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(54) Title: PRODUCT SHIPPING

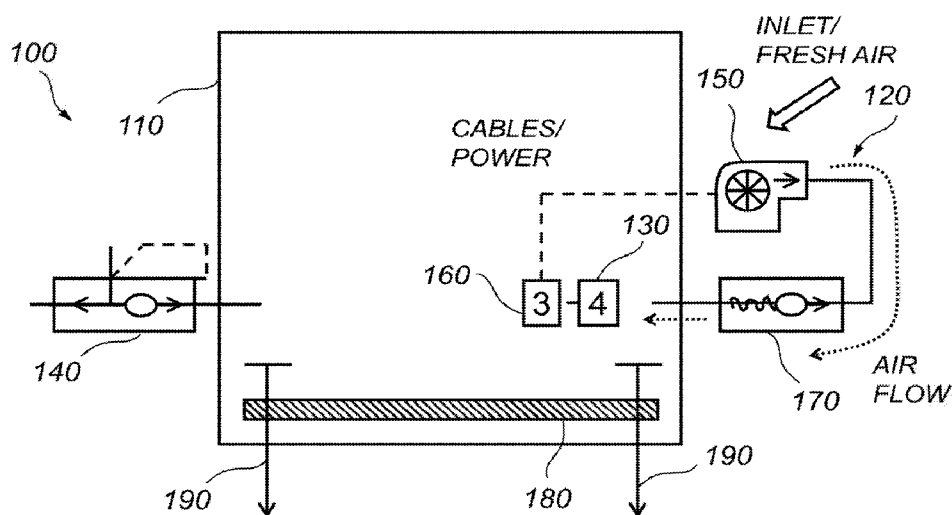


Figure 1

(57) Abstract: A product shipping apparatus is disclosed comprising an inflatable enclosure to receive an item and be pressurised, a support structure to secure an item within the enclosure, and a pressurisation system to regulate an internal pressure of the enclosure to a predetermined pressure value after the enclosure has been sealed. A product shipping method and computer program product are also disclosed.

TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to the identity of the inventor (Rule 4.17(i))*

Published:

— *with international search report (Art. 21(3))*

PRODUCT SHIPPING

BACKGROUND

[0001] Packaging can be used to protect products during storage, transport and shipping. Types of packaging can include the common cardboard box, polystyrene foam and inflatable packaging. For example, a rendering apparatus, such as a 2D or 3D printer for example, can be protected for shipping using end caps that are formed of expanded polystyrene (EPS) foam and which are fitted onto the printer. The end caps and printer can then be placed inside an electro-static discharge (ESD) protective bag before being placed inside a cardboard box. The cardboard box can also be wrapped in an external plastic film. The printer can then be shipped on top of a wooden pallet in protective packaging. To improve the level of protection offered to the printer during shipping bigger end caps or more robust cardboard boxes can be used.

BRIEF DESCRIPTION OF THE DRAWINGS

[0002] Various features of certain examples will be apparent from the detailed description which follows, taken in conjunction with the accompanying drawings, which together illustrate, by way of example only, a number of features, and wherein:

[0003] Figure 1 shows a schematic of an end view of a product shipping apparatus according to an example;

[0004] Figure 2A shows a schematic of an enclosure before sealing according to an example;

[0005] Figure 2B shows a schematic of a sealing arrangement for an enclosure according to an example;

[0006] Figure 3 shows a schematic of an angled view of a product shipping apparatus before sealing according to an example;

[0007] Figure 4A shows a schematic of an end view of a sealed enclosure secured to an external anchor according to an example;

[0008] Figure 4B shows a schematic of a sealed enclosure having a product therein and an external anchor according to an example;

[0009] Figure 5 shows a schematic of a product shipping apparatus having a product therein and an external anchor according to an example;

[0010] Figure 6A shows a schematic differential pressure of a product shipping apparatus and product for shipping by air according to an example;

[0011] Figure 6B shows a schematic differential pressure of a product shipping apparatus and product for shipping by sea according to an example;

[0012] Figure 7 shows a product shipping method according to an example; and

[0013] Figure 8 shows a schematic of a processor associated with a memory and machine-readable instructions to be executed by the processor according to an example.

DETAILED DESCRIPTION

[0014] In the following description, for purposes of explanation, numerous specific details of certain examples are set forth. Reference in the specification to "an example" or similar language means that a particular feature, structure, or characteristic described in connection with the example is included in at least that one example, but not necessarily in other examples.

[0015] Inflatable packaging can come in the form of air bladders and air cushions that fit snugly around a product. Air cushions can be used instead of polystyrene peanuts when a product is placed inside a box and the air cushions can be used to fill the surrounding space around the product inside the box. During shipping the product is protected by the air cushions which absorb impact forces. Some types of packaging when inflated can fold around a product to envelope the product when it is initially packaged.

[0016] According to an example, there is provided an apparatus for protecting a product from impact during storage or shipping. The apparatus can be an inflatable packaging into which the product is placed.

[0017] In an example, a product shipping apparatus comprises an inflatable enclosure and a pressurisation system. The inflatable enclosure can be formed from a textile or plastic bag which may have electrostatic discharge protective properties and/or act as a humidity barrier. The enclosure is able to withstand pressurisation up to at least a desired pressure value before becoming unstable. The enclosure comprises a support structure for securing the product to the enclosure. The support structure can be a wooden or metal frame forming part of the enclosure. The support structure can be located at the base of the enclosure or elsewhere on the enclosure such as at the side of the enclosure. A product to be shipped can be placed inside the enclosure and secured to the support structure. The support structure can allow the enclosure to be secured to an external anchor to support the product inside the enclosure during shipping. The external anchor may be a wooden pallet. In an example, the enclosure and product are assembled on top of a wooden pallet for shipping the product. The product shipping apparatus can include a pressurisation system for regulating an internal pressure of the inflatable enclosure during shipping of the product. The internal pressure of the enclosure can be monitored or regulated using a pressure sensor, a relief valve and a fan or blower connected to a power supply. It is also possible to monitor temperature, pressure and humidity during shipping and along the transport route. During this monitoring during shipping an alarm may be activated in the event that the inner product (e.g. printer) is at risk of suffering conditions that could compromise the integrity or quality of the product, for example conditions that could damage or reduce its functionality or performance.

[0018] According to an example, the product shipping apparatus provides an inflatable packaging for shipping products, such as printers, in a protective environment. The inflatable packaging offers protection from external impact to a product contained therein. The packaging can be suitable for holding and shipping products, for example printers from 24 inches up to 64 inches wide, by way of a pressurised textile or plastic bag that can be assembled on top of a wooden pallet. The air space inside the packaging surrounding the product is pressurised to maintain a predetermined pressure value inside the enclosure. This effectively provides an air cushion to prevent damage to the product during

shipping or accidental drops and knocks to the packaging. The product shipping apparatus may be re-usable and recyclable.

[0019] In an example, the enclosure or textile bag has a frame at its base through which a securing arrangement is provided for securing the enclosure to the external anchor. In an example, the product shipping apparatus is anchored to the wooden pallet to provide support for the product. The securing arrangement may be a set of bolts (e.g. lag bolts) that pass through both the frame of the enclosure and the wooden pallet.

[0020] Figure 1 shows a product shipping apparatus 100 according to an example. The apparatus comprises an enclosure 110 and a pressurisation system 120. The pressurisation system comprises a pressure sensor 130, a relief valve 140 and a fan 150 connected to a power supply 160. A non-return valve 170 may also be provided having an air conduit in fluidic communication with the interior of the enclosure. The pressure sensor may be positioned inside the enclosure or outside the enclosure with a conduit in fluidic communication with the interior of the enclosure. The relief valve and fan allow the internal pressure of the enclosure to be maintained at a predetermined pressure value. The relief valve has a conduit in fluidic communication with the interior of the enclosure and allows the release of air or gas from within the interior of the enclosure. The relief valve prevents over-inflation of the enclosure during initial inflation and allows a reduction in an internal pressure of the enclosure during storage or shipping. In an example, the fan is connected to a 12V power supply for drawing external air (Arrow) from outside the enclosure into the interior of the enclosure via the non-return valve, although the enclosure may be pressurised with an inert gas. The enclosure has a support structure or frame 180 at its base and a securing arrangement 190 passing therethrough.

[0021] Figure 2A shows an open enclosure 110 before sealing and without the pressurisation system. A sealing arrangement 220 is provided for airtight sealing of the enclosure. The sealing arrangement may take the form of a zip system 230 and/or a hook and loop system. The sealing arrangement allows the enclosure or textile bag to be closed. In an example, the hook and loop system is provided as tabs 240, 250 that allow a flap 260 to cover the zip

system once the zip teeth have been engaged. At least one tab 240 is provided on the outer surface of the enclosure to one side of the zip system and at least one tab 250 is provided on the flap to the opposite side of the zip system. Once the textile bag has been sealed the zip system can be folded or rolled, as shown in Figure 2B, and the hook and loop system tabs engaged 270 to secure the sealing arrangement and to avoid unfolding of the sealing arrangement. It will be appreciated that either one of the closures described above may be used in isolation instead.

[0022] Figure 3 shows the product shipping apparatus 100 comprising the enclosure 110 before sealing, the pressurisation system 120 and the sealing arrangement 220.

[0023] Figures 4A (end view) and 4B (angled view) show a sealed enclosure 400 secured to an external anchor 410 via the support structure 480 and securing arrangement 490. Figure 4B shows a sealed enclosure having a product 450 therein.

[0024] In an example, the product is a printer that is inserted into the enclosure such that the enclosure completely surrounds the product before the enclosure is sealed.

[0025] The enclosure may be a protective, external textile (e.g. nylon) bag with a plastics liner (e.g. Cordura). The textile bag can be pressurised once the product is placed inside the bag and anchored to the support frame and/or wooden pallet. The bag can be transparent to enhance the product or enable it to be inspected or the bag can be opaque to protect the printer against ultraviolet light which can degrade plastics. The bag can have a polyhedron shape and an upper opening with a zip-tight sealing mechanism, which can be a mechanical zip, slide zip or sliderless zipper for example.

[0026] Once the product has been inserted into the bag, the enclosure is then sealed by activating the sealing arrangement to produce an airtight enclosure with the product retained therein.

[0027] In an example, the support structure is a wooden frame with locking bolts that secure the enclosure to a wooden pallet. The product can be secured to

the support structure before the bag is sealed and pressurised. The product that is secured to the support structure may then be secured to the wooden pallet before or after the bag is sealed and pressurised. In some examples, the enclosure does not comprise a support structure in which cases the product is secured to the external anchor before the enclosure is pressurised.

[0028] According to an example, once the enclosure has been closed, the inner volume of the enclosure is pressurised to approximately 1 – 2.5 atm (atmospheric pressure), and more particularly 1.3 – 1.5 atm using the fan or blower to protect the product. Any suitable fan that is able to maintain the predetermined or desired pressure in the enclosure can be used, for example an auxiliary blower located at factory facilities that can inflate the enclosure faster than the fan to be installed with the product shipping apparatus. In an example, the enclosure can withstand greater pressurisations above 1.5 atm. The pressurised enclosure protects the product in this pressurised state from external hits or impacts as it is cushioned on all sides and from above and protected from the bottom by the enclosure and/or the support structure and/or the external anchor.

[0029] After the bag has been sealed and pressurised the internal pressure of the enclosure is monitored using the pressurisation system. This system avoids over-pressurisation and provides an automated system to keep the internal pressure of the enclosure on target. Deviation in the internal pressure can be corrected using the pressurisation system in order to regulate the internal pressure to a desired or pre-determined pressure value. The bag provides a flexible enclosure around the printer during shipping. As such the support structure and pressurisation system of the enclosure allow the product or printer inside the enclosure to be efficiently protected during shipping and/or storage.

[0030] The pressurisation system may comprise temperature sensors and/or other environment sensors that allow the system to adjust to temperature variations or other environmental changes during storage or shipping. Environmental sensors may include a temperature sensor or humidity sensor that monitor the temperature and humidity respectively. The temperature, pressure and humidity can be monitored during shipping along the transport route and the alarm activated should the desired conditions move outside a

predetermined threshold or range that may otherwise cause damage to the product being shipped or reduce its functionality or performance.

[0031] Figure 5 shows a product shipping apparatus 500 having a product 505 secured to an external anchor 580 according to an example. In order to avoid any risk of leakage or indeed explosion due to over inflation of the enclosure 510, the pressurisation system 520 ensures that a pre-determined pressure level inside the enclosure is maintained. The pressure relief valve 540 provides a conduit that allows escape of excess air from inside the enclosure and hence prevents over-pressurisation of the enclosure. That is, the valve 540 triggers once a predetermined pressure value is reached inside the enclosure in order to vent air (or gas) and this reduces the pressure in the enclosure until it reaches a value at which the valve 540 switches off. The valve 540 can be set or selected to enable a desired pressure release value to be achieved.

[0032] A printed circuit assembly 530 (e.g. PCA or printed circuit board, PCB) and a pressure sensor 531 monitor the internal pressure of the enclosure and regulates any differential pressure variations from the desired pressure value. In an example, the PCA is powered by a power supply 560 of 12 volts in which the power supply may be re-chargeable. A suitable power supply may be a rechargeable Lithium-Ion 12V power supply (6500mAh). The supply 560 and PCA 530 may be provided outside of the enclosure.

[0033] A fan 550 is used to increase the internal pressure value by forcing air from outside the enclosure, into and through a conduit, into the internal region of the enclosure. Any fan that can maintain the desired or predetermined internal pressure of the enclosure can be used. A suitable fan may be a 12V DC Blower (e.g. brushless) having an air flow at zero static pressure of around 0.632m³/min or 22.32CFM, a maximum air pressure at zero air flow of 49.54mmH₂O, input power of 12W and speed of 8200+/-10% RPM.

[0034] In an example, a non-return valve 570 is provided to prevent the escape of air from within the pressurised enclosure.

[0035] In some examples, the non-return valve may be replaced by a two-way valve to provide an arrangement in which a relief valve is no longer used, since

the two-way valve can also provide a conduit for the escape of excess air from within the enclosure.

[0036] In some examples, the PCA can be used to provide the product shipping apparatus with different functions that can offer a user more dynamic control. For example, different default settings may be provided by way of computer-readable instructions loaded onto a memory of a processor. This can provide, for example, a default setting for shipping via different methods (e.g. by air, land or sea) in different regions of the world.

[0037] In an example, a default setting installed onto the PCA may relate to shipping by sea, in which studies have provided nominal pressures and pressure variations that the product being shipped may experience. For example, it is expected that pressure variations between air and sea shipping methods have a maximum pressure variation around 1.16 atm. The enclosure therefore withstands a pressure variation or over-pressure of at least 1.16 atm. The product shipping apparatus can provide automatic pressure and environmental adjustments during shipping.

[0038] Figures 6A and 6B show a product shipping apparatus and product for shipping by air and sea respectively. For example, the product shipping apparatus when shipped by air (Figure 6A) can experience atmospheric pressures around 0.74 atm. The pressurisation system can regulate the internal pressure of the enclosure to a desired pressure level, for example at a pressure value around 1.3 atm. In another example, the product shipping apparatus when shipped by sea (Figure 6B) can experience atmospheric pressures around 1 atm and temperatures experience inside a metal hulled ship may reach 80 degrees Celsius. As such, the environmental sensors can be activated to control the temperature environment within the enclosure and immediately surrounding the product being shipped to a pre-determined or desired temperature value (e.g. 70 degrees Celsius).

[0039] The product shipping apparatus may be comprised of recyclable materials. The ability to provide packaging that is re-usable several times reduces company shipping costs and reduces the cost per printer to ship. For example, once the product is placed in its final location at the customer

facilities, the enclosure can be folded on top of the wooden pallet and returned together to a regional distribution centre or warehouse, where after consolidation with similar units they can be sent back to the supplier factory for re-use and start again the shipping process.

[0040] Figure 7 shows a product shipping method according to an example. At block 710 a product to be shipped or stored is placed inside the inflatable enclosure. At block 720 the product is secured within the enclosure to the support structure and/or the external anchor (e.g. wooden pallet). The product can be tightened to the support structure or external anchor. In an example, the textile bag enclosure can be anchored to the wooden pallet by means of the wooden frame and locked in position using lag bolts. At block 730 the enclosure having the product inside is sealed by activating the sealing arrangement and the enclosure is pressurised. In an example, the enclosure is pressurised with air to 1.3 – 1.5 atm. At block 740 the internal pressure of the enclosure is regulated to maintain a pre-determined or desired pressure value. The regulation of the internal pressure can be performed automatically during storage or shipping.

[0041] The product shipping apparatus disclosed reduces the number of shipped products that are DOA (Defective on Arrival) because accelerations/decelerations due to dropping or tilting of the main packaging are absorbed by the flexible, pressurised enclosure. The air cushion within the enclosure effectively acts as an air bag to protect the printer inside. The product shipping apparatus allows printer units to be shipped without end-caps and as mitigates common packaging issues such as adding bigger end-caps or more robust cardboard boxes. The costs associated with shipping materials are reduced since it reduces material usage and hence direct material costs.

[0042] Examples in the present disclosure can be provided as methods, systems or machine-readable instructions. Such machine-readable instructions may be included on a computer readable storage medium (including but not limited to disc storage, CD-ROM, optical storage, etc.) having computer readable program codes therein or thereon.

[0043] The present disclosure is described with reference to flow charts and/or block diagrams of the method, devices and systems according to examples of the present disclosure. Although the flow diagrams described above show a specific order of execution, the order of execution may differ from that which is depicted. Blocks described in relation to one flow chart may be combined with those of another flow chart. In some examples, some blocks of the flow diagrams may not be necessary and/or additional blocks may be added. It shall be understood that each flow and/or block in the flow charts and/or block diagrams, as well as combinations of the flows and/or diagrams in the flow charts and/or block diagrams can be realized by machine readable instructions.

[0044] The machine-readable instructions may, for example, be executed by a general purpose computer, a special purpose computer, an embedded processor or processors of other programmable data processing devices to realize the functions described in the description and diagrams. In particular, a processor or processing apparatus may execute the machine-readable instructions. Thus, modules of the product shipping apparatus (for example, the pressurisation system) may be implemented by a processor executing machine readable instructions stored in a memory, or a processor operating in accordance with instructions embedded in logic circuitry. The term 'processor' is to be interpreted broadly to include a CPU, processing unit, ASIC, logic unit, or programmable gate set etc. The methods and modules may all be performed by a single processor or divided amongst several processors.

[0045] Such machine-readable instructions may also be stored in a computer readable storage that can guide the computer or other programmable data processing devices to operate in a specific mode. For example, the instructions may be provided on a non-transitory computer readable storage medium encoded with instructions, executable by a processor.

[0046] Figure 8 shows an example of a processor 800 associated with a memory 810. The memory 810 comprises computer readable instructions 820 which are executable by the processor 800. The instructions 820 may comprise instructions to monitor an internal pressure value of the enclosure, instructions to regulate the internal pressure value of the enclosure to a pre-determined

pressure value, or monitor and regulate environmental conditions such as temperature within the enclosure.

[0047] Such machine-readable instructions may also be loaded onto a computer or other programmable data processing devices, so that the computer or other programmable data processing devices perform a series of operations to produce computer-implemented processing, thus the instructions executed on the computer or other programmable devices provide a operation for realizing functions specified by flow(s) in the flow charts and/or block(s) in the block diagrams.

[0048] Further, the teachings herein may be implemented in the form of a computer software product, the computer software product being stored in a storage medium and comprising a plurality of instructions for making a computer device implement the methods recited in the examples of the present disclosure.

[0049] While the method, apparatus and related aspects have been described with reference to certain examples, various modifications, changes, omissions, and substitutions can be made without departing from the spirit of the present disclosure. For example, other atmospheric pressures are possible for maintaining the enclosure at other desired internal pressures that may be outside the range of 1 – 2.5 atm, provided that these pressures protect the product therein. In particular, a feature or block from one example may be combined with or substituted by a feature/block of another example.

[0050] The word "comprising" does not exclude the presence of elements other than those listed in a claim, "a" or "an" does not exclude a plurality, and a single processor or other unit may fulfil the functions of several units recited in the claims.

[0051] The features of any dependent claim may be combined with the features of any of the independent claims or other dependent claims.

CLAIMS

1. A product shipping apparatus, comprising:
an inflatable enclosure, to receive an item and be pressurised;
a support structure, to secure an item within the enclosure; and
a pressurisation system, to regulate an internal pressure of the enclosure to a predetermined pressure value after the enclosure has been sealed.
2. An apparatus according to claim 1, wherein the item is a printer.
3. An apparatus according to claim 1, wherein the enclosure comprises a sealing arrangement that comprises a zip mechanism and a hook and loop fastening mechanism.
4. An apparatus according to claim 1, wherein the enclosure is a flexible, textile-based bag with a plastics liner.
5. An apparatus according to claim 1, wherein the enclosure is configured to withstand pressure variations up to 2.5 atmospheric pressure.
6. An apparatus according to claim 1, wherein the apparatus is re-usable.
7. An apparatus according to claim 1, further comprising anchoring means to secure the item to the support structure.
8. An apparatus according to claim 1, further comprising an external anchor and wherein the support structure secures the apparatus to the external anchor.
9. An apparatus according to claim 1, wherein the pressurisation system comprises one or more of: a relief valve; an electronic circuit with a pressure sensor; environmental sensors; a power supply; a fan blower; temperature sensor; humidity sensor; and alarm.
10. A product shipping method, comprising:

placing a product inside an inflatable enclosure;
securing the product to the enclosure;
pressurising the enclosure; and
regulating an internal pressure of the enclosure to maintain a
predetermined pressure value thereof after the enclosure has been sealed.

11. A method according to claim 10, wherein the product is a printer that is received in an internal space of the enclosure.

12. A method according to claim 10, wherein the internal pressure of the enclosure is pressurised to and automatically maintained during storage or shipping between 1.3 – 1.5 atmospheric pressure.

13. A method according to claim 10, further comprising regulating an environmental parameter inside the enclosure.

14. A method according to claim 10, wherein the enclosure protects the product therein from ultraviolet radiation.

15. A computer program product, comprising a computer usable medium having computer readable program code embodied therein, said computer readable program code adapted to be executed to implement a product shipping method for regulating an internal pressure of an enclosure to maintain a predetermined pressure value thereof after the enclosure has been sealed.

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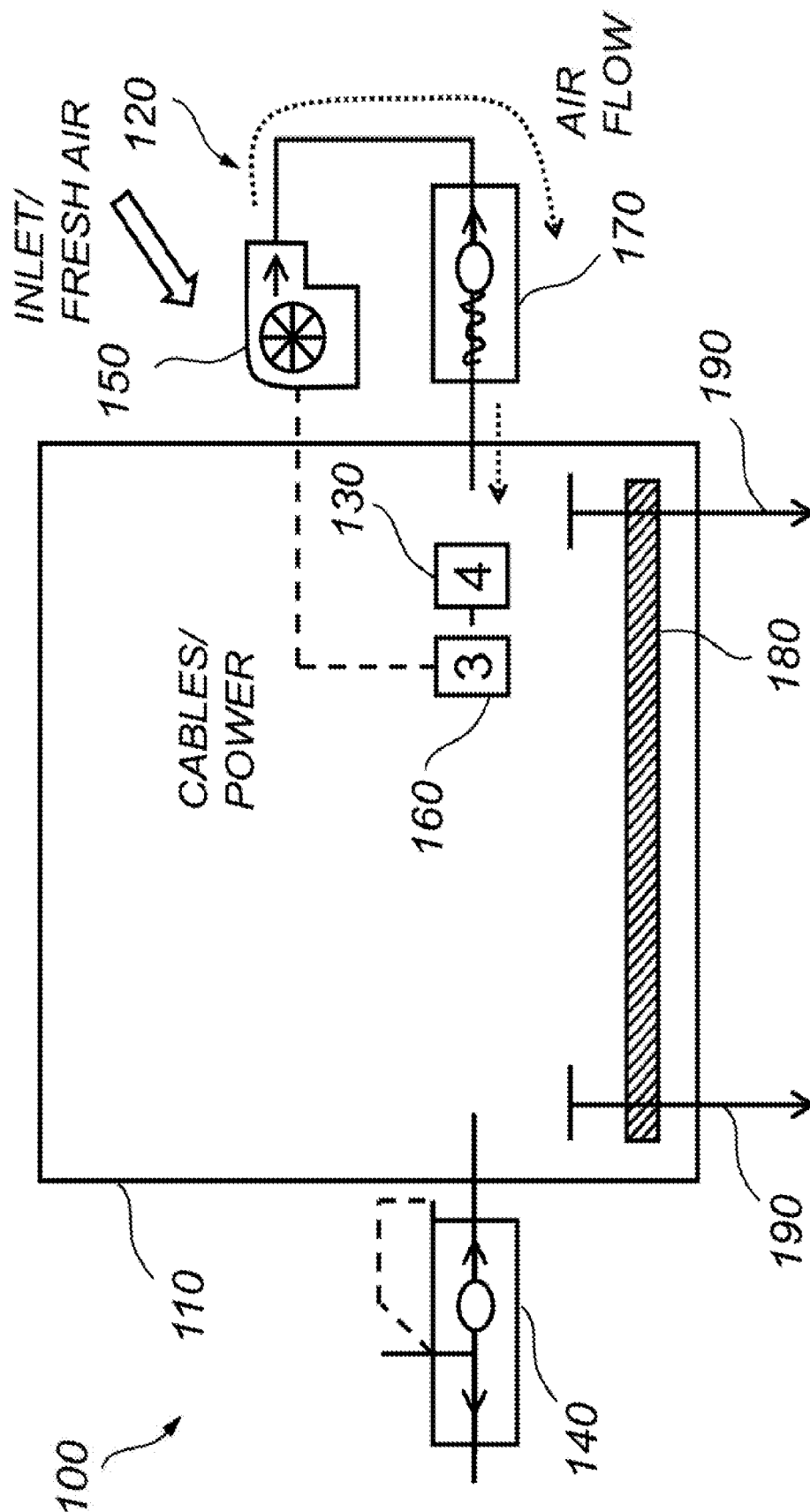
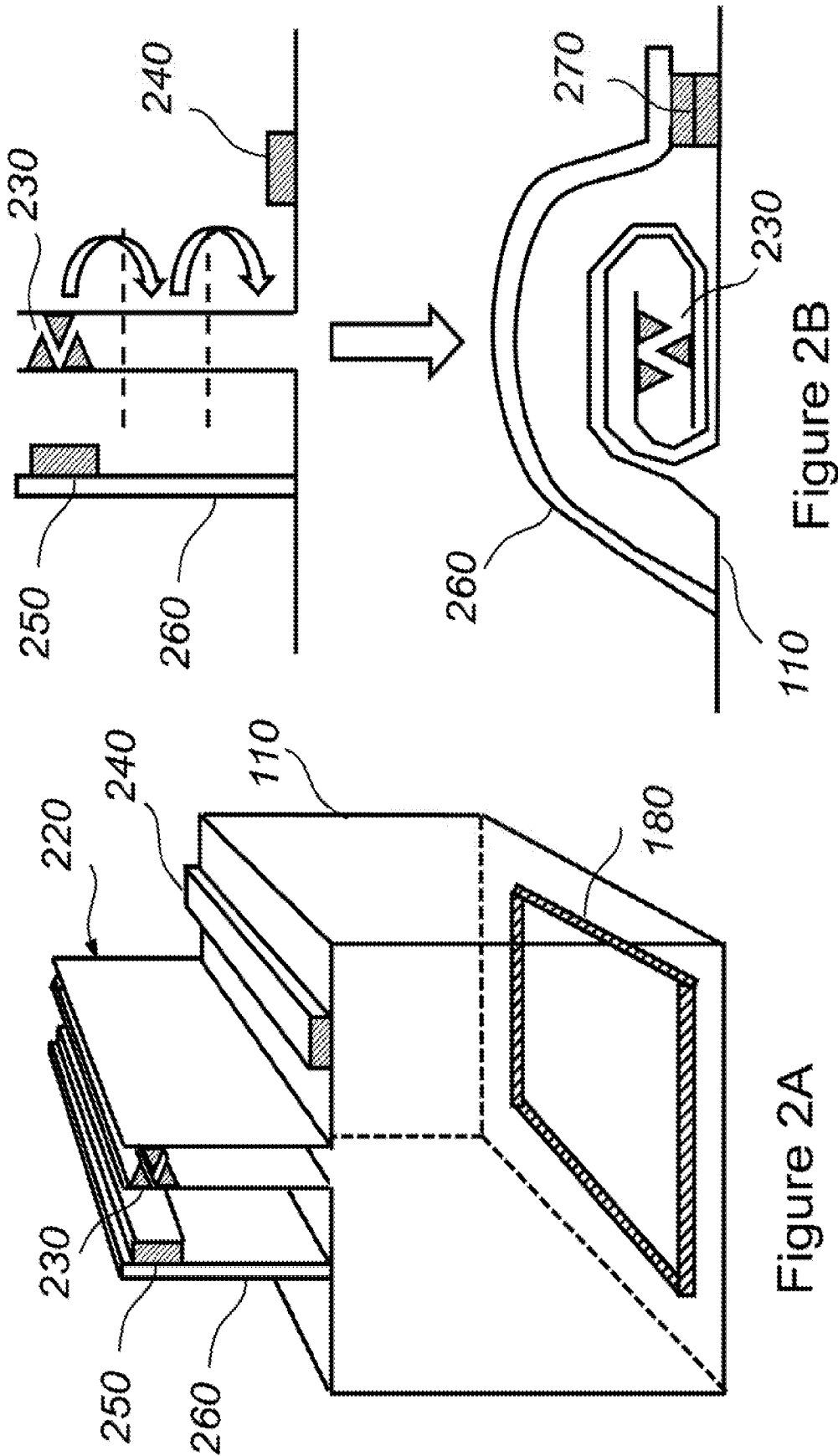


Figure 1



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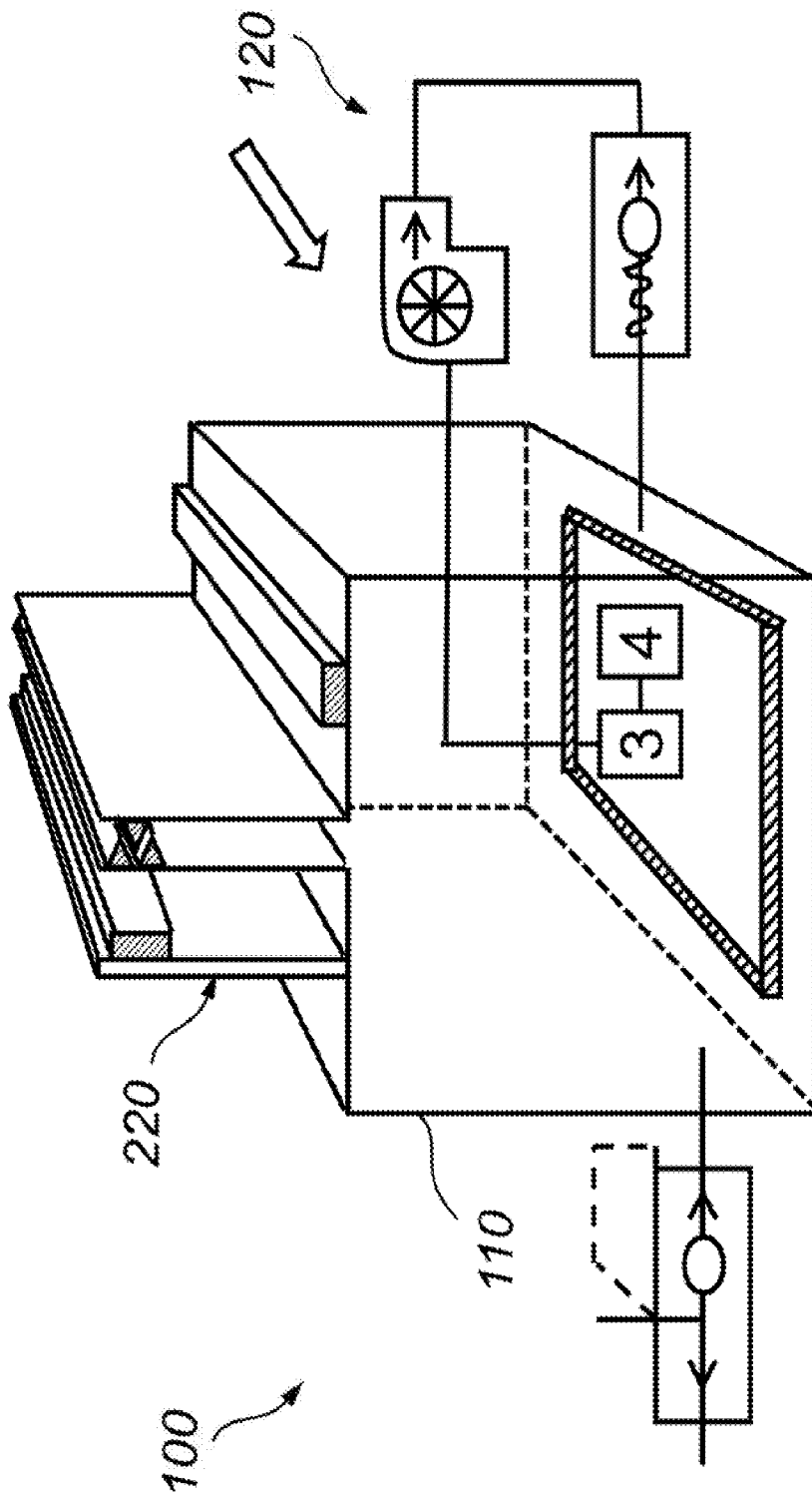


Figure 3

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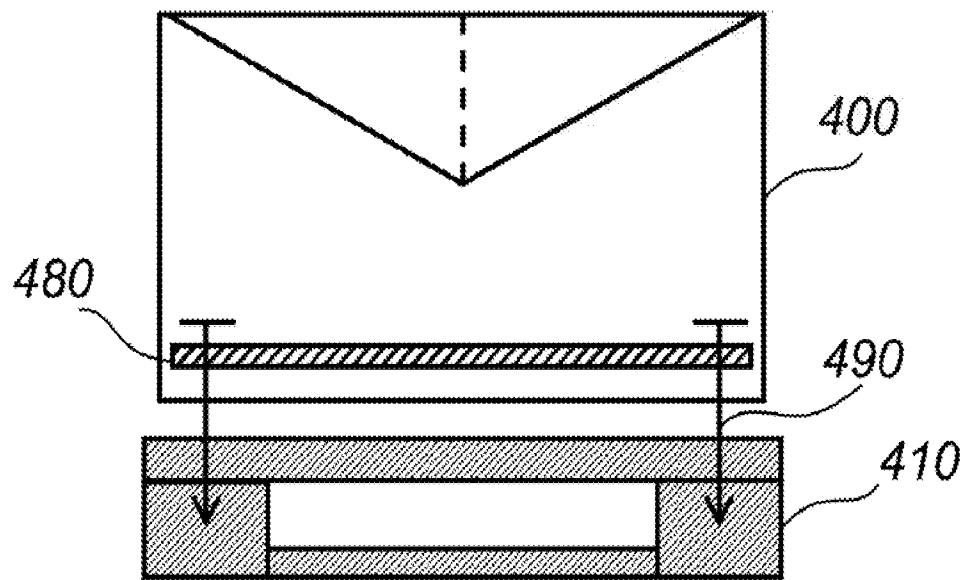


Figure 4A

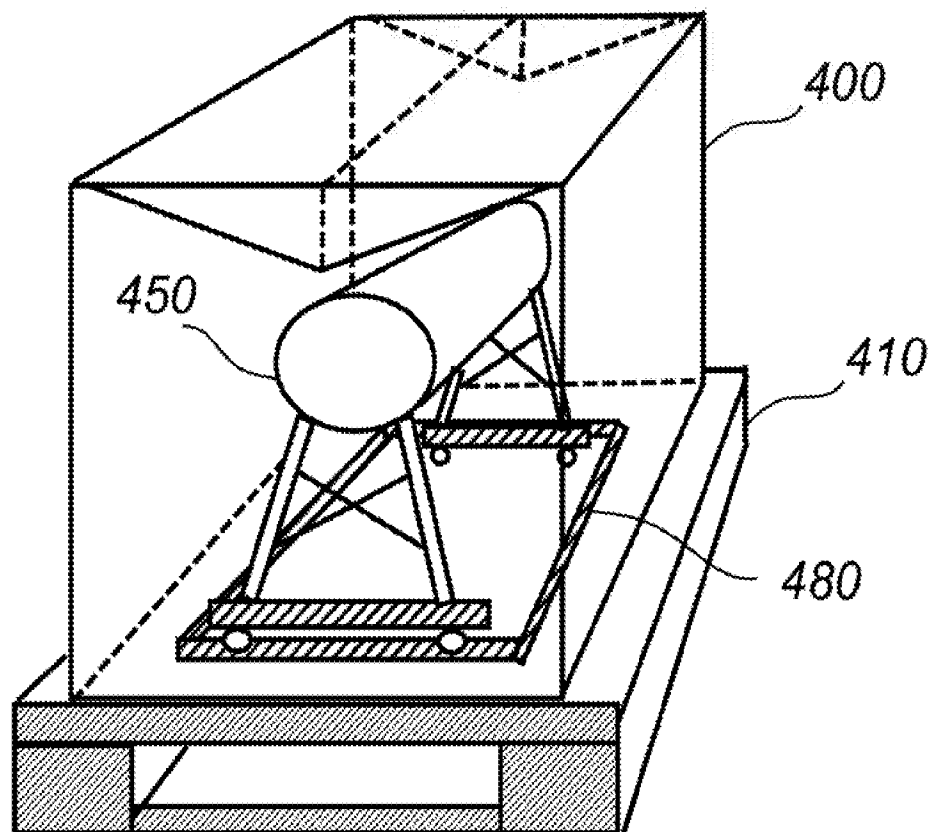


Figure 4B

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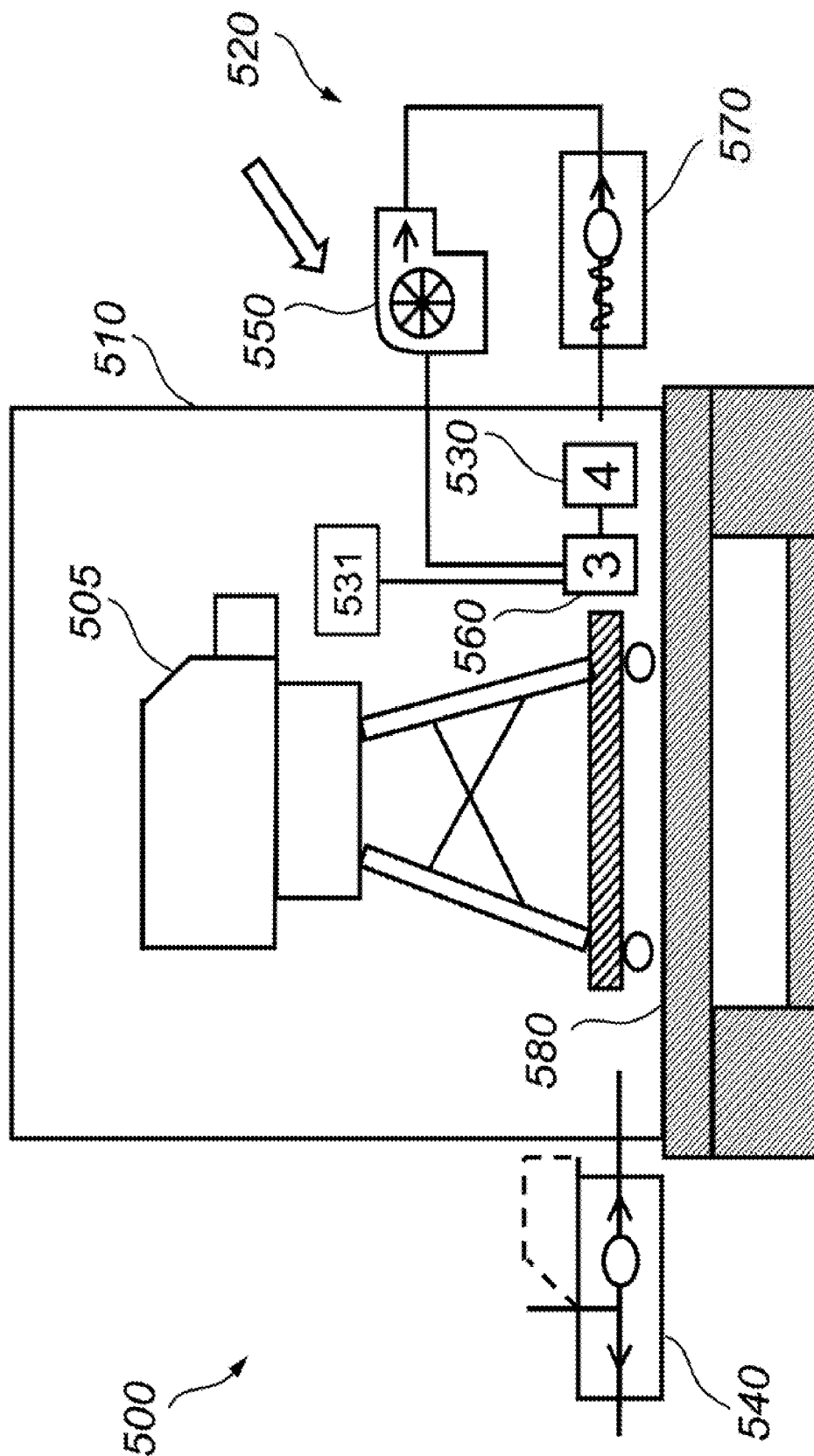


Figure 5

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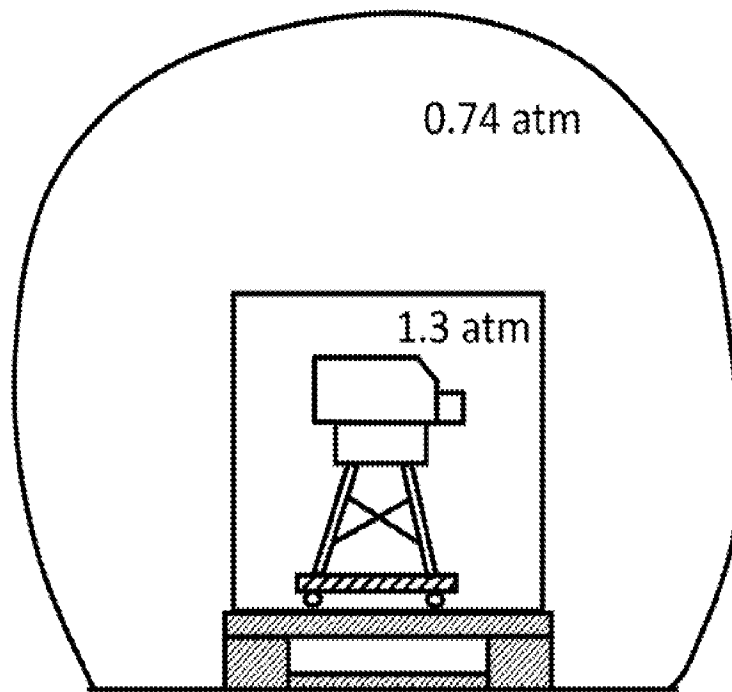


Figure 6A

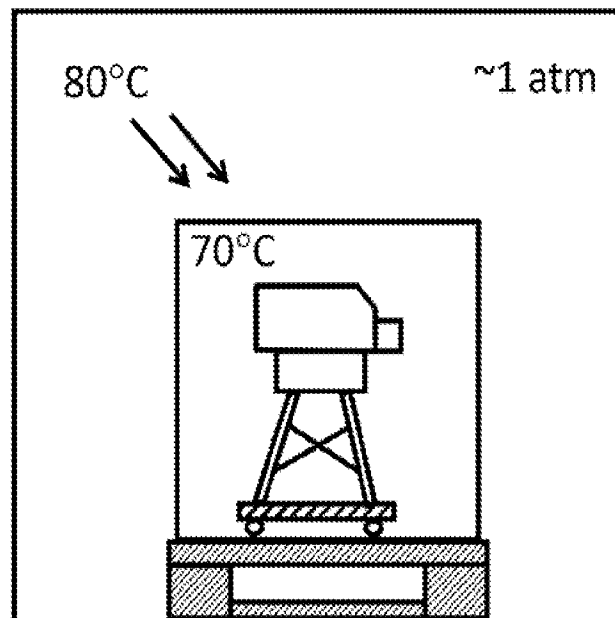


Figure 6B

7 / 7

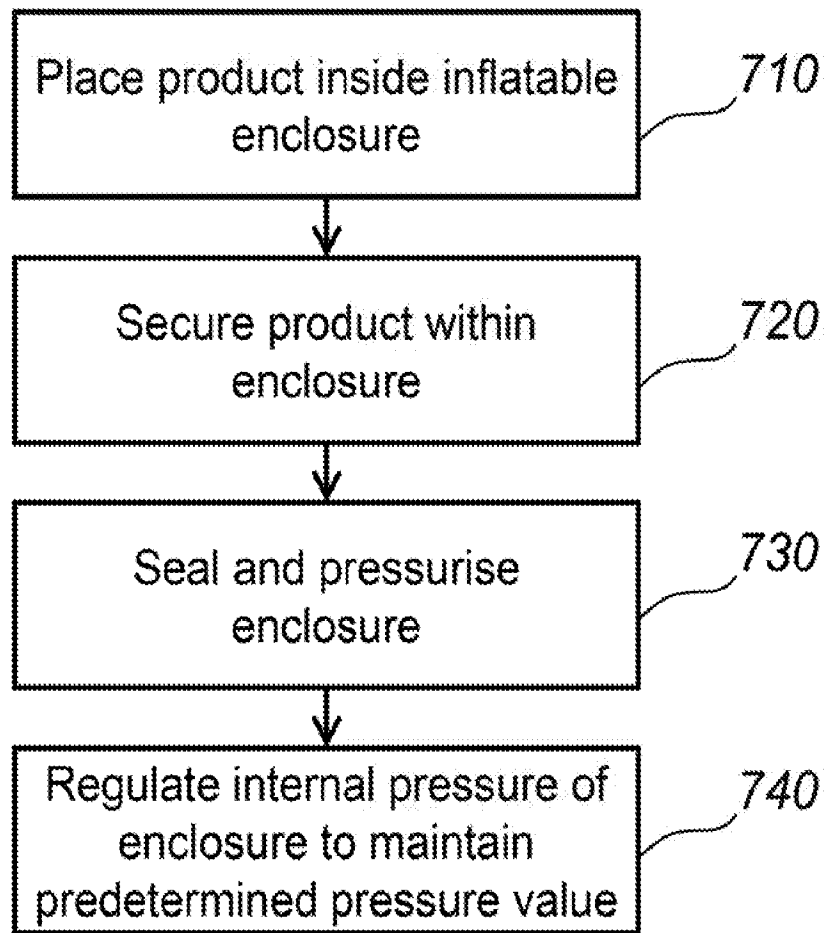


Figure 7

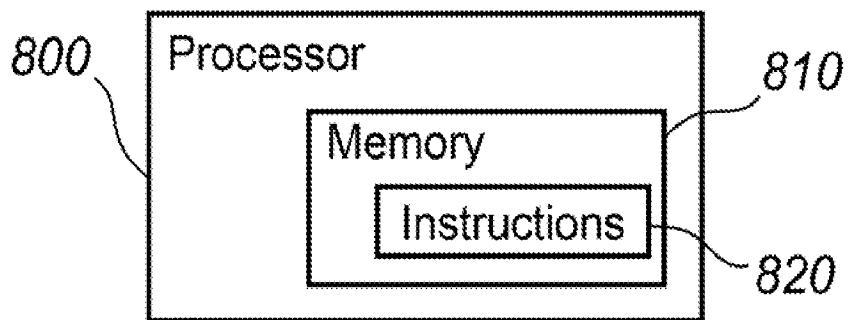


Figure 8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 2017/042852

A. CLASSIFICATION OF SUBJECT MATTER		
B65D 30/04 (2006.01) B65D 30/18 (2006.01) B65D 81/02 (2006.01) B66B 31/02 (2006.01)		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
B65D 30/00, 30/04, 30/18, 81/02, 81/34, 88/12, 88/74, 88/78, F16N 31/00, B65B 31/02		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
Esp@cenet, PatSearch (RUPTO internal), RUPTO		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 3126559 A (TWENTY-FIVE PERCENT TO SOL B. WICZER) 31.03.1964, abstract, claims, col. 2, lines 14-34, col. 3, lines 1-44, 50-60, fig. 1, 2	1-2, 5-6, 10-13 3-4, 7-9, 14-15
Y	PH 22016000121 U1 (VALENCIA PENATO C et al.) 18.03.2016, abstract, claims, p. 1, lines 27-32, p. 3, lines 33-39, p. 4, lines 1-11, p. 5, lines 10-20, p. 7, lines 34-38, p. 8, lines 10-18, p. 9, line 11, fig. 2, 3	8, 15
Y	US 2009/0266722 A1 (EGGS OVERNIGHT, INC.) 29.10.2009, abstract, claims, paragraphs [0147], [0148], [0168], [0169], [0176], fig. 1-30	3-4, 7
Y	RU 110722 U1 (OTKRYTOE AKTSIONERNOE OBSHESTVO "INFORMATSIONNYE SPUTNIKOVYE SISTEMY" IMENI AKADEMIKA M.F. RESHETNEVA") 27.11.2011, abstract, claims, p. 3, lines 1-9, 23-30, p. 4, lines 1-42, fig. 1	9
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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09 February 2018 (09.02.2018)	28 February 2018 (28.02.2018)	
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 2017/042852

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2015/0026949 A1 (MATSON, INC.) 29.01.2015, abstract, claims, paragraph [0044]	14
A	US 4961944 A (GOURMEC LABORATORY CO., LTD.) 09.10.1990, abstract, claims	1-15