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(54) **AN APPARATUS FOR FREEZING AND STORAGE OF ORGANIC MATERIAL AND A DOOR
MODULE FOR SUCH AN APPARATUS**

VORRICHTUNG ZUM EINFRIEREN UND ZUM LAGERN VON ORGANISCHEM MATERIAL UND EIN
TÜRMODUL FÜR EINE SOLCHE VORRICHTUNG

APPAREIL PERMETTANT DE CONGELER ET DE STOCKER UNE MATIÈRE ORGANIQUE ET
MODULE DE PORTE POUR LEDIT APPAREIL

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(56) References cited:

GB-A- 2 412 717 **JP-A- 2002 291 455**
US-A- 2 474 069 **US-A1- 2002 023 444**
US-A1- 2010 199 703

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Description

[0001] The present invention relates to a door module according to claim 1 for use in an apparatus for freezing and storage of organic material, said apparatus comprising an internal conveyor system for transporting stored portions of material inside the apparatus, an insulated shell, said door module comprising a primary and a secondary door, the primary door in the shell facing the exterior of the apparatus and the secondary door in the shell facing the interior of the apparatus, where the secondary door opens to a limited number of the stored portions, and where the primary door and the secondary door are arranged so that portions of material can be deposited into or removed from the apparatus only when the primary door and the secondary door are open at the same time.

[0002] In order to successfully preserve biomolecules, cells, and biological tissue for extended periods of time, storage below -80 degrees Celsius (C°) is generally required. However, both shelf life and the ability to recover living cells are dramatically improved at even lower temperatures down to about -196C°, which is the boiling point of liquid nitrogen. Therefore, liquid nitrogen is often used as a cooling agent for preservation of organic material, even though it is a very expensive substance.

[0003] Freezers operating at such low temperatures are generally known as cryogenic freezers, and the material stored therein is said to be cryo-preserved. There are different opinions on the upper temperature limit below which the term "cryogenic" should be applied to temperatures. The American National Institute of Standards and Technology has suggested an upper limit of -150C°, while some scientists regard the boiling point of oxygen (-183C°) as the upper limit. However, it is generally agreed, that a freezer refers to a storage device that operates from about -5C° to -20C°, an ultra low freezer operates from about -50C° to -90C°, and a cryogenic freezer operates from about -140C° to -196C°. Whenever the term "freezer" is used in the following it is to be understood that reference is made to an apparatus capable of operating as a cryogenic freezer.

[0004] Hospitals, laboratories, and research institutes all over the world experience an ever increasing need to be able to cryo-preserve, store and handle different types of organic material, and many hospitals have storage systems for frozen and cryo-preserved material spread around in many different departments. Such use of a number of relatively small storage systems is not very efficient, neither when it comes to the space occupied by the many systems, nor when regarding the energy consumed to keep the stored material at sufficiently low temperatures.

[0005] Many storage systems are arranged as ordinary laboratory freezers, where containers are stored in front of and on top of each other in order to maximize the use of the available space within the apparatus. Here, the apparatus door often has to be kept open for an extended

period of time while the desired sample container is found and the interior temperature of the apparatus increases temporarily. Not only is it energy consuming to bring back the interior temperature to a desired level, the samples of material stored near the door may also degrade due to repeated warming and refreezing.

[0006] An example of a cryogenic freezer, where the use of liquid nitrogen and the warming of stored material, have been minimized, is known from WO2008/083685. In this apparatus, a series of boxes for housing stored material is arranged in a paternoster system, and the insulating shell is provided with double doors, which open to only one or a few boxes at a time. When having to deposit or remove material from the freezer the paternoster is simple turned until the relevant box is opposite the doors and the doors are then opened only for as long as it takes to handle the relevant portions of material. This works very well in terms of achieving good insulating properties when the doors are closed, but there is still a considerable thermal loss when the doors are opened and the system can only be operated by a human operator.

[0007] Other prior art includes US 2 474 069 related to equipment for freezing food products, GB 2 412 717 related to a process for handling meat patties including an escapement, US 2002/023444 related to storage and retrieval of frozen biological samples and US2010/199703 related to an apparatus for thermal gas treatment.

[0008] It is therefore the object of the present invention to provide an apparatus, where the temperature inside can be kept even more constant and which can be operated by automated storage and retrieval systems.

[0009] The present invention is disclosed in the independent claim 1. Further embodiments are disclosed in the dependent claims. The object of the present invention is achieved with an apparatus, where the primary door and the secondary door are coupled such that the when the primary door is opened and closed, the secondary door is also opened and closed in a substantially synchronous manner. The synchronous movement of the doors minimizes the time, where an opening is present in the insulating shell, since the primary door does no longer has to be left open, while the secondary door is being opened or closed. In addition, the coupling of the doors allows them to be operated by an automated system or robot, which, on average, works faster and more focused than a human operator. Still another advantage is that the risk of forgetting to close one of the doors is minimized since one will always follow the other. All of these factors contribute to a reduced thermal loss and hence to the temperature inside the apparatus being less affected. This not only means that the material inside deteriorates more slowly; it also means a reduction of the energy needed for running the apparatus.

[0010] It is noted that the term "synchronous" is intended to mean a substantially simultaneous movement of the two doors. An embodiment showing an identical but

mirror-inverted patterns of movement will be given below. Moreover, the movement of one door may be slightly delayed in relation to the other, for example to prevent the doors from colliding, as long as the main part of their opening and closing intervals overlap.

[0011] In a preferred embodiment, the insulated shell comprises an outer wall and an inner wall, where the primary door is arranged in the outer wall and the secondary door is arranged in the inner wall, and where each door has insulating properties corresponding substantially to those of the wall in which it is arranged. Doors arranged in door modules are preferably embodied in the same way, the doors being arranged in walls of the door module corresponding to the inner and outer walls of the insulated shell. In this way the insulating properties of the insulated shell is substantially continuous in the closed state of the doors, which minimizes the risk of the formation of thermal bridges and other undesired thermal gradients.

[0012] As the inner and outer walls may advantageously be of similar design, this may result in the primary and secondary doors also being very similar with regards to insulating properties, and as the doors are designed to work synchronously, it may also be advantageous to make them with substantially the same dimensions. The result may therefore be doors that are substantially identical and even though an aesthetically pleasing design and wear-proof surface layer is normally only needed on the outer side of the primary door, it is imaginable to use the same design for the secondary door. This will reduce production costs and the number of parts to be kept on stock.

[0013] In a preferred embodiment, both doors are swing doors, where at least one of the doors is preferably top-hung to pivot about a substantially horizontal axis during opening and closing. This allows easy opening by external force, either manual, automated or robotic, particularly when the primary door opens inwards, since access to the interior of the freezer can then be gained by simply pushing on the primary door. Bottom-hung or side-hung doors may, however, also be employed.

[0014] The secondary door preferably opens outwards, i.e. away from the interior of the apparatus and into the lumen of the insulating shell or door module. This means that it does not take valuable room inside the freezer compartment and that the risk of the mechanism blocking due to the low temperature is minimised.

[0015] As in WO2008/083685, cassettes may be used for housing portions of material, in order to enable the users of the system to organize and arrange different stored portions of material that are related to each other in an orderly manner. Also, the use of cassettes enables storage of portions of different sizes and dimensions and the requirement for packaging of the individual portions can be loosened.

[0016] If using such cassettes, the size and shape of the doors of the apparatus should preferably be adapted to fit the size and shape of the cassettes, the primary and

secondary doors having substantially the same width as the width of one or a multiple of cassettes. A certain over-size will, however, be required to allow handling of the cassettes, manual handling usually requiring a larger over-size than automated or robotic handling. Over-sizes of between 2 mm and 80 mm, preferably between 5 mm and 50 mm and still more preferred about 25 mm for manual handling may be employed.

[0017] According to the present invention the primary and secondary doors are interconnected by a mechanical system, which transmits a force applied on the primary door to the secondary door in the form of a push or pull thereon. Such a system, an embodiment of which will be described below, is relatively insensitive to the low temperatures encountered in the apparatus according to the invention and may be easily maintained and repaired when needed.

[0018] Preferably a series of primary doors and a series of secondary doors extend in two respective parallel rows across the width of the apparatus to give easy access to all areas of the interior of the apparatus. It is of course also possible to provide a system for lateral movement of portions of material and/or cassettes inside the apparatus, possibly even in a space between the primary and secondary doors. At present such a system is, however, less preferred as the running of complex moving systems at cryogenic temperatures is a difficult task.

[0019] When having two or more doors arranged in series, it is of course possible to provide for the possibility of opening two or more neighbouring doors at the same time so that they form one larger opening, and/or to provide doors of different sizes.

[0020] It is noted that the term "door" is also intended to include doors comprising two or more parts that open together as is known for example from elevator doors.

[0021] As in WO2008/083685 the apparatus may include boxes arranged in a paternoster system to receive and house the portions or cassettes during storage, but, as mentioned above, this system should be relatively simple to avoid down-time.

[0022] As the apparatus according to the invention will often be made in relatively large sizes it may advantageously be constructed and manufactured in two or more modules adapted to be combined with each other to form the complete apparatus on the use-site. If possible, each of these modules should be made with dimensions small enough for it to pass through standard door openings or fit into a standard truck or cargo-container.

[0023] As will be understood from the above, the present invention is concerned with the improvement of the doors of the apparatus, whereas the rest of the apparatus may in principle be embodied as described in WO2008/083685. Accordingly, a new door module may be used for transforming a prior art apparatus into one according to the invention. Such a door module is therefore also considered as part of the invention.

[0024] Any suitable material, such as a plastic material may be used for the wall(s) of the insulated shell. It is,

however, preferred that they comprise at least one layer of vacuum panels enclosed by at least one layer of fibrous material, such as fibreglass. A space between the walls may advantageously contain insulating foam, such as polyurethane or polystyrene foam, and/or the air pressure in a space between the walls can be kept higher than the air pressure outside said insulated shell to avoid thermal loss by the ingress of warmer air from outside. For similar reasons, the air pressure in the interior of the apparatus, i.e. on the inside of the inner wall, is preferably higher than the air pressure outside said insulated shell. An even better prevention of an air exchange is, however, achieved by providing at least one gas inlet for establishing a gas flow between the primary door and the secondary door in a direction substantially in parallel to the doors when in a closed state. Such a gas flow, which may be led in the right direction by providing an outlet with active suction, functions as an air curtain between the doors and the gas should preferably be cold and dry.

[0025] Examples of organic material that may be stored in the apparatus according to the invention could be tissue samples, such as biopsies or scraps of skin stored for later analysis, or half-litre portions of human blood stored for use in connection with a surgical operation or the like. The apparatus may, however, be used for freezing and storage of any portions of blood or tissue of human or animal origin as well as any other material, which is to be cryo-preserved.

[0026] In the following an example and preferred embodiments of the invention will be described with reference to the drawing, where

Fig. 1 is a perspective view of an example of an apparatus for freezing and storage of organic material, Fig. 2 is a perspective view of a door module according to the present invention

Fig. 3 is a cross-sectional view of another door module according to the present invention with doors in a closed and in a semi-open position, and

Fig. 4 corresponds to Fig. 3 but with the doors in a closed and in a fully open position.

[0027] An example of an apparatus 1 for freezing and storage of portions of organic material is shown in Fig. 1. It comprises an insulated shell 2 in which a primary door 3 is positioned for providing access to the interior of the apparatus 1.

[0028] The apparatus may contain a plurality of boxes connected together to form an endless chain or pater-noster and being part of an internal conveyor system, just as in the apparatus known from WO2008/083685. The conveyor system is preferably driven by an external motor (not shown) via a drive axle entering the apparatus through the insulated shell 2. In this way any heat generated by the motor will not have to be compensated for within the apparatus, but some thermal loss is unavoidable since the axle lead-in will necessitate an interruption of the insulated shell and the axle itself potentially forms

a thermal bridge.

[0029] A cooling tank (not shown) containing a cooling agent, preferably liquid nitrogen, is preferably placed in the centre of the apparatus 1 to keep it cool and save energy. The tank is preferably enclosed by the endless chain formed by the conveyor system, so that it does not take up space that could otherwise have been used for storage of portions of organic material.

[0030] The apparatus is meant to be installed in laboratories, hospitals etc., preferably with a minimum of special installations. It is therefore preferably made to work with standard line voltage and frequency, typically 220 V and 50 Hz in Europe, and made primarily from lightweight materials in order to minimize the load on the supporting structure of the building. Moreover, all interior parts of the apparatus 1 should preferably be made from materials that are stable at cryogenic temperatures at least down to about -170°C°. This is for example achieved by using self-lubricating materials for moving parts, which also reduces the need for cleaning and maintenance.

[0031] The insulated shell preferably comprises an inner wall and an outer wall with a shell space between them (not shown), insulating foam, preferably polyurethane, preferably being provided in the shell space. The walls may each comprise one or more layers of fibreglass and one or more layers of vacuum panels and both walls may be divided in an upper part and a bottom part (not shown), which are bolted together. In this way each wall may be formed from two bowl-shaped shells and if the apparatus needs to be disassembled, for example for maintenance purposes, the two upper shells may be simply lifted off.

[0032] As may be seen, the apparatus 1 shown in Fig. 1 is assembled from two modules, namely a door module 4 and a freezer compartment module 5, but it is to be understood that a division into smaller modules is also possible. This, however, requires extra care during assembly to make sure that thermal bridges are not formed at the joints between modules. The division into modules not only allows easy transportation and assembly; it also provides for the opportunity of replacing only a single module for maintenance or repair while leaving the rest in place.

[0033] An embodiment of a door module 40 is shown in Fig. 2. As may be seen, this module comprises a series of eight primary doors 41 and a corresponding number of secondary doors 42 are found on the other side of the module, only a few of these being visible from the inner side in Fig. 2. As for the insulated shell, the door module too comprises an outer wall 401 and an inner wall 402 with a space 403 between them, and even though shown empty in Fig. 2, this space too may be filled with an insulating material such as polyurethane foam, expanded polystyrene or mineral wool.

[0034] Each primary door is connected to a secondary door via a linkage mechanism 43 as will be explained in detail later, so that they open and close in a substantially synchronous manner but the primary doors are inde-

pendent of each other. If making the door module without posts between the individual door openings, it is, however, possible that two or more primary doors may be opened at the same time, thus forming one larger door opening.

[0035] Horizontal plates 44, 45 are provided just below and above the door openings spanning the width and length of the door module, so that a compartment is formed between the primary and secondary doors. This provides stiffness and stability to the door module and allows the air flow at the doors to be controlled as will be explained below. In addition, the lowermost plate 44 may serve as a support surface for objects being inserted into the apparatus and/or prevent them from being dropped into the space below. The plates may be in the form of grids or like materials/structures with openings.

[0036] At the top and bottom the width W_1 of the door module corresponds substantially to the thickness of the insulated shell and at the centre section the width W_2 is approximately doubled. This increased width has two purposes.

[0037] Firstly, as may be seen from Figs. 3 and 4, which show a slightly different embodiment than Fig. 2, it allows the primary 141 and secondary 142 doors to be swung upwards and into the module 140 without colliding, and, secondly, it contributes to minimizing the thermal loss occurring during opening and closing of the doors.

[0038] Turning first to Fig. 3 the doors are shown with one set 141, 142 in a semi-open position and another 141', 142' in a closed position, whereas further sets potentially being hidden behind these. As may be seen, the linkage mechanism 143 interconnecting the two doors 141, 142 comprises two elongate brackets 431, 432 each having a longitudinal slit. A bolt 433 penetrating through both slits interconnects the two brackets, but allows them to move in relation to each other. When the primary door 141 is opened, the arm 434 swings as indicated by the double arrow P and the elongate bracket 431 is forced inwards and upwards. This causes the elongate bracket 432 on the secondary door 142 to also be forced upwards and since this too is provided with an arm 435, which swings as indicated by the double arrow S, the secondary door is caused to open.

[0039] In Fig. 4 the doors 141, 142 are shown in the fully open position and it may be seen that the height of the doors is such that they meet at the middle in the fully open position. This need not be the case, but has the advantage that the door module and hence the distance which has to be covered to insert an object into the apparatus is kept at a minimum. It would of course also be possible to let the two doors overlap in the open position, but that would necessitate a different opening mechanism. More complex mechanisms, including hydraulic or pneumatic solutions, for opening and closing the doors are of course imaginable, but the more complex the bigger the risk of failure, e.g. because of the mechanism freezing.

[0040] The primary and secondary doors are prefera-

bly made with substantially the same insulating properties as the outer and inner walls of the door module, respectively, possibly even from the same material, and in the embodiment of Figs. 3 and 4 they are entirely identical.

[0041] In the embodiment shown in Figs. 3 and 4 the doors are arranged as part of an opening module 146, which is connected to the rest of the door module 140 by means of bolts 147. As may be seen, the top 145 of the opening module is here slightly inclined in order to make it easier to insert it into the door module. This not only eases the initial assembly, but also facilitates a replacement in case of malfunction.

[0042] The apparatus comprising the door module in Figs. 3 and 4 further comprises a gas inlet pipe 149 and a gas outlet pipe 150 for supplying gas, preferably air, to the system and extracting it as indicated by the arrows A in Fig. 3. It is to be understood that the pipes are T-shaped with a horizontal part 491, 501 running along the length of the door module and the openings 492, 502 being either a longitudinal slit or a series of openings in the length direction. Blowers or suction means (not shown) may be used for forcing the gas through the system.

[0043] This gas or air flow A creates what may be described as an air curtain in the apparatus comprising the door module, which to a large degree prevents an air flow in the horizontal direction and hence an exchange of air between the interior of the apparatus and the exterior. In other words, the curtain keeps the cold air inside and the warm ambient air outside. The air curtain is most important when the doors are open, but a permanent flow of cold air may compensate for the lack of insulating material between the doors.

[0044] When the doors are open as shown in Fig. 4 they will of course obstruct the air flow, but as neighbouring doors will usually be in the closed non-obstructing state, this will simply result in the air flow bypassing the open doors on the sides thereof.

[0045] Any type of air or gas may in principle be used for this purpose, but it should preferably be cold and dry, and air conditioning equipment (not shown) may be provided for this purpose. It may also be advantageous to utilise the cooling capacity of the nitrogen on its way out of the system.

[0046] It is also preferred to keep the air pressures in the shell space 403 and in the interior of the apparatus 1 higher than the pressure outside the shell 2. This assures that the gaseous nitrogen 42 flows in the right direction and significantly reduces the amount of air at ambient temperature that enters the inner space 41 of the apparatus 1. Preferably, the pressure in the interior of the apparatus is higher than in the shell space.

[0047] The apparatus may be connected to a computer used for registration of portions of material to be stored within the apparatus and automating storage, search of and/or access to individual portions of material stored within the apparatus. For this purpose the individual portions and/or cassettes may be provided with barcodes,

RFID tags or the like and corresponding scanners may be arranged at or integrated in the apparatus or at a door module according to the invention.

[0048] The same or a separate computer may also be used for controlling the operation of the apparatus, such as the movement of the internal conveyor system and the regulation of temperature.

Claims

1. A door module (40, 140) for use in an apparatus (1) for freezing and storage of organic material, said apparatus (1) comprising an internal conveyor system for transporting stored portions of material inside the apparatus (1), an insulated shell (2), a primary door (41) in the shell (2) facing the exterior of the apparatus (1) and a secondary door (42) in the shell (2) facing the interior of the apparatus (1), where the secondary door (42) opens to a limited number of the stored portions, and where the apparatus (1) is an ultra low temperature freezer or a freezer arranged for operating below -80 degrees C, wherein the primary door (41) and the secondary door (42) are arranged so that portions of material can be deposited into or removed from the apparatus (1) only when the primary door (41) and the secondary door (42) are open at the same time, said door module (40) comprising the primary door (41) and the secondary door (42), **characterized in that** the primary door (41) and the secondary door (42) are coupled such that when the primary door (41) is opened and closed, the secondary door (42) is also opened and closed in a substantially synchronous manner, contributing to a reduced thermal loss and hence to the temperature inside the apparatus (1) being less affected, and further comprising means for interconnection to the insulated shell (2) of the apparatus (1), wherein the primary (41) and secondary (42) doors are interconnected by a mechanical system (43, 143), which transmits a force applied to the primary door (41) to the secondary door (42) in the form of a push or pull thereon.
2. An apparatus (1) for freezing and storage of organic material comprising a door module (40, 140) according to claim 1, where the insulated shell (2) comprises an outer wall (401) and an inner wall (402), where the primary door (41) is arranged in the outer wall (401) and the secondary door (42) is arranged in the inner wall (402), and where each door (41, 42) has insulating properties corresponding substantially to those of the wall in which it is arranged.
3. An apparatus (1) for freezing and storage of organic material according to claim 2, where the primary (41) and the secondary doors (42) are substantially identical.

4. An apparatus (1) for freezing and storage of organic material according to any of the preceding claims, where both doors (41, 42) are swing doors, at least one of the doors (41, 42) preferably being top-hung to pivot about a substantially horizontal axis during opening and closing.
5. An apparatus (1) for freezing and storage of organic material according to any of the preceding claims, where the primary door (41) opens inwards.
6. An apparatus (1) for freezing and storage of organic material according to any of the preceding claims, where a series of primary doors (41) and a series of secondary doors (42) extend in two respective parallel rows across the width of the apparatus (1).
7. An apparatus (1) for freezing and storage of organic material according to any of the preceding claims, where at least one gas inlet (149) is provided for establishing a gas flow between the primary door (41) and the secondary door (42) in a direction substantially in parallel to the doors (41, 42) when in a closed state.
8. Apparatus (1) for freezing and storage of organic material according to any of the preceding claims, said apparatus (1) being constructed and manufactured in two or more modules adapted to be combined with each other to form the complete apparatus (1) on the use-site, each module preferably having dimensions small enough for it to pass through standard door openings.

Patentansprüche

1. Türmodul (40, 140) zur Verwendung in einer Vorrichtung (1) zum Einfrieren und Lagern von organischem Material, wobei die Vorrichtung (1) ein internes Fördersystem zum Transportieren von gelagerten Materialportionen innerhalb der Vorrichtung (1), eine isolierte Schale (2), eine primäre Tür (41) in der Schale (2), die der Außenseite der Vorrichtung (1) zugewandt ist, und eine sekundäre Tür (42) in der Schale (2), die dem Innern der Vorrichtung (1) zugewandt ist, umfasst, wobei sich die sekundäre Tür (42) zu einer begrenzten Anzahl der gelagerten Portionen öffnet und wobei die Vorrichtung (1) ein Ultratiefgefriergerät oder ein Gefriergerät ist, das für den Betrieb unterhalb von -80 Grad C angeordnet ist, wobei die primäre Tür (41) und die sekundäre Tür (42) so angeordnet sind, dass Materialportionen nur dann in die Vorrichtung (1) eingebracht oder aus dieser entnommen werden können, wenn die primäre Tür (41) und die sekundäre Tür (42) gleichzeitig geöffnet sind, wobei das Türmodul (40) die primäre Tür (41) und die sekundäre Tür (42) umfasst, **da-**

durch gekennzeichnet, dass die primäre Tür (41) und die sekundäre Tür (42) so gekoppelt sind, dass beim Öffnen und Schließen der primären Tür (41) auch die sekundäre Tür (42) im Wesentlichen synchron geöffnet und geschlossen wird, was zu einem geringeren Wärmeverlust und damit zu einer geringeren Beeinträchtigung der Temperatur im Innern der Vorrichtung (1) beiträgt, und ferner umfassend Mittel zur Verbindung mit der isolierten Schale (2) der Vorrichtung (1), wobei die primäre (41) und die sekundäre Tür (42) durch ein mechanisches System (43, 143) miteinander verbunden, das eine auf die primäre Tür (41) ausgeübte Kraft auf die sekundäre Tür (42) in Form eines Drucks oder Zugs auf diese überträgt.

2. Vorrichtung (1) zum Einfrieren und Lagern von organischem Material, umfassend ein Türmodul (40, 140) nach Anspruch 1, wobei die isolierte Schale (2) eine Außenwand (401) und eine Innenwand (402) umfasst, wobei die primäre Tür (41) in der Außenwand (401) angeordnet ist und die sekundäre Tür (42) in der Innenwand (402) angeordnet ist und wobei jede Tür (41, 42) Isoliereigenschaften hat, die im Wesentlichen denen der Wand, in der sie angeordnet ist, entsprechen.
3. Vorrichtung (1) zum Einfrieren und Lagern von organischem Material nach Anspruch 2, wobei die primäre (41) und die sekundäre Tür (42) im Wesentlichen identisch sind.
4. Vorrichtung (1) zum Einfrieren und Lagern von organischem Material nach einem der vorhergehenden Ansprüche, wobei beide Türen (41, 42) Schwenktüren sind, wobei mindestens eine der Türen (41, 42) vorzugsweise oben aufgehängt ist und sich beim Öffnen und Schließen um eine im Wesentlichen horizontale Achse dreht.
5. Vorrichtung (1) zum Einfrieren und Lagern von organischem Material nach einem der vorhergehenden Ansprüche, wobei sich die primäre Tür (41) nach innen öffnet.
6. Vorrichtung (1) zum Einfrieren und Lagern von organischem Material nach einem der vorhergehenden Ansprüche, wobei sich eine Anzahl von primären Türen (41) und eine Anzahl von sekundären Türen (42) in zwei jeweiligen parallelen Reihen über die Breite der Vorrichtung (1) erstrecken.
7. Vorrichtung (1) zum Einfrieren und Lagern von organischem Material nach einem der vorhergehenden Ansprüche, wobei mindestens ein Gaseinlass (149) vorgesehen ist, um einen Gasfluss zwischen der primären Tür (41) und der sekundären Tür (42) in einer Richtung herzustellen, die im Wesentlichen

parallel zu den Türen (41, 42) verläuft, wenn diese geschlossen sind.

8. Vorrichtung (1) zum Einfrieren und Lagern von organischem Material nach einem der vorhergehenden Ansprüche, wobei die Vorrichtung (1) in zwei oder mehr Modulen konstruiert und hergestellt wird, die dazu ausgeführt sind, miteinander kombiniert zu werden, um die vollständige Vorrichtung (1) am Einsatzort zu bilden, wobei jedes Modul vorzugsweise so klein ist, dass es durch Standardtüröffnungen passt.

15 Revendications

1. Module de porte (40, 140) pour une utilisation dans un appareil (1) pour la congélation et le stockage de matière organique, ledit appareil (1) comprenant un système de transport intérieur pour transporter des portions stockées de matière à l'intérieur de l'appareil (1), une enveloppe isotherme (2), une porte principale (41) dans l'enveloppe (2) orientée vers l'extérieur de l'appareil (1) et une porte secondaire (42) dans l'enveloppe (2) orientée vers l'intérieur de l'appareil (1), la porte secondaire (42) donnant accès à un nombre limité de portions stockées, et l'appareil (1) étant un congélateur ultra-basse température ou un congélateur conçu pour fonctionner à une température inférieure à -80 °C, la porte principale (41) et la porte secondaire (42) étant conçues de telle sorte que des portions de matière puissent être déposées dans l'appareil (1) ou sorties de celui-ci uniquement lorsque la porte principale (41) et la porte secondaire (42) sont ouvertes en même temps, ledit module de porte (40) comprenant la porte principale (41) et la porte secondaire (42), **caractérisé en ce que** la porte principale (41) et la porte secondaire (42) sont accouplées de telle sorte que, lorsque la porte principale (41) est ouverte et fermée, la porte secondaire (42) est également ouverte et fermée de manière sensiblement simultanée, ceci contribuant à réduire la perte thermique, de sorte que l'effet sur la température à l'intérieur de l'appareil (1) est moindre, et comprenant, en outre, des moyens de raccordement à l'enveloppe isotherme (2) de l'appareil (1), les portes principale (41) et secondaire (42) étant raccordées l'une à l'autre par un système mécanique (43, 143), qui transmet à la porte secondaire (42) une force appliquée à la porte principale (41) sous la forme d'une poussée ou d'une traction sur celle-ci.
2. Appareil (1) pour la congélation et le stockage de matière organique comprenant un module de porte (40, 140) selon la revendication 1, l'enveloppe isotherme (2) comprenant une paroi extérieure (401) et une paroi intérieure (402), la porte principale (41) étant placée dans la paroi extérieure (401) et la porte

secondaire (42) étant placée dans la paroi intérieure (402), et chaque porte (41, 42) ayant des propriétés d'isolation correspondant sensiblement à celles de la paroi dans laquelle elle est placée.

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3. Appareil (1) pour la congélation et le stockage de matière organique selon la revendication 2, les portes principale (41) et secondaire (42) étant sensiblement identiques.

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4. Appareil (1) pour la congélation et le stockage de matière organique selon l'une quelconque des revendications précédentes, les deux portes (41, 42) étant des portes battantes, au moins une des portes (41, 42) étant, de préférence, suspendue par le dessus pour pivoter autour d'un axe sensiblement horizontal lors de l'ouverture et de la fermeture.

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5. Appareil (1) pour la congélation et le stockage de matière organique selon l'une quelconque des revendications précédentes, la porte principale (41) s'ouvrant vers l'intérieur.

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6. Appareil (1) pour la congélation et le stockage de matière organique selon l'une quelconque des revendications précédentes, une série de portes principales (41) et une série de portes secondaires (42) s'étendant en deux rangées parallèles respectives sur la largeur de l'appareil (1).

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7. Appareil (1) pour la congélation et le stockage de matière organique selon l'une quelconque des revendications précédentes, comprenant au moins une entrée de gaz (149) pour établir un écoulement de gaz entre la porte principale (41) et la porte secondaire (42) dans une direction sensiblement parallèle aux portes (41, 42) lorsqu'elles se trouvent dans un état fermé.

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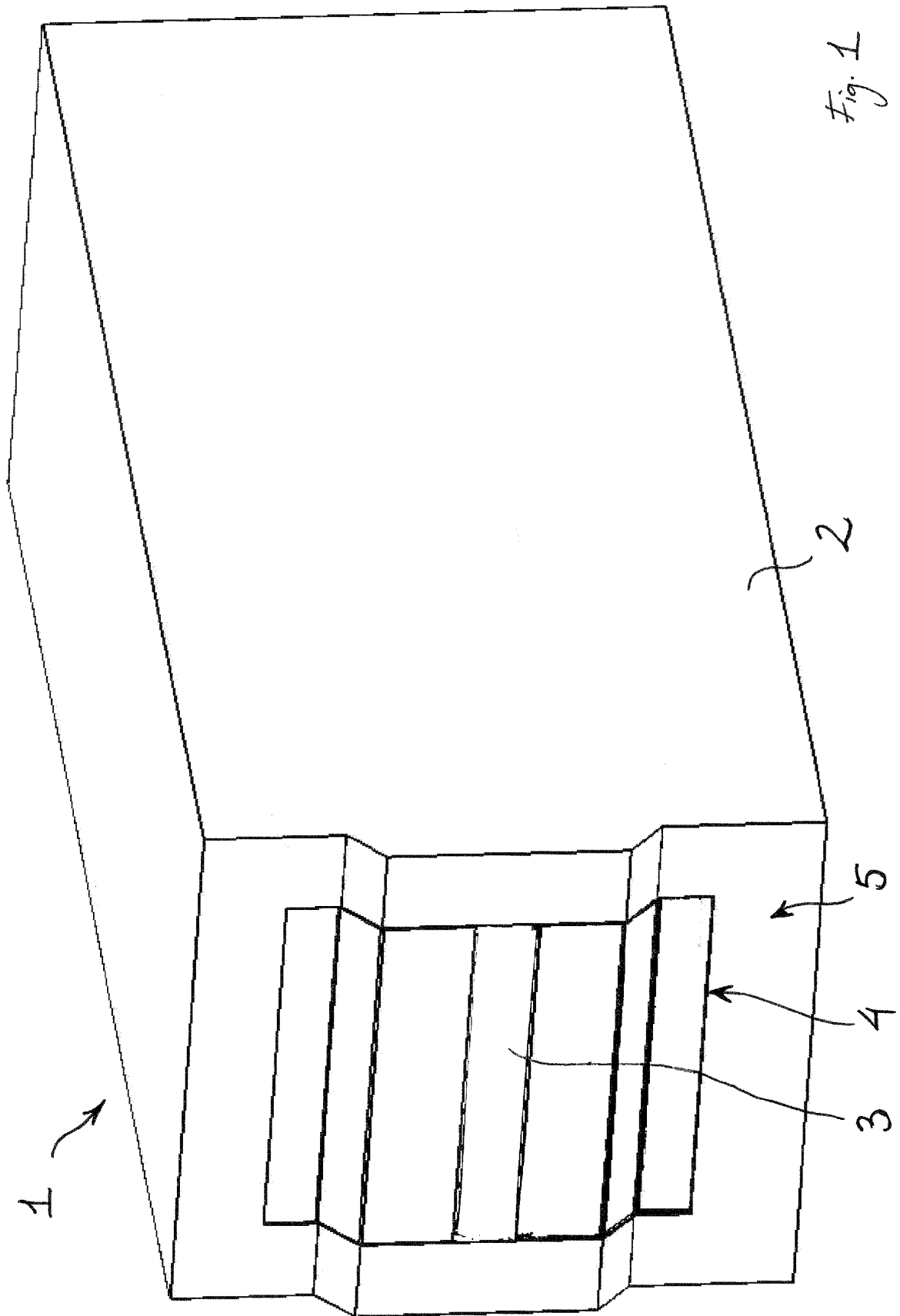
8. Appareil (1) pour la congélation et le stockage de matière organique selon l'une quelconque des revendications précédentes, ledit appareil (1) étant construit et fabriqué en deux modules ou plus propres à être combinés entre eux pour former l'appareil (1) complet sur le site d'utilisation, chaque module présentant, de préférence, des dimensions suffisamment faibles pour qu'il puisse passer par des ouvertures de porte standard.

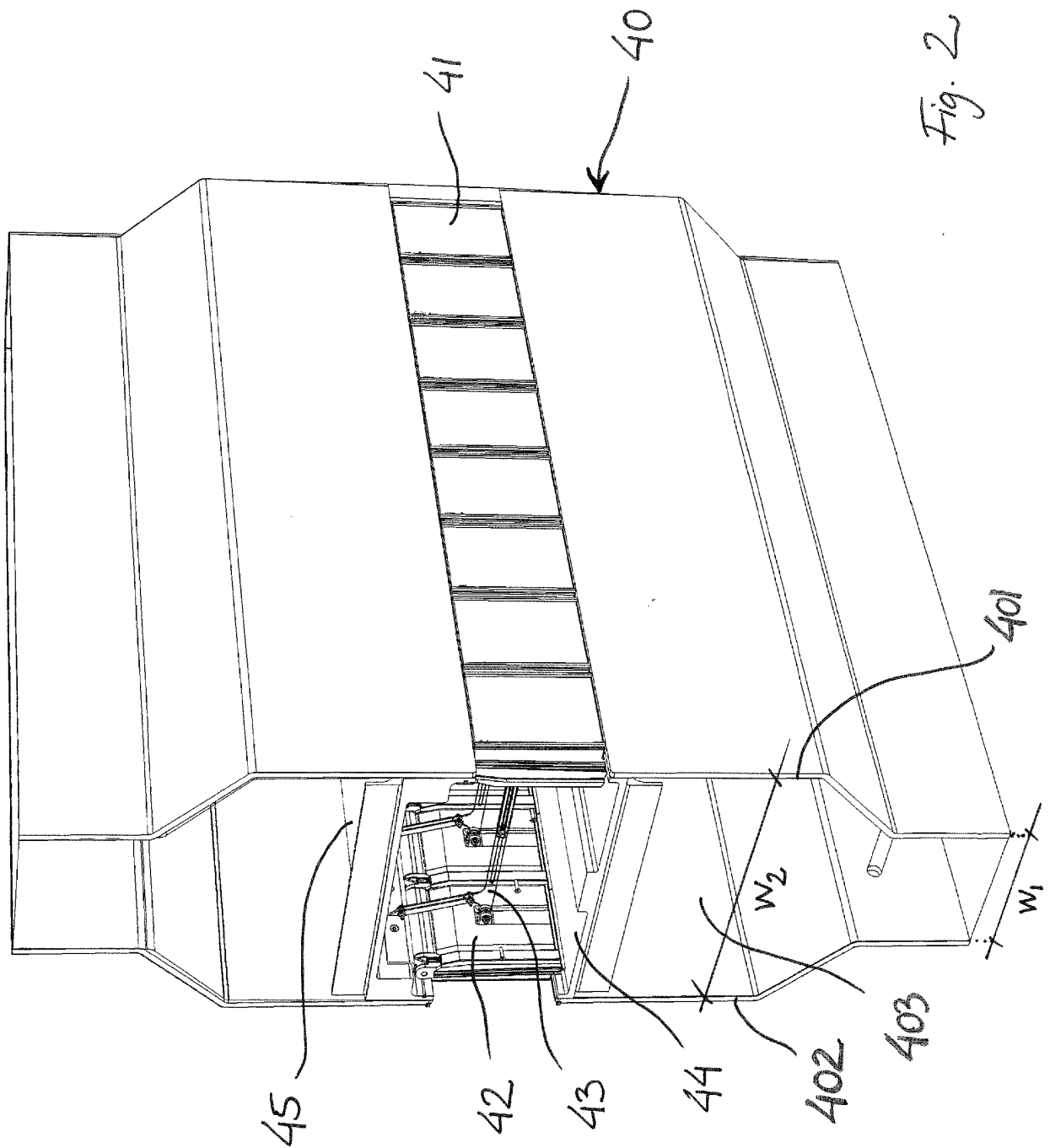
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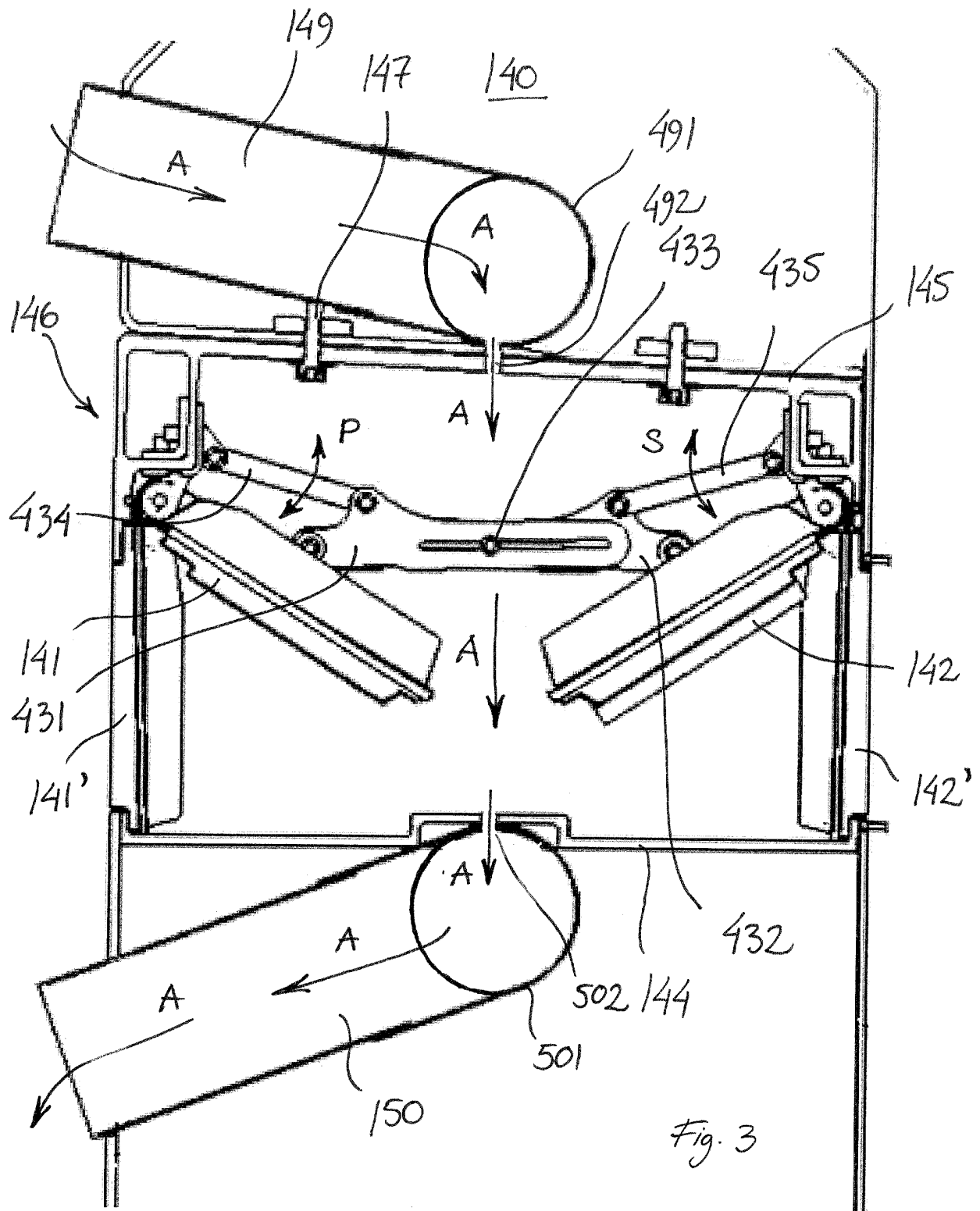
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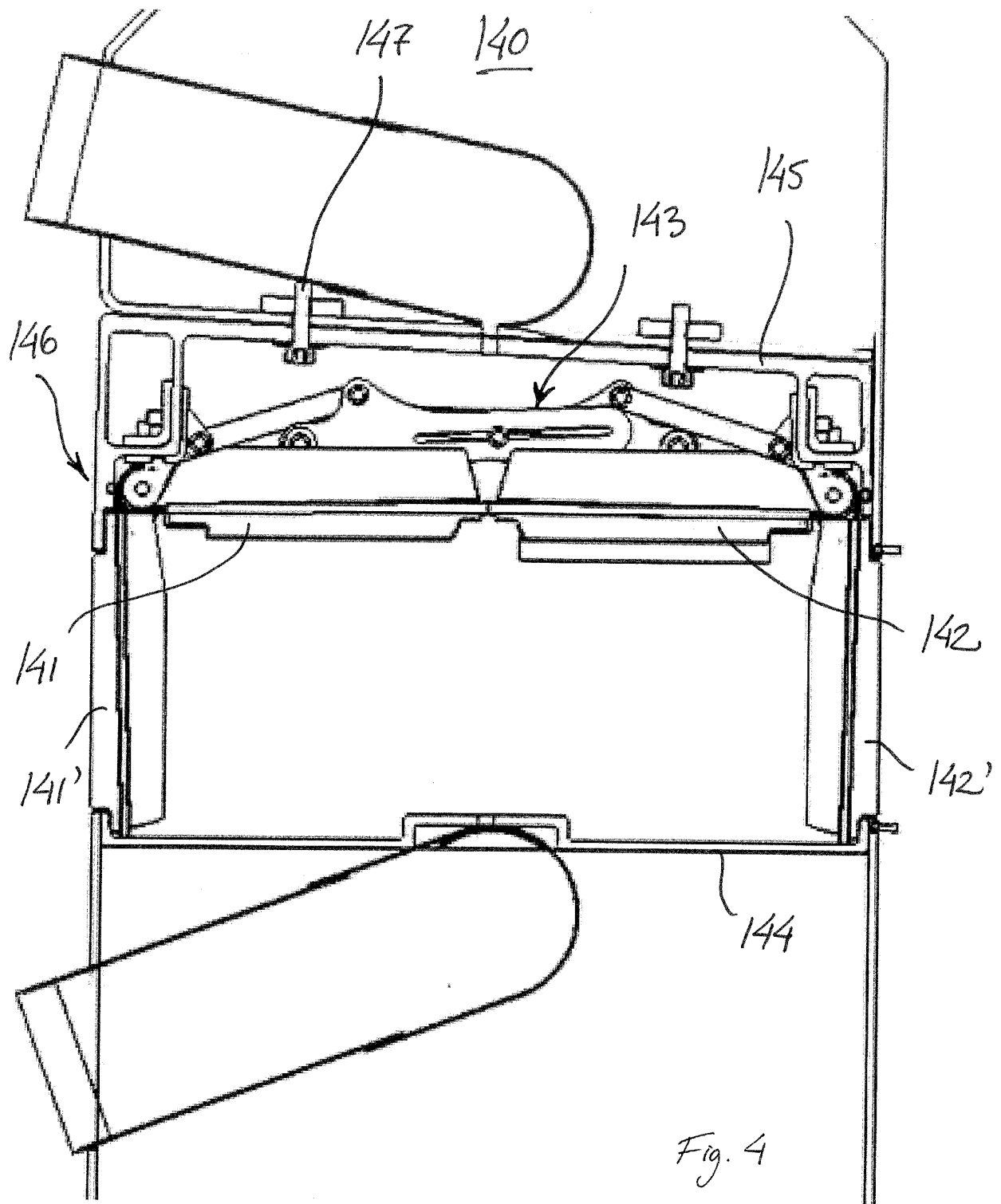
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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2008083685 A [0006] [0015] [0021] [0023] [0028]
- US 2474069 A [0007]
- GB 2412717 A [0007]
- US 2002023444 A [0007]
- US 2010199703 A [0007]