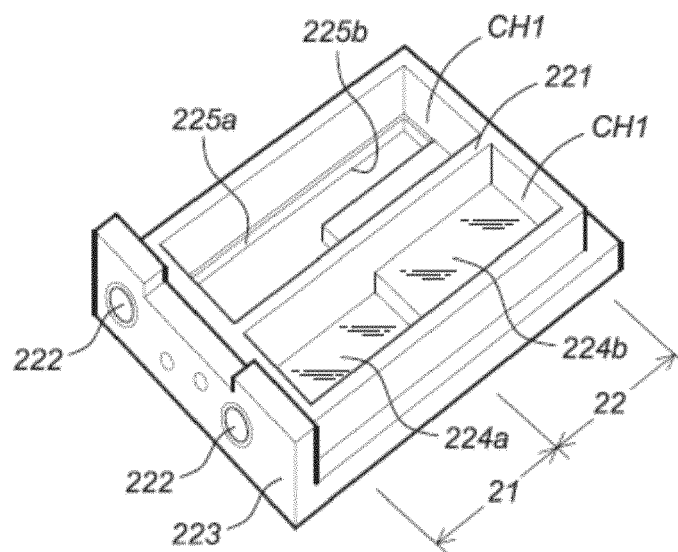


Fig. 21

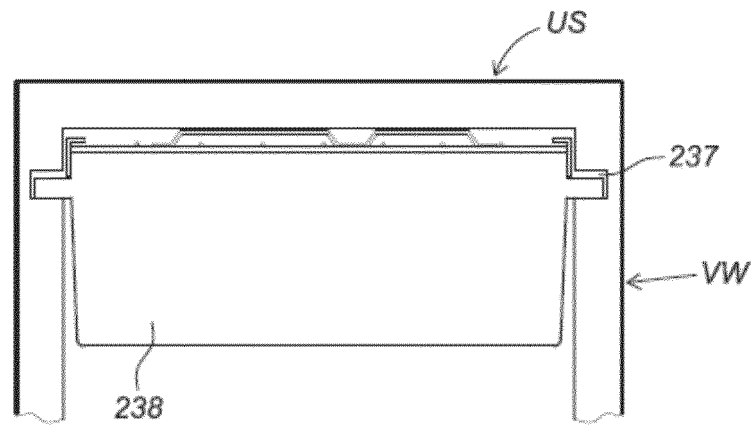


Fig. 22

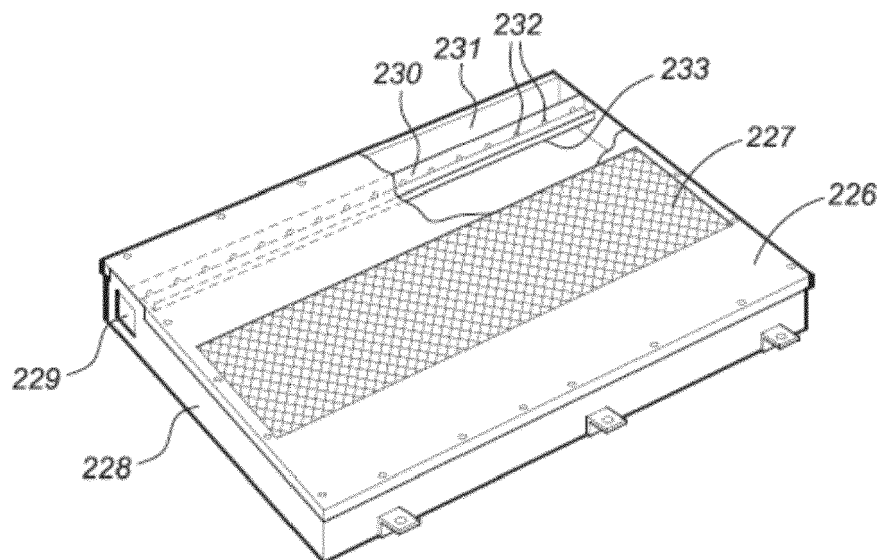


Fig. 23

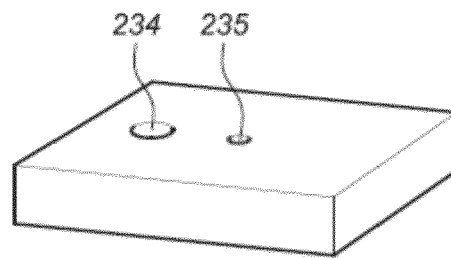


Fig. 24

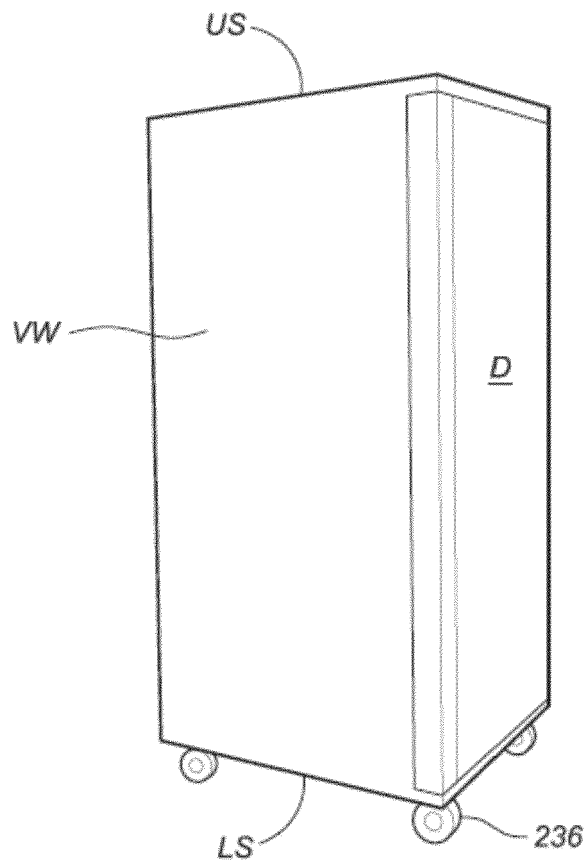


Fig. 25

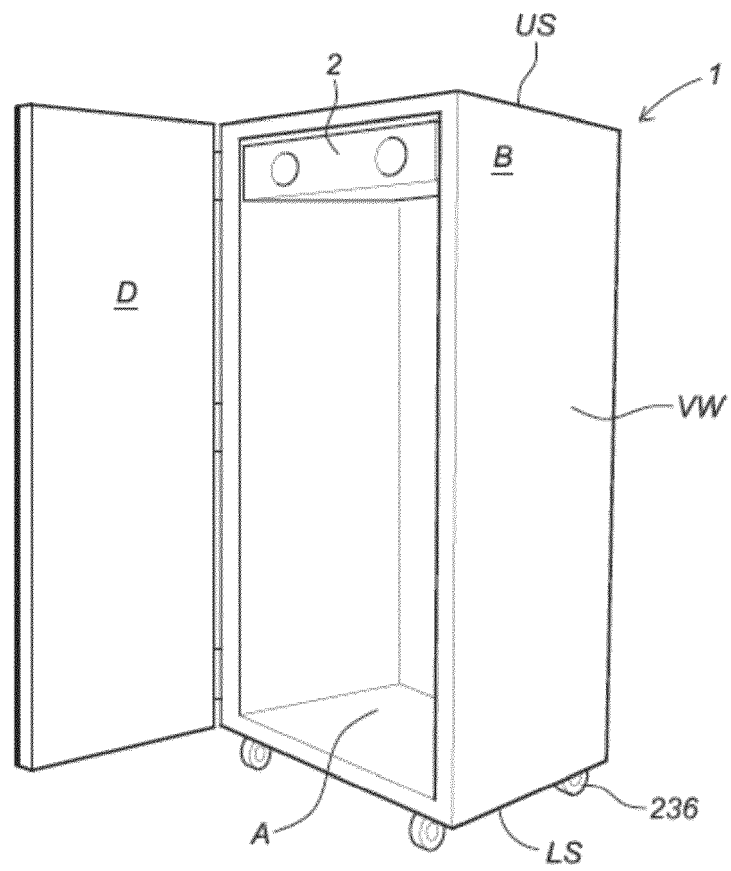


Fig. 26

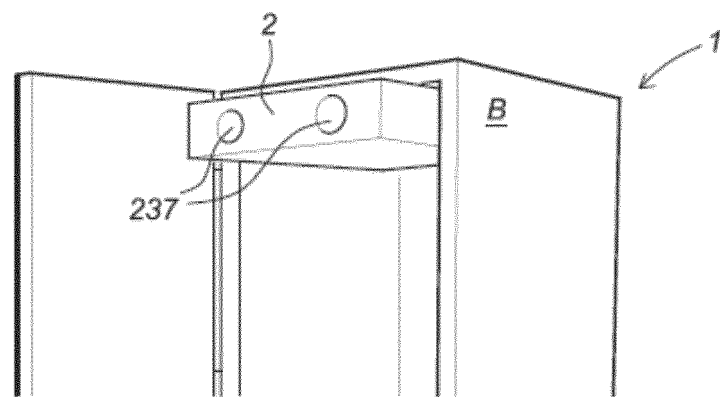


Fig. 27

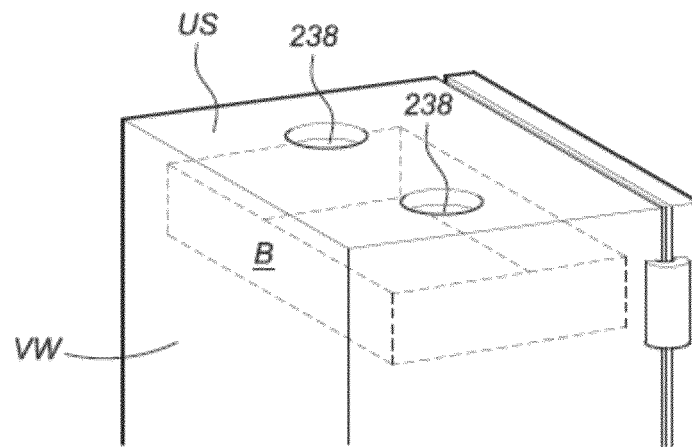


Fig. 28

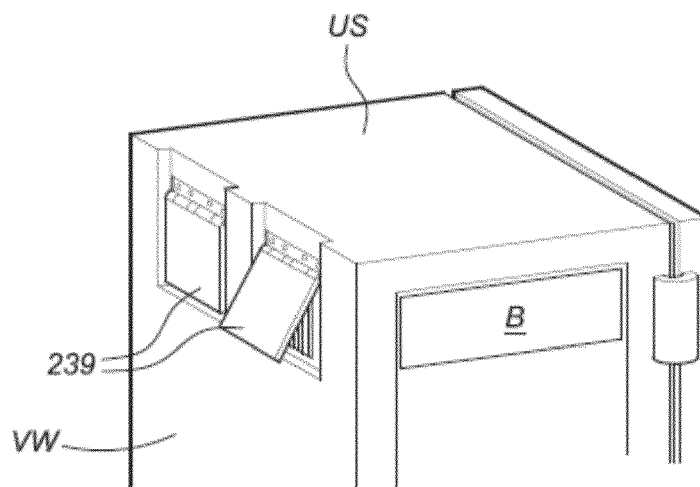


Fig. 29

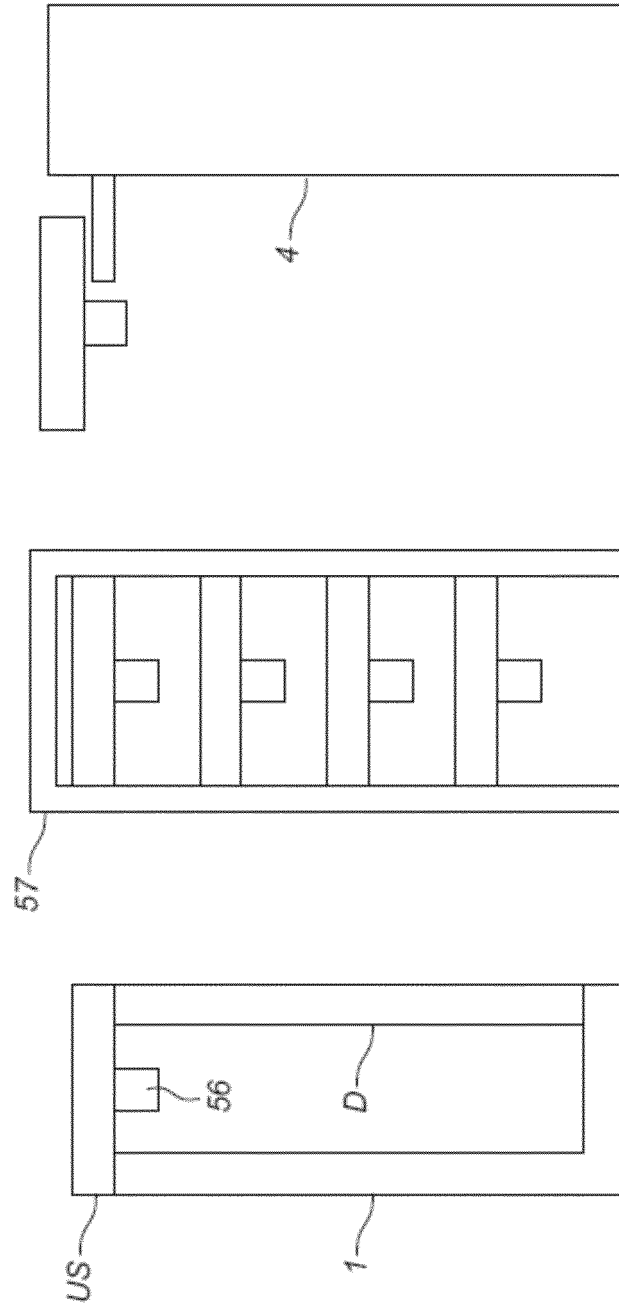


Fig. 30

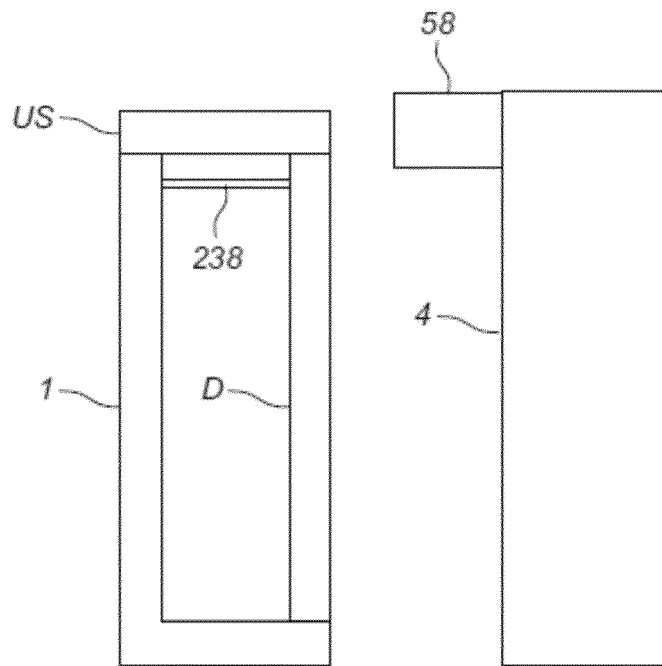


Fig. 31

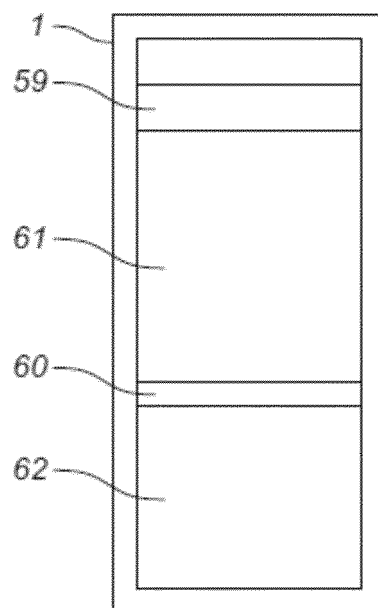


Fig. 32

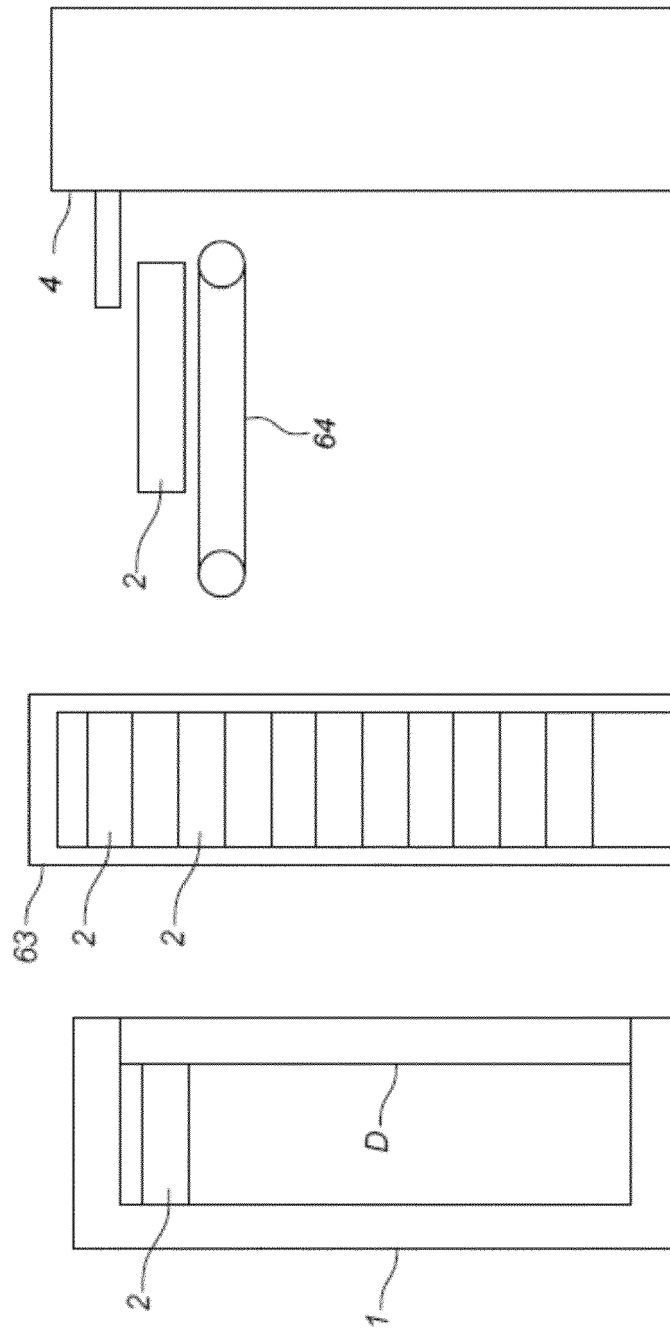


Fig. 33

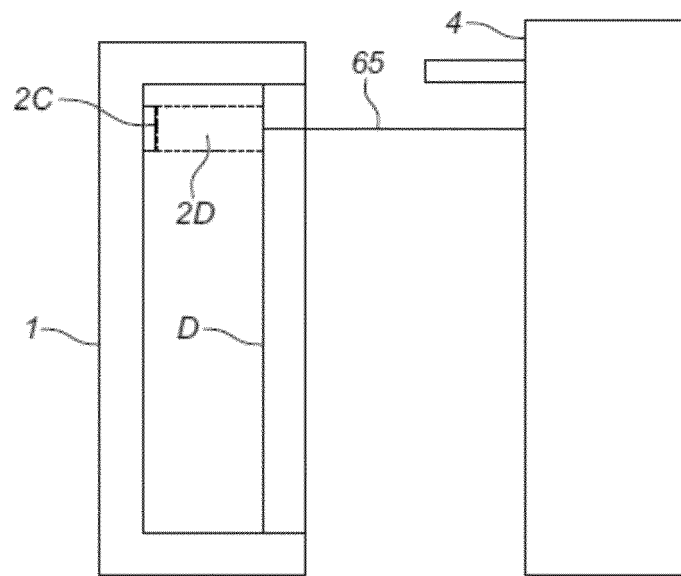


Fig. 34

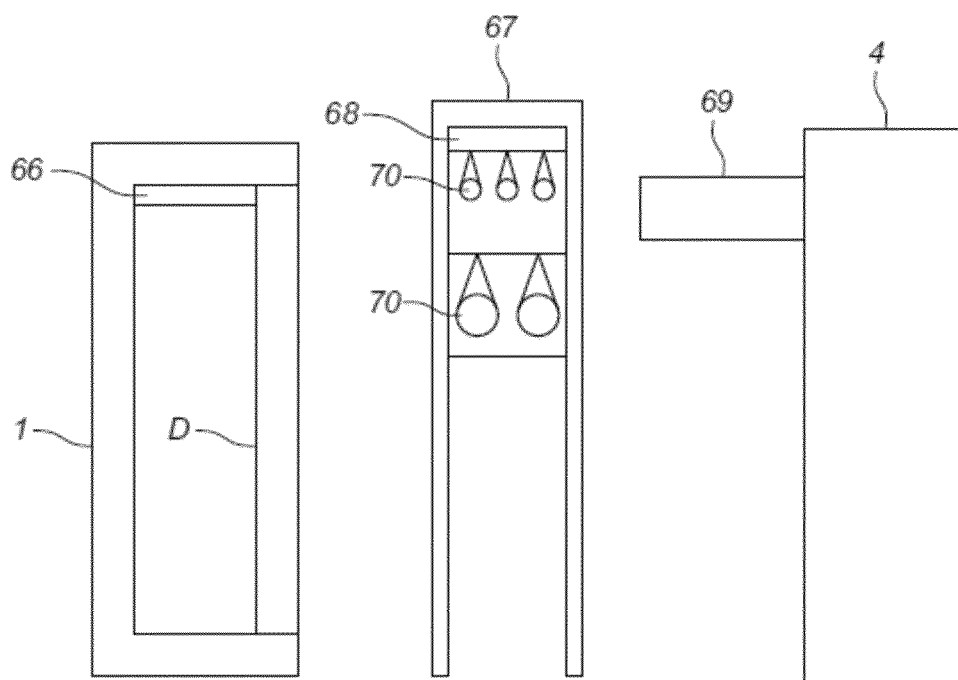


Fig. 35

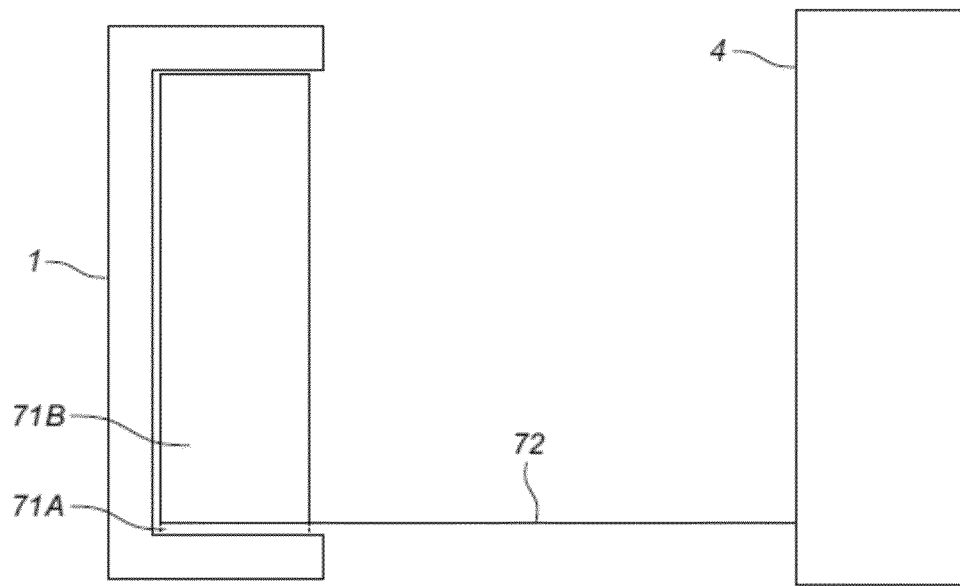


Fig. 36

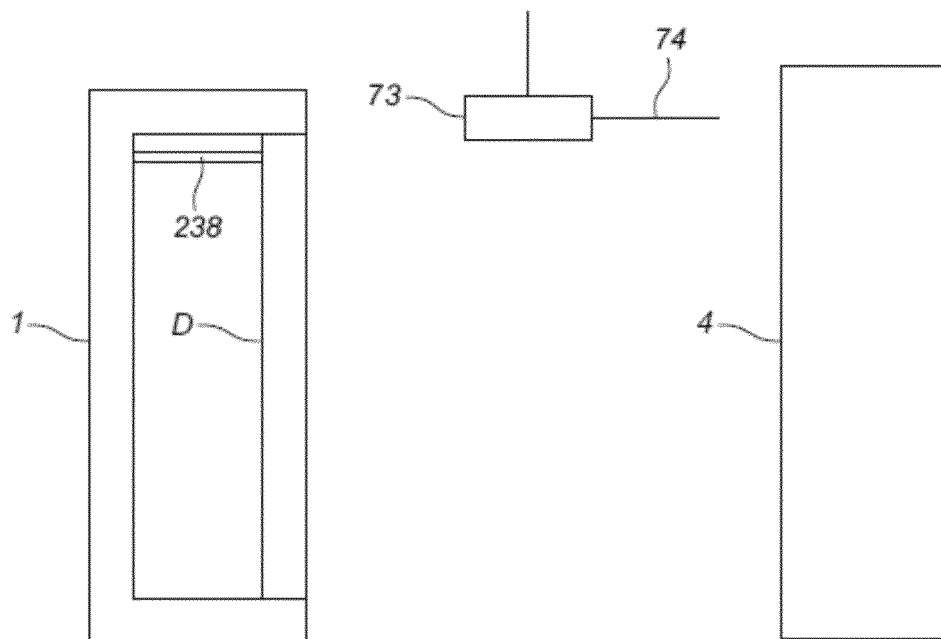


Fig. 37

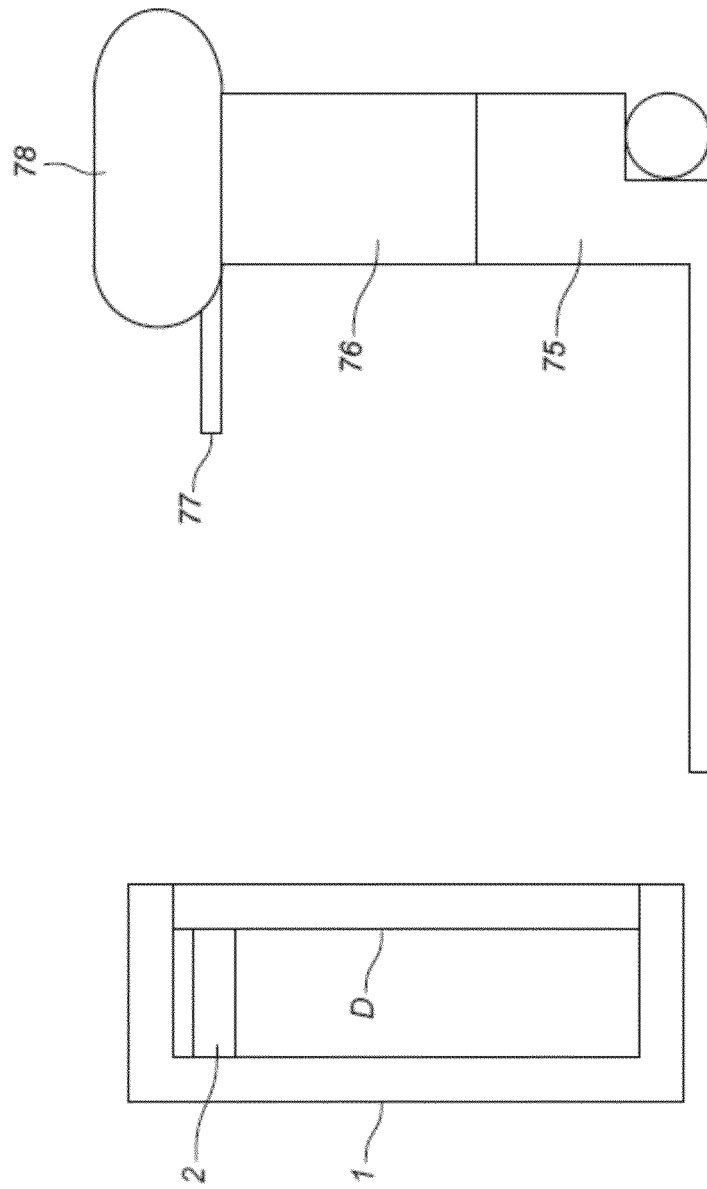


Fig. 38

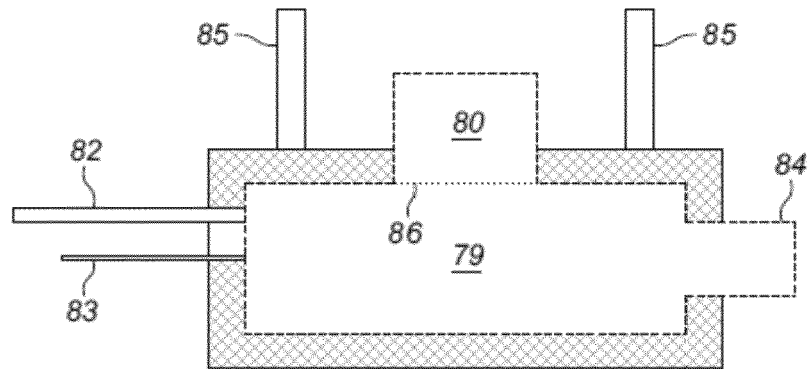


Fig. 39

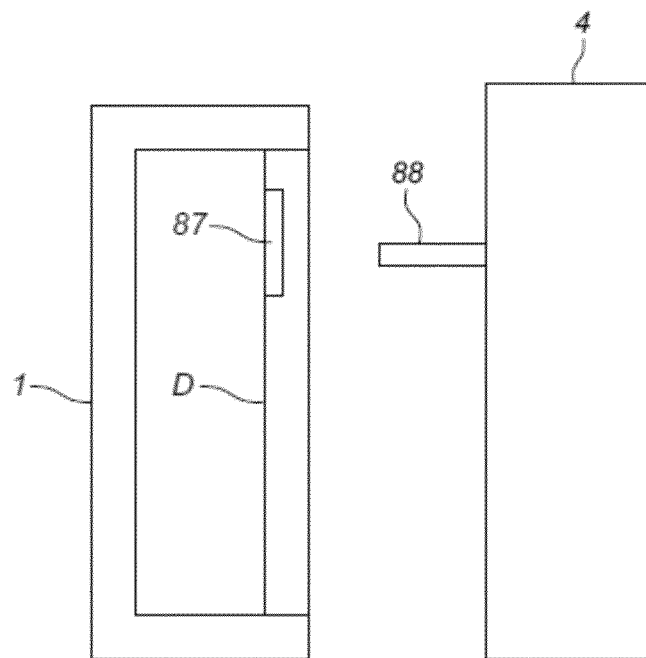


Fig. 40

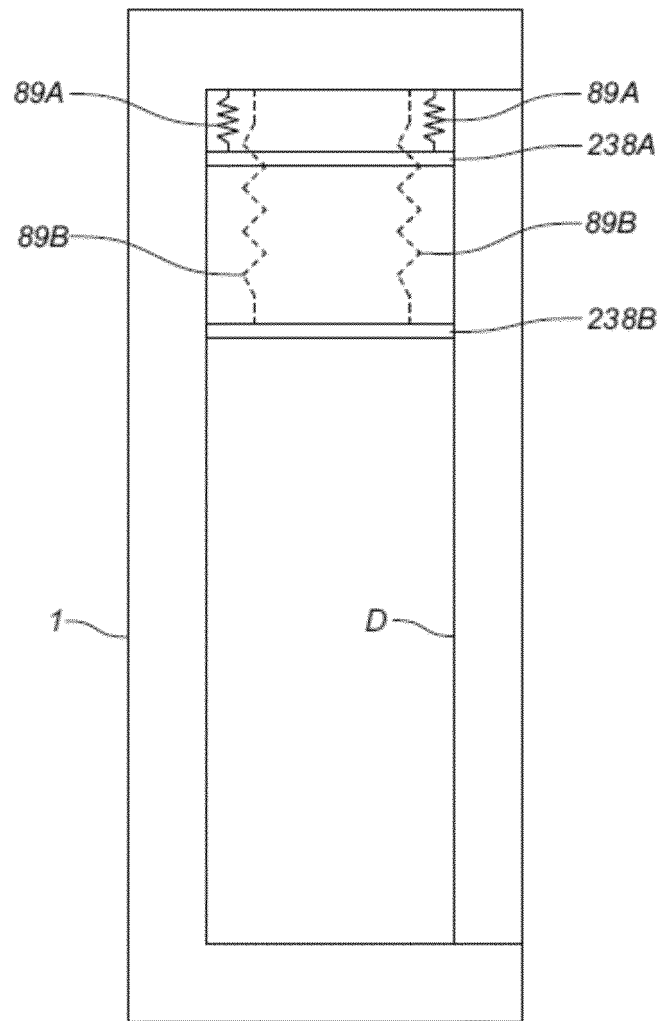


Fig. 41

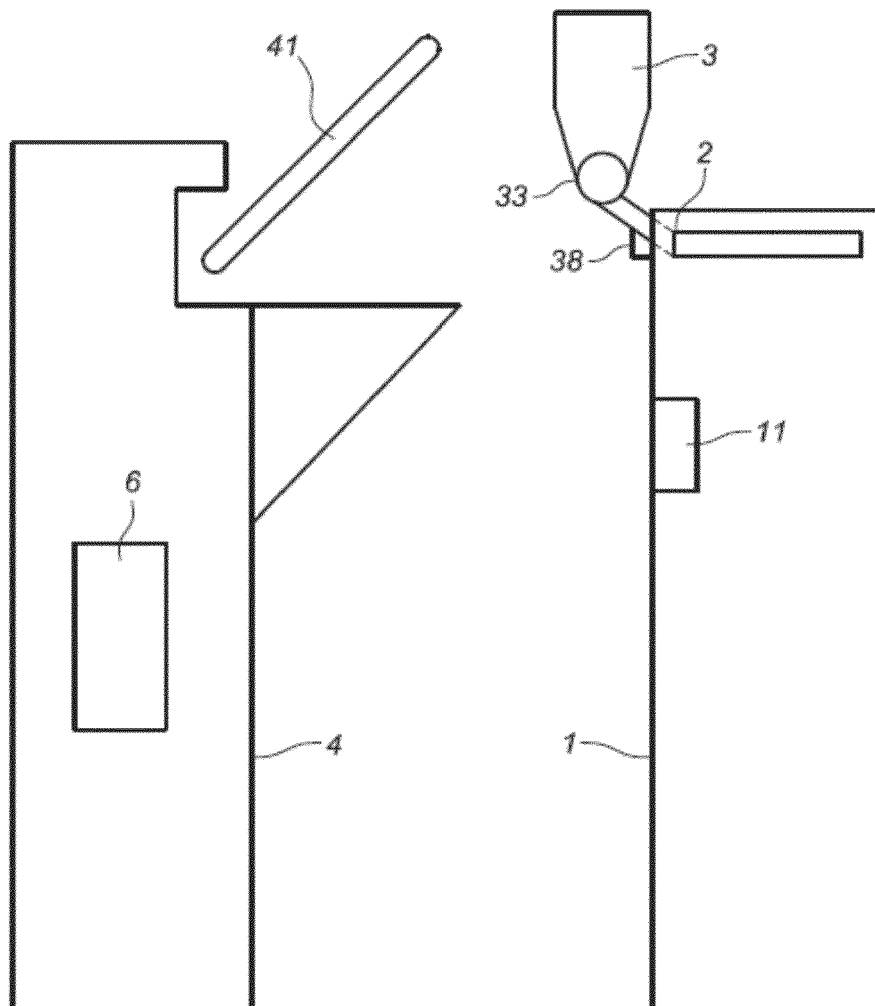


Fig. 42

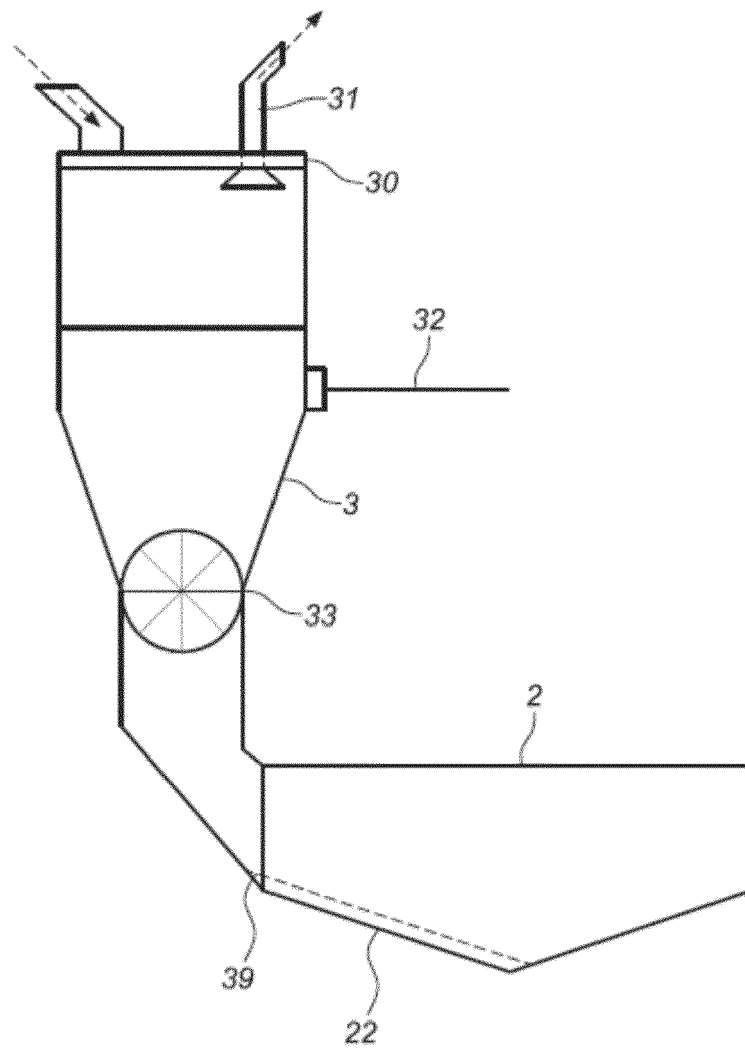


Fig. 43

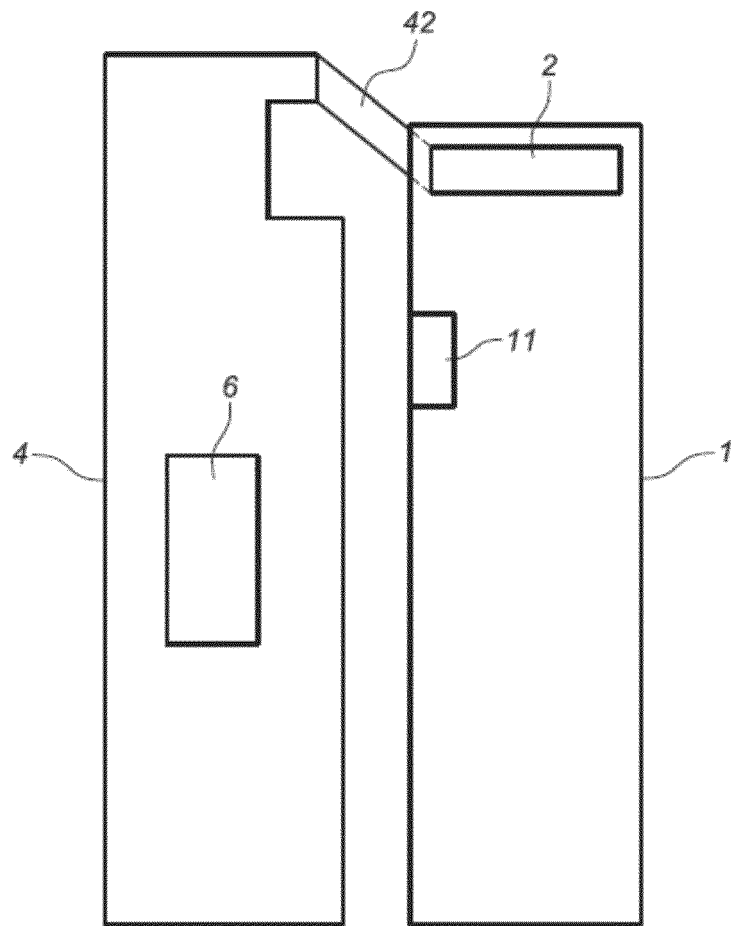


Fig. 44

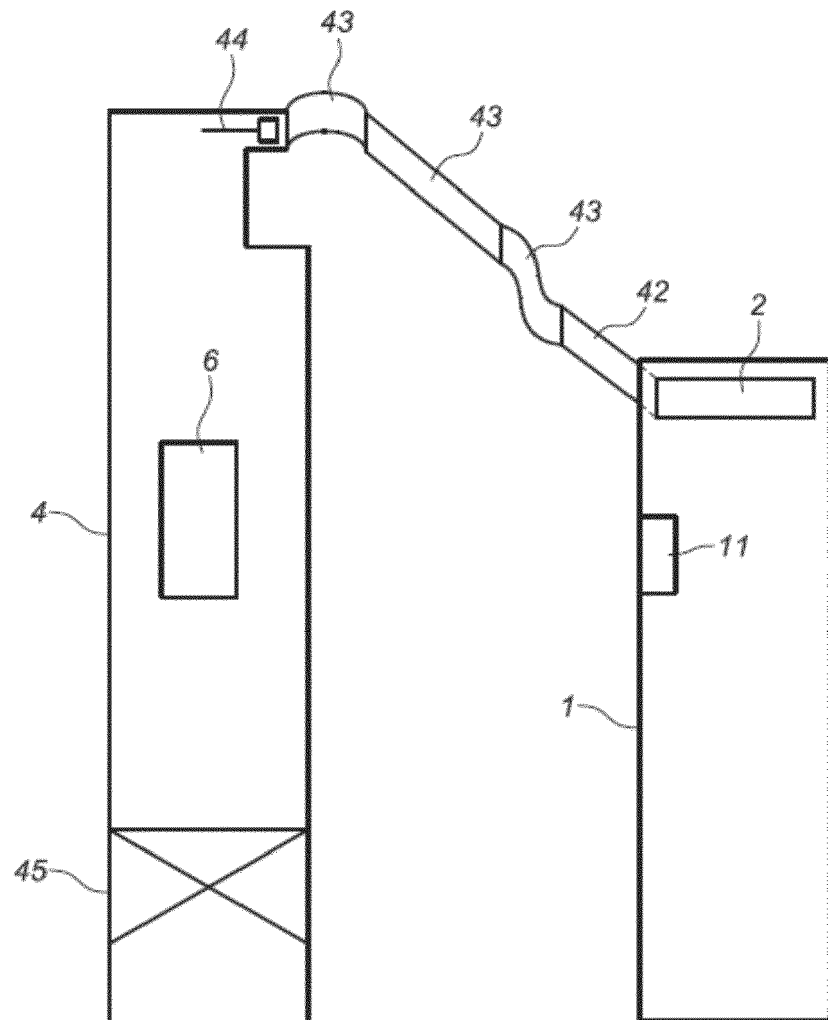


Fig. 45

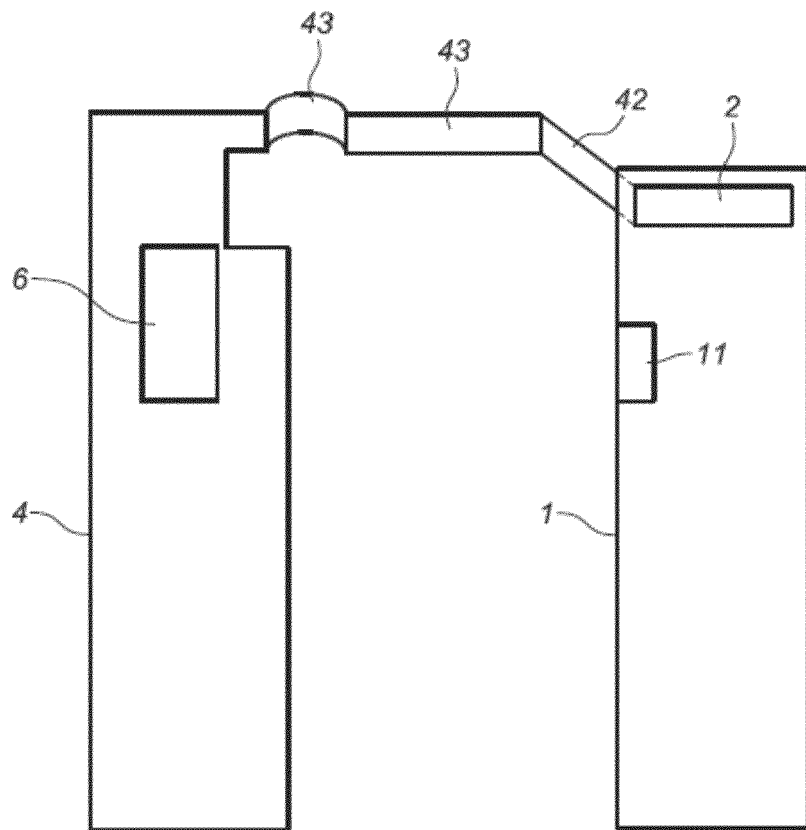


Fig. 46

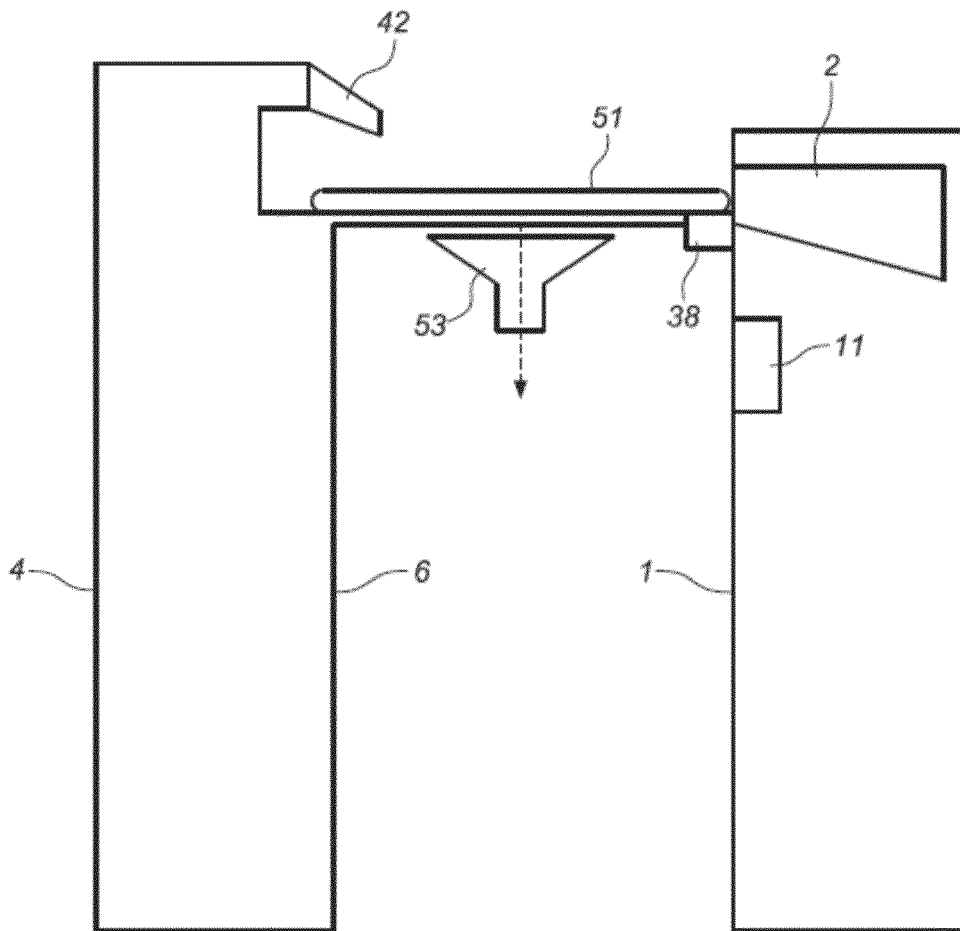


Fig. 47

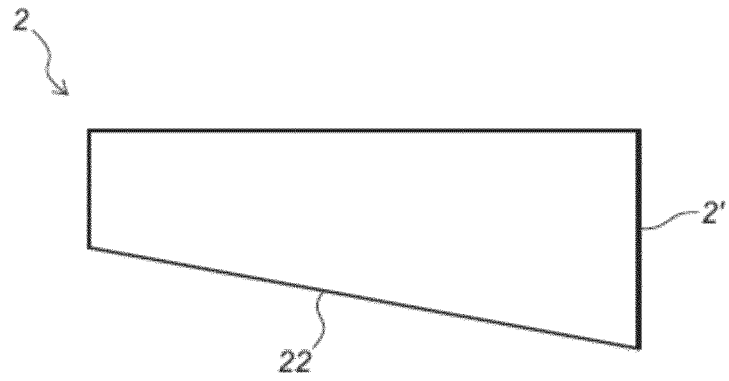


Fig. 48a

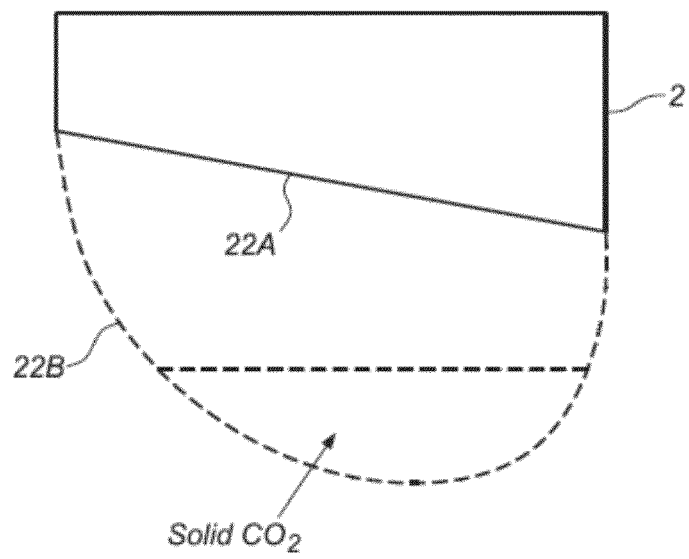


Fig. 48b



EUROPEAN SEARCH REPORT

Application Number
EP 14 19 2457

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X,D	EP 1 408 295 A2 (MESSER GRIESHEIM GMBH [DE] AIR LIQUIDE DEUTSCHLAND GMBH [DE] AIR LIQUI) 14 April 2004 (2004-04-14) * paragraphs [0001], [0063] - [0078]; claims 1-10; figures *	1-7,9,10,15	INV. F25D3/12 C01B31/22
X	EP 2 604 956 A1 (ACP BELGIUM N V [BE]) 19 June 2013 (2013-06-19) * paragraphs [0080] - [0082]; claims 1-4,9,10; figures *	1-7,9,10,15	
X	WO 94/12836 A1 (GRUMMAN AEROSPACE CORP [US]) 9 June 1994 (1994-06-09) * page 11, last paragraph - page 18, paragraph first; figures *	1,2,4,5,7	
X	WO 2012/107518 A2 (ACP BELGIUM N V [BE]; DYCKMANS PETER [BE]; TIMMERMANS RIK [BE]; VANSAN) 16 August 2012 (2012-08-16) * the whole document *	1	
X	US 4 898 294 A (JENNINGS GARY K [US]) 6 February 1990 (1990-02-06) * column 2, lines 29-38; figures 2,3 *	11-13	TECHNICAL FIELDS SEARCHED (IPC) F25D C01B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 12 March 2015	Examiner Vigilante, Marco
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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12-03-2015

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