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(54) Title: STORAGE SYSTEM INCLUDING A VERTICAL TRANSFER DEVICE

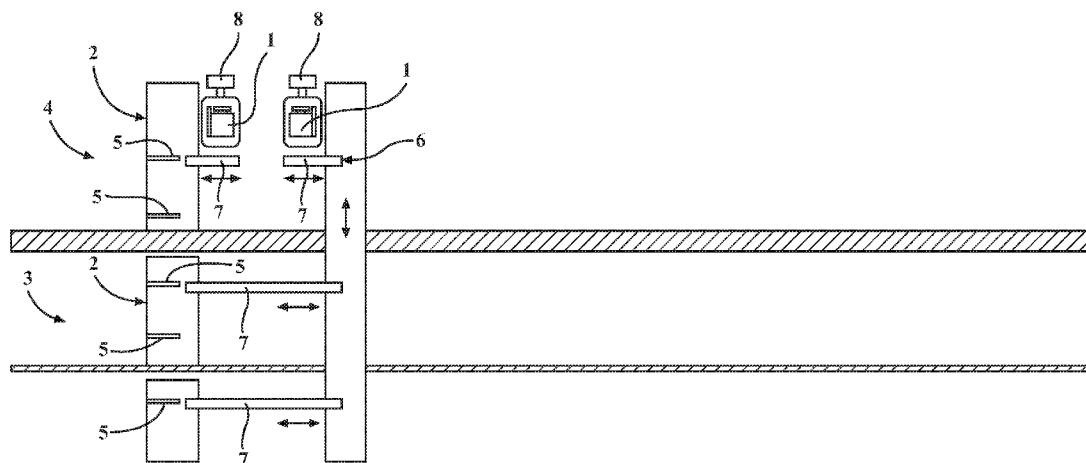


FIG. 1
PRIOR ART

(57) Abstract: A load storage system is provided for holding standardized containers including a first stocker for being positioned on a first story and a second stocker for being positioned on a second story. The first and second stockers each include at least one load support for supporting the standardized containers. A floor is positioned between the first and second stockers. The floor defines a portal between and directly connecting the first and second stockers. The portal is positioned in alignment with the load supports in the first and second stockers. A vertical transfer device is positioned in alignment with the load supports in the first and second stockers and is configured to move the standardized containers through the portal between the first and second stockers. A method of operating the load storage system is also provided.





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Published:

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STORAGE SYSTEM INCLUDING A VERTICAL TRANSFER DEVICE

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This PCT International Patent Application claims the benefit of U.S. Provisional Patent Application Serial No. 62/482,395 filed April 6, 2017 entitled “Vertical Transfer Device,” the entire disclosure of the application being considered part of the disclosure of this application and hereby incorporated by reference.

TECHNICAL FIELD

[0002] A storage system. More specifically, storage system including a vertical transfer device for moving standardized containers directly between stockers on different floors of a building.

BACKGROUND OF THE INVENTION

[0003] Stockers (STKs) are a type of storage compartment used in a number of industries for holding standardized containers, articles of manufacture or components thereof. Specialized versions of stockers may include special features for specific applications. For instance, stockers used for holding front opening unified pods (FOUPs) in semiconductor fabrication plants may include enclosures for maintaining a controlled atmosphere and specialized interfaces for interacting with an automated material handling system (AMHS). In some applications, stockers are required on multiple different stories of a building. As illustrated in FIGS. 1-4, the traditional method of moving a standardized container **1** between a stocker **2** on a second story **4** to a stocker **2** on a first story **3** of a building requires horizontally moving the standardized container **1** out of a shelf **5** of the stocker **2** on the second story **4** to a separate lifting device **6**. Once the standardized container **1** is positioned on the lifting device **6**, it is vertically moved to the first story **3** with the lifting device **6**. The standardized container **1** is then horizontally moved into a shelf **5** of the stocker **2** on the first story **3** by way of conveyor **7**. The system may further

include an overhead transfer system **8** for moving the standardized containers **1** to different regions of the stockers **2**. Accordingly, this method requires multiple steps and involves multiple pieces of equipment to move the standardized containers **1**. The method also requires moving the standardized containers **1** through multiple different spaces, thus increasing the risks of potential contamination.

[0004] In view of the foregoing, there remains a need for improvements to systems for moving standardized containers within a load storage system, and particularly between vertical racks on different stories of a building.

SUMMARY OF THE INVENTION

[0005] According to an aspect of the disclosure, a load storage system is provided for holding standardized containers. The load storage system includes a first stocker for being positioned on a first story of a building and a second stocker for being positioned on a second story of a building. The first and second stockers each include at least one load support for supporting the standardized containers. A floor is positioned between the first and second stockers. The floor defines a portal between, and directly connecting the first and second stockers for allowing the standardized containers to be moved between the first and second stockers. The portal is positioned in alignment with at least one of the load supports in the first stocker and at least one of the load supports in the second stocker. A vertical transfer device is positioned in alignment with at least one of the load supports in the first stocker and at least one of the load supports in the second stocker and is configured to move the standardized containers through the portal between the first and second stockers.

[0006] According to another aspect of the disclosure, a method is provided for moving a standardized container within a load storage system directly between a first stocker on a first story of a building including a first load support, and a second stocker on a

second story of a building directly above the first stocker and including a second load support. A floor is positioned between the first and second stockers. A portal is defined by the floor between the first and second stockers in alignment with the first load support in the first stocker and the second load support in the second stocker. The method comprises the steps of disposing a standardized container upon the load support within the first stocker, engaging the standardized container with a vertical transfer device, moving the standardized container with the vertical transfer device through the portal from the first stocker to the second stocker, positioning the standardized container on the second load support within the second stocker, and disengaging the standardized container from the vertical transfer device.

[0007] Accordingly, the vertical transfer device of the present invention can transfer standardized containers more quickly than systems of the prior art because it transfers the containers directly between the stockers through the portal with the vertical transfer device, without requiring transfer by other conveying devices. Also, risks associated with potential contamination are minimized because the present invention allows standardized containers to be moved directly between vertical racks on different stories of a building without requiring the standardized containers to be moved through multiple different spaces (such as on conveyors or overhead transfer devices). Furthermore, the present invention allows the standardized containers to be moved with fewer transfers between different conveyance devices than the methods of the prior art, thereby minimizing the risk of damage to the contents of the standardized containers which may result from each transfer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Other advantages of the present invention will be readily appreciated, as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

[0009] FIG. 1 is cross-sectional side view of a fabrication facility including a load storage system of the prior art;

[0010] FIG. 2 is a layout top view of the upper, cleanroom story of the fabrication facility of FIG. 1;

[0011] FIG. 3 is a layout top view of the intermediate, subfab/utility story of the fabrication facility of FIG. 1;

[0012] FIG. 4 is a design drawing showing a side cross-sectional view of a stocker on the intermediate, subfab/utility story of the fabrication facility of FIG. 1;

[0013] FIG. 5 is a schematic cross-sectional side view of a fabrication facility including a first embodiment of a vertical transfer device according to an aspect of the present disclosure;

[0014] FIG. 6A is a top view of a partitioned shelf plate in a first configuration according to an aspect of the present disclosure;

[0015] FIG. 6B is a top view of the partitioned shelf plate of FIG. 6A in a second configuration according to an aspect of the present disclosure;

[0016] FIG. 7 is a schematic cross-sectional side view of a fabrication facility including a second embodiment of a vertical transfer device according to an aspect of the present disclosure;

[0017] FIG. 8A is a side view of a load support including a cab frame surrounding a standardized container according to an aspect of the present disclosure;

[0018] FIG. 8B is a front view of the load support including a cab frame surrounding a standardized container of FIG. 8A;

[0019] FIG. 9 is a flow chart of a method of moving a standardized container within a load storage system;

[0020] FIG. 10 is a flow chart including a sub-step of the method of FIG. 9 according to an aspect of the present disclosure;

[0021] FIG. 11 is a flow chart including sub-steps of the method of FIG. 9 according to another aspect of the present disclosure; and

[0022] FIG. 12 is a flow chart including sub-steps of the method of FIG. 9 according to another aspect of the present disclosure.

DESCRIPTION OF THE ENABLING EMBODIMENTS

[0023] Referring to the Figures, wherein like numerals indicate corresponding parts throughout the several views, a load storage system **20, 120** for storing standardized containers is provided. As best shown in FIGS. 5-8B, the standardized containers **22** may be front opening unified pods (FOUPs) **22**, as commonly used in semiconductor fabrication plants for holding and transporting semiconductor wafers. It should be appreciated that other containers could be utilized. As shown, the system **20, 120** may include an upper room **24**, an intermediate room **26** and a lower room **28** vertically stacked on top of one another. Each of the rooms **24, 26, 28** may be at any physical level at, above, or below ground level, and any number of rooms may be provided. Additionally, the rooms may be used for various purposes including but not limited to, a sub fabrication room, a utility room and a clean room for semi-conductor assembly operations. A first porous plate **30**, or floor, divides the upper and intermediate rooms **24, 26**, and a second porous plate **32**, or floor, divides the intermediate and lower rooms **26, 28**. A bottom floor **34** is provided in the lower room **28**, and a ceiling **36** is provided in the upper room **24**. The porous plates **30, 32**, floor **34** and ceiling **36** may allow the room to be kept clean by way of a downflow system wherein clean air is supplied through the ceiling **36** and flows downwardly through the first and second porous plates **30, 32** and ultimately flows out through the floor **34** to provide a

controlled atmosphere. It should be appreciated that other types of floors / plates could be utilized.

[0024] Each of the rooms **24, 26, 28** includes a stocker (STK) **38, 40, 42**. More particularly, the upper room **24** includes a first stocker **38**, the intermediate room **26** includes a second stocker **40** and the lower room **28** includes a third stocker **42**. Each stocker **38, 40, 42** is an area at which one or more standardized containers **22**, such as front opening unified pods (FOUPs) **22**, are contained. The stockers **38, 40, 42** may each include an enclosure for maintaining a controlled atmosphere and specialized interfaces for interacting with an automated material handling system (AMHS).

Additionally/alternatively, the entire room in which the stocker **38, 40, 42** is located may be a controlled atmosphere, as explained above. Each stocker **38, 40, 42** includes a plurality of load supports **44, 144**, each configured to hold at least one of the standardized containers **22**. The load supports **44, 144** may include, for example, shelves **44, 144**, compartments, racks, hooks, clamps, or other structures or mechanisms for holding one or more of the standardized containers **22**. In the example embodiments, the load supports **44, 144** are shelves **44, 144**. Each of the stockers **38, 40, 42** further includes a crane **46** that is adapted to move the containers between different load supports **44, 144** within the stocker **38, 40, 42**. Each of the cranes **46** may include an arm assembly **48** (schematically shown) including corresponding pulleys, cables and/or other mechanism for moving the containers **22** within the stocker **38, 40, 42**.

[0025] A first portal **50** connects the first stocker **38** in the upper room **24** and the second stocker **40** in the intermediate room **26**. A second portal **51** connects the second stocker **40** in the intermediate room **26** and the third stocker **42** in the lower room **28**. The first portal **50** provides direct access between the first and second stockers **38, 40**, and the second portal **51** provides direct access between the second and third stockers **40, 42**. The

first and second portals **50, 51** take the openings in the first and second porous plates **30, 32**. The portals **50, 51** are sized such that the standardized containers **22** may pass therethrough. The upper, intermediate and lower rooms **24, 26, 28** of the building may be immediately adjacent one another, as shown in FIGS. 5 and 7. Alternately, the upper, intermediate and lower rooms **24, 26, 28** may be separated by one or more intermediate stories or other space such as a catwalk or plenum. In such a case, the portal **50, 51** may take the form of one or more tubes or other extended passage that extend vertically between the stockers **38, 40, 42** of the upper, intermediate and lower rooms **24, 26, 28**, similar to an elevator shaft.

[0026] One or more vertical transfer device **52, 152** are provided for transferring the standardized containers through the portals **50** between the stockers **38, 40, 42**. The vertical transfer devices **52, 152** are provided in vertical alignment with the shelves **44, 144** and portals **50** and are linearly moveable such that the standardized containers **22** may move linearly between the stockers **38, 40, 42** while remaining in vertical alignment with the shelves **44, 144**.

[0027] According to an aspect, one or more of the load supports **44, 144** may be movable between a first configuration for holding a standardized container **22** and a second configuration for allowing a standardized container **22** to pass vertically therethrough by way of the vertical transfer device **52, 152**. For example, according to the embodiment of the system shown in FIGS. 5-6B, the load support **44** may be a partitioned shelf plate **44** including two legs **54** generally parallel to one another and each extending in a forward direction from a backing wall **56** and each configured to move laterally outwardly, perpendicularly to the forward direction. The partitioned shelf plate **44** may move between the first configuration shown in FIG. 6A with the legs **54** proximate to one another for holding a standardized container **22** thereupon to the second configuration shown in FIG. 6B with the legs **54** spaced apart from one another for allowing a standardized container **22**

to pass vertically therethrough. A linear motion (LM) block **58** may be attached to each of the legs **54** and movable along a linear motion rail **60** disposed along the backing wall **56** to allow each of the legs **40** to be moved laterally between the first and second configurations.

[0028] As shown in FIG. 5, the vertical transfer device **52** may include one or more hoists **52** disposed within the stocker **38, 40, 42**. The hoists **52** may include a grasping mechanism **62** to selectively engage a corresponding lug **49** on one of the standardized containers **22** and to move the one of the standardized containers **22** vertically below the hoist **48** and between the vertical racks **26, 30**. The hoist **48** may be similar to the type used in prior art cleanway overhead transport vehicles (CLW). As shown, the hoist **48** may be connected to the crane **46** for providing movement of the hoist **48**, or it could be connected to a separate actuating mechanism.

[0029] According to the embodiment of the system **120** shown in FIGS. 7-8B, at least one of the load supports **144** may include a cab frame **64** for surrounding a standardized container **22**, and the load support **144** may be movable between the stockers **38, 40, 42** for conveying a standardized container **22** therein. In this way, the load support **144** may function similarly to an elevator car for conveying a standardized container **22** vertically between the stockers **38, 40, 42**.

[0030] According to an aspect shown in FIG. 8, the vertical transfer device **152** may include a shelf plate **152**, or rail, to move one or more of the load supports **144** with a corresponding standardized container **22** disposed thereupon between the stockers **38, 40, 42**. The shelf plate **152** may, for example, provide movement of two or more of the load supports **144** together. According to an aspect, one or more of the load supports **144** may be moveably connected to the shelf plate **152** to move vertically relative to the shelf plate **152**. In this way, selected ones of the movable shelf plates **152** may be moved between the stockers **38, 40, 42** while others may be left stationary. Alternatively, the shelf plate **152**

could be configured to be moveable relative to the rest of the stocker **38, 40, 42** and the load supports **144** could be fixed to the shelf plate **152** to move therewith.

[0031] With reference to FIG. 9, a method **100** is provided for moving a standardized container **22** within a load storage system **20, 120** directly between a first stocker **38** on a first story **24** of a building including a first load support **44, 144** and a second stocker **40** on a second story **26** of the building directly above the first stocker **38** and including a second load support **44, 144**, wherein a floor and/or plate **30** is positioned between the first and second stockers **38, 40**, and wherein a portal **50** is defined by the floor **30** between the first and second stockers **38, 40** in alignment with the first load support **44, 144** in the first stocker **38** and the second load support **44, 144** in the second stocker **38, 40**. The method **100** includes **102** disposing a standardized container upon the load support **44, 144** within the first stocker **38**. The method also includes **104** engaging the standardized container with a vertical transfer device **52, 152**. The method also includes **106** moving the standardized container **22** with the vertical transfer device **52, 152** through the portal **50** from the first stocker **38** to the second stocker **40**. The method also includes **108** positioning the standardized container **22** on the second load support **44, 144** within the second stocker **40**.

[0032] According to the embodiment shown in FIG. 5, and shown in the flowchart of FIG. 10, the step of **104** engaging the standardized container with a vertical transfer device **20** may include the sub-step **110** of directly engaging a lug **49** on the standardized container **22** with a corresponding grasping mechanism **62** attached to a hoist **52**.

[0033] According to the embodiment of the system **120** shown in FIG. 7 and shown in the flowchart at FIG. 11, the step of **104** engaging the standardized container with a vertical transfer device **20** may include the sub-step of **112** of moving the load support **144** along the rail **60** from the first stocker **38**, through the portal **50**, to the second stocker **40**.

[0034] According to the flowchart at FIG. 12, the step of **104** engaging the standardized container with a vertical transfer device **20** may also include the sub step **114** of moving one or more of the load supports **44** between a first configuration for holding a standardized container **22** and a second configuration for allowing a standardized container **22** to pass vertically therethrough. Specifically, as shown in FIGS. 6A and 6B, the method may include moving two legs **54** of the load support **44** laterally outwardly.

[0035] Obviously, many modifications and variations of the present invention are possible in light of the above teachings and may be practiced otherwise than as specifically described while within the scope of the appended claims. These antecedent recitations should be interpreted to cover any combination in which the inventive novelty exercises its utility. The use of the word "said" in the apparatus claims refers to an antecedent that is a positive recitation meant to be included in the coverage of the claims whereas the word "the" precedes a word not meant to be included in the coverage of the claims.

CLAIMS

What is claimed is:

Claim 1. A load storage system for holding standardized containers, comprising:

- a first stocker for being positioned on a first story of a building and a second stocker for being positioned on a second story of a building, said first and second stockers each including at least one load support for supporting the standardized containers;
- a floor positioned between said first and second stockers;
- said floor defining a portal between and directly connecting said first and second stockers for allowing the standardized containers to be moved between said first and second stockers, said portal defined in alignment with at least one of said load supports in said first stocker and at least one of said load supports in said second stocker; and
- a vertical transfer device positioned in alignment with at least one of said load supports in said first stocker and at least one of said load supports in said second stocker and configured to move the standardized containers through said portal between said first and second stockers.

Claim 2. The load storage system as set forth in Claim 1 wherein said vertical transfer device includes a hoist including a grasping mechanism to selectively engage a corresponding lug on the standardized container and to move the standardized container vertically below said hoist.

Claim 3. The load storage system as set forth in Claim 2 wherein each of said stockers further includes a crane, and wherein said hoist is coupled with said crane to provide movement of said hoist.

Claim 4. The load storage system as set forth in Claim 1 wherein said at least one load support of said first stocker and said at least one load support of said second stocker each include a shelf plate including two legs being moveable relative to one another between a first configuration in which said legs are positioned proximate to one another to hold the standardized containers and a second configuration in which said legs are spaced from one another to allow said vertical transfer device and the standardized containers to pass between said legs.

Claim 5. The load storage system as set forth in Claim 4 wherein said vertical transfer device further includes a backing wall, wherein said legs extend in parallel relationship with one another in a forward direction being perpendicular to said backing wall, and wherein said legs are slideably coupled to said backing wall and moveable along said backing wall between said first and second configurations.

Claim 6. The load storage system as set forth in Claim 1 wherein said vertical transfer device includes at least one rail extending through said portal between said first and second stockers, and wherein at least one of said load supports is coupled with and moveable along said rail between said first and second stockers.

Claim 7. The load storage system as set forth in Claim 6 wherein said load support includes a housing for surrounding the standardized containers, and wherein said housing is coupled with said at least one rail.

Claim 8. The load storage system as set forth in Claim 1 wherein said at least one load support in each of said stockers includes a plurality of load supports positioned in vertical alignment with one another.

Claim 9. The load storage system as set forth in Claim 8 each of said stockers further includes a crane for moving the standardized containers between said plurality of load supports.

Claim 10. A method for moving a standardized container within a load storage system directly between a first stocker on a first story of a building including a first load support and a second stocker on a second story of a building directly above the first stocker and including a second load support, wherein a floor is positioned between the first and second stockers, and wherein a portal is defined by the floor between the first and second stockers in alignment with the first load support in the first stocker and the second load support in the second stocker, said method comprising the steps of:

disposing a standardized container upon the first load support within the first stocker;

engaging the standardized container with a vertical transfer device;

moving the standardized container with the vertical transfer device through the portal from the first stocker to the second stocker and positioning the standardized container on the second load support within the second stocker; and

disengaging the standardized container from the vertical transfer device.

Claim 11. The method as set forth in Claim 10 wherein the vertical transfer device includes a hoist including a grasping mechanism, and wherein said method further

includes engaging a lug on the standardized container to position the standardized container vertically below the hoist.

Claim 12. The method as set forth in Claim 10 wherein at least one of the first and second load supports includes a shelf plate including a pair of legs being moveable relative to one another, and wherein the method further includes moving the legs relative to one another into a first configuration in which the legs are positioned proximate to one another for holding the standardized container, moving the legs into a second configuration in which the legs are spaced from one another, and passing the vertical transfer device and one of the standardized containers between the legs.

Claim 13. The method as set forth in Claim 1 wherein the vertical transfer device includes at least one rail extending through the portal between the first and second stockers, and wherein the least one of the load supports is moveable along the rail between the first and second stockers through the portal, and wherein said method further includes moving the load support along the rail from the first stocker, through the portal and to the second stocker.

Claim 14. The load storage system as set forth in Claim 13 wherein the load support includes a housing for surrounding the standardized containers, and wherein the housing is coupled with the at least one rail.

Claim 15. The load storage system as set forth in Claim 10 wherein the first stocker includes a plurality of first load supports positioned in vertical alignment with one

another and wherein the second stocker includes a plurality of second load supports positioned in vertical alignment with one another.

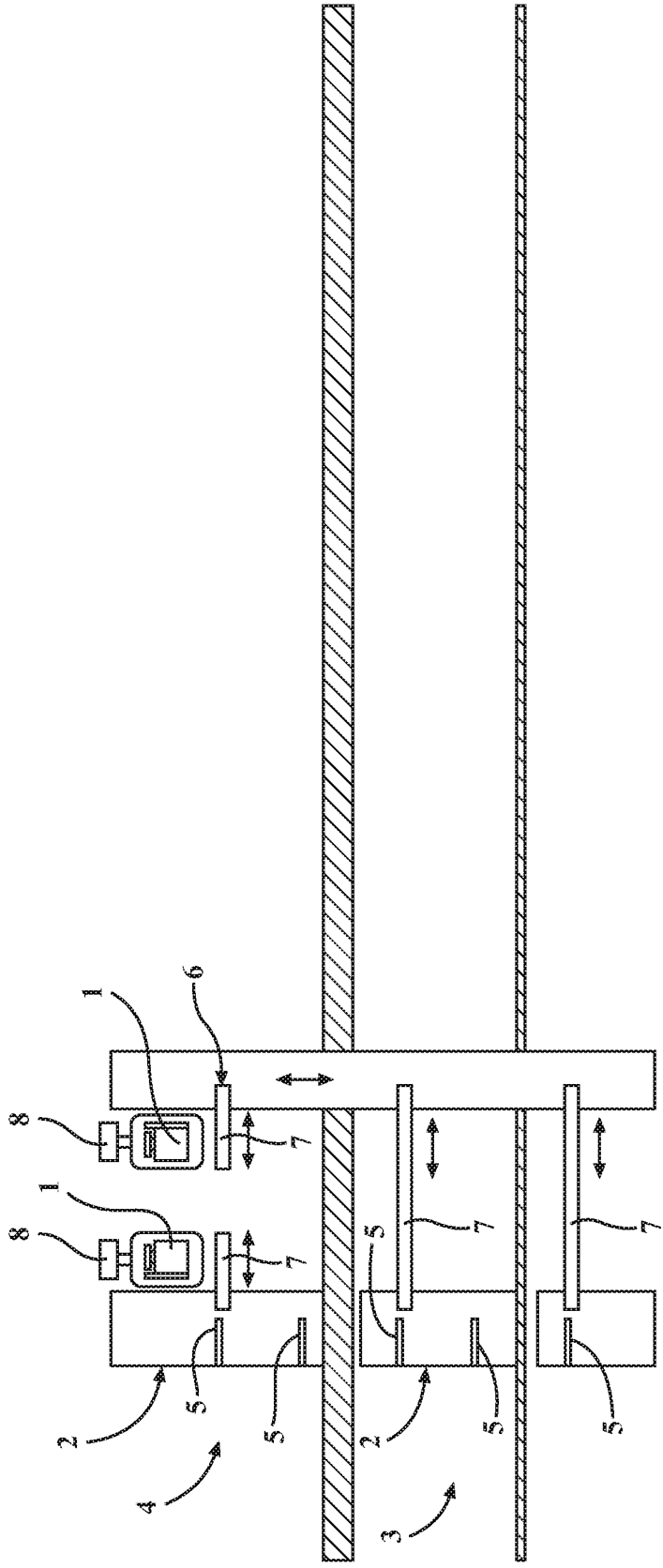


FIG. 1
PRIOR ART

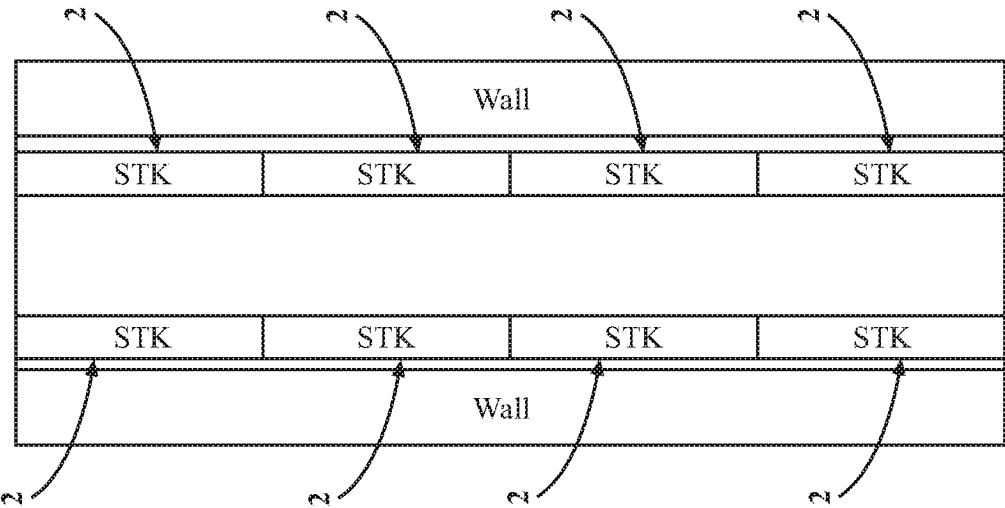


FIG. 3

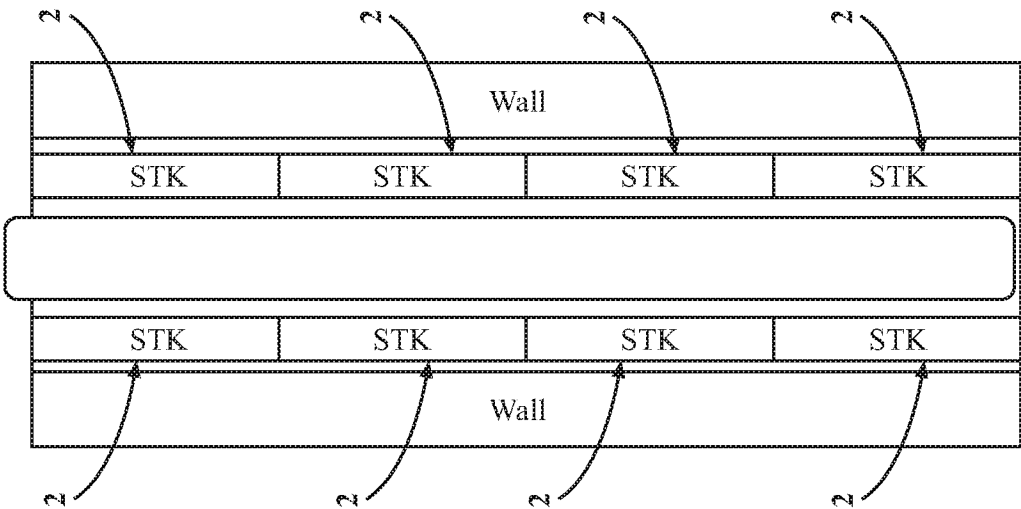


FIG. 2

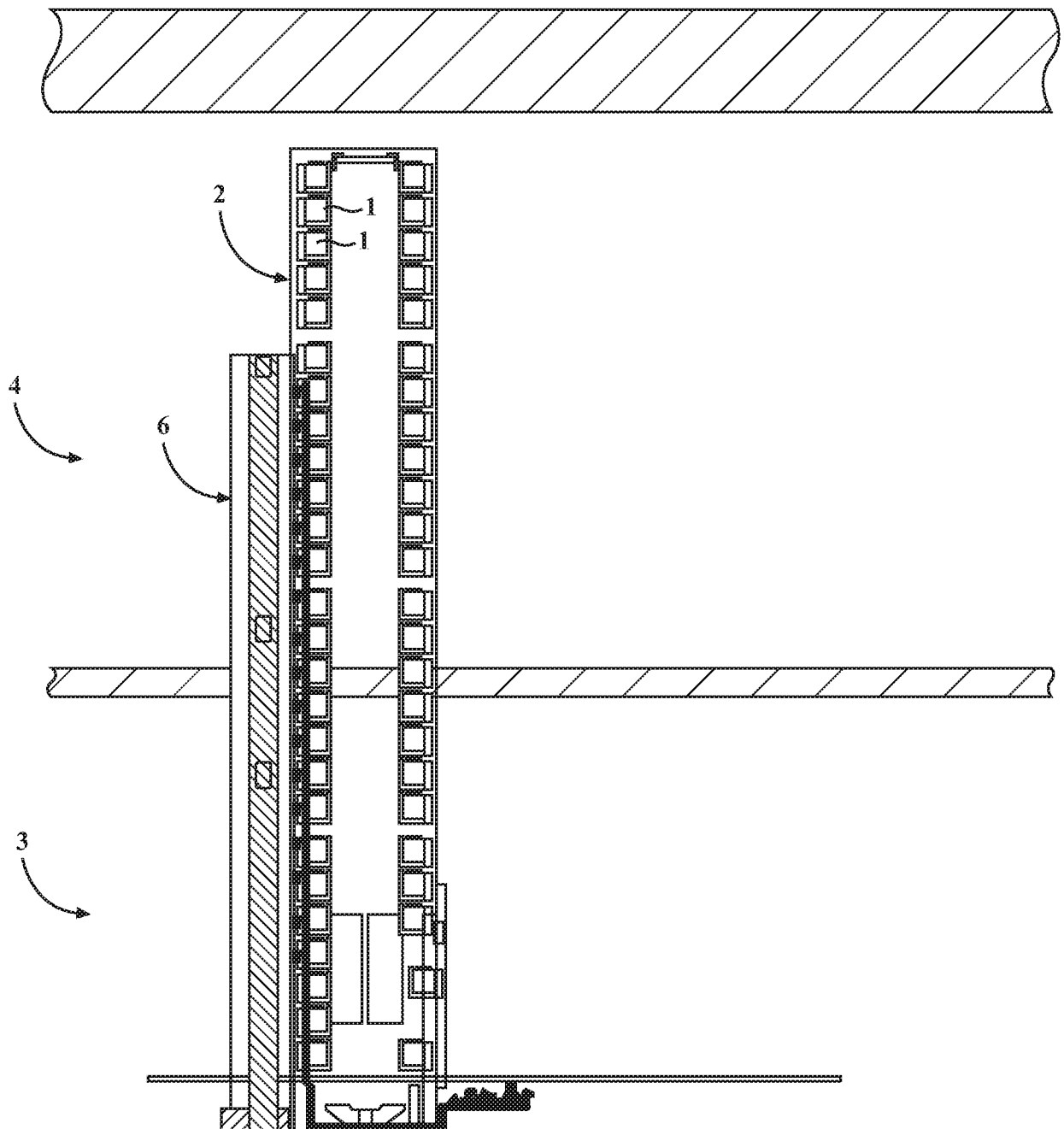


FIG. 4

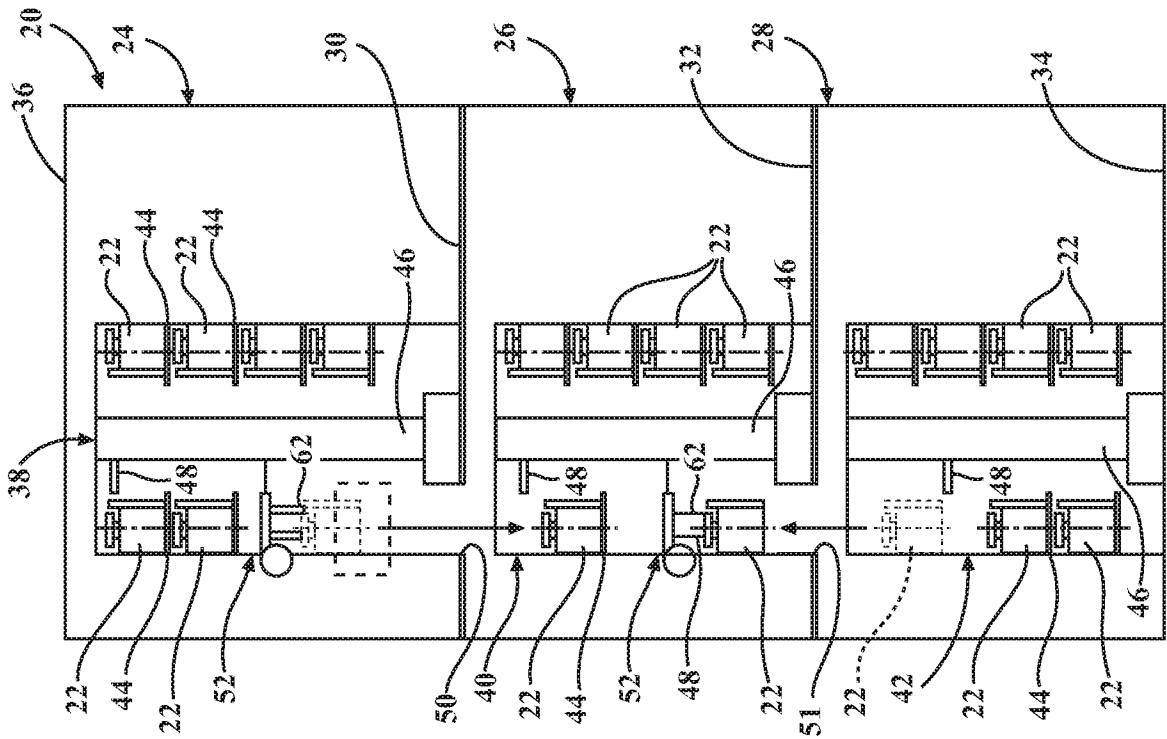


FIG. 5

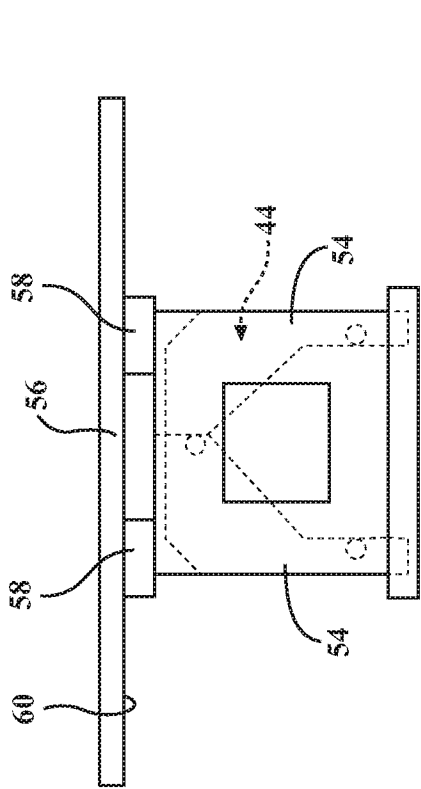


FIG. 6A

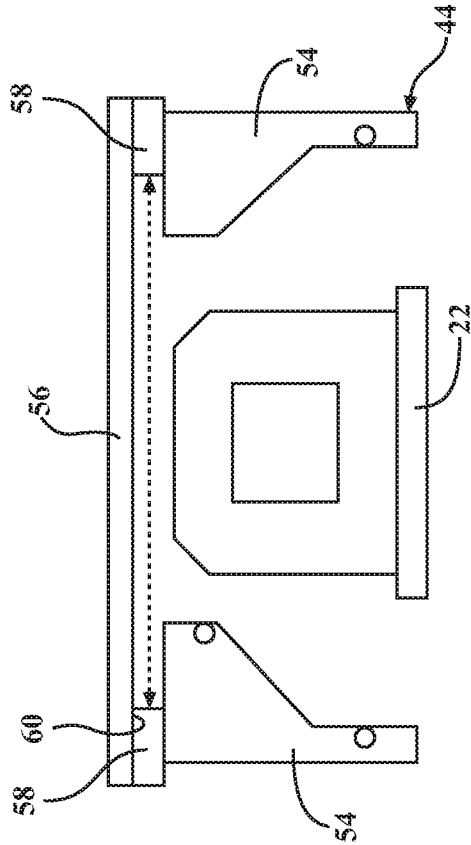


FIG. 6B

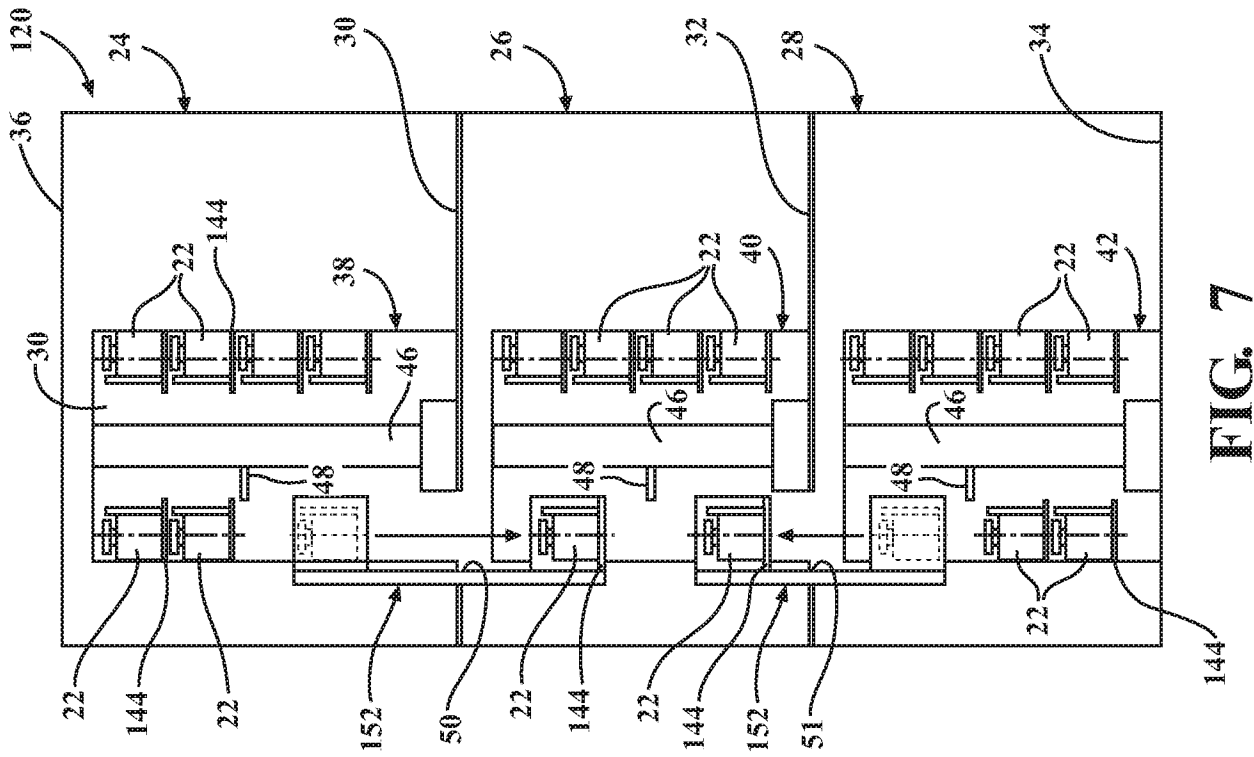


FIG. 7

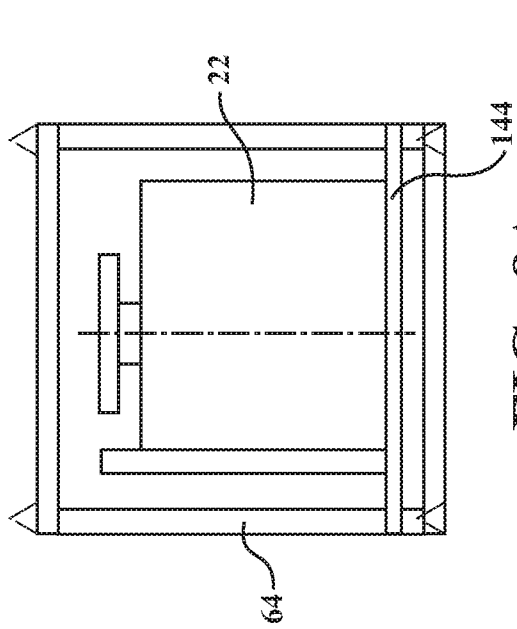


FIG. 8A

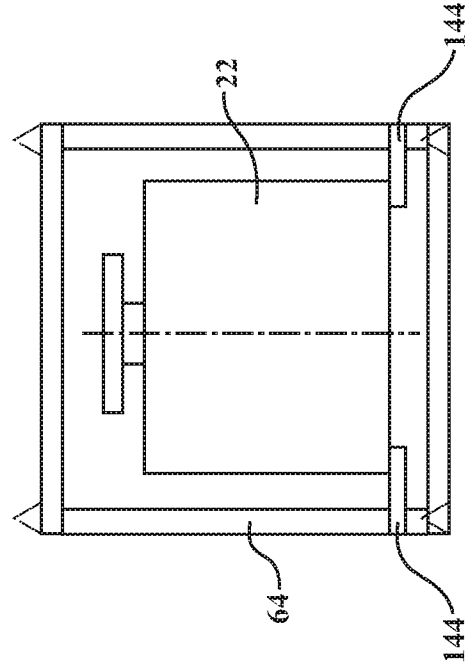


FIG. 8B

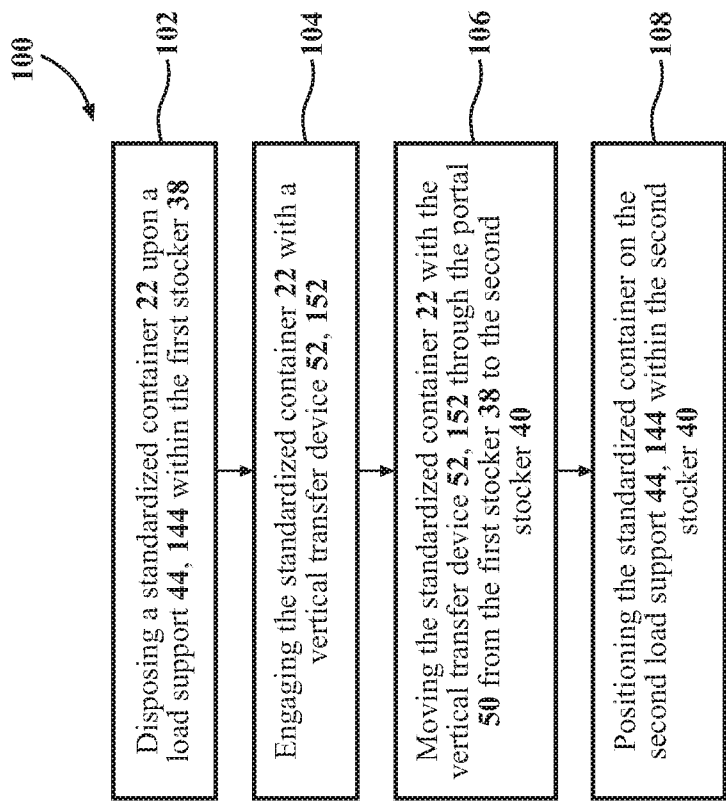


FIG. 10

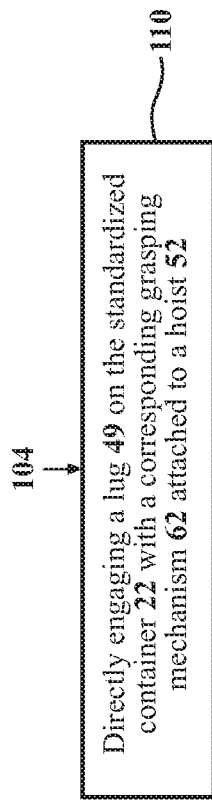


FIG. 11



FIG. 12

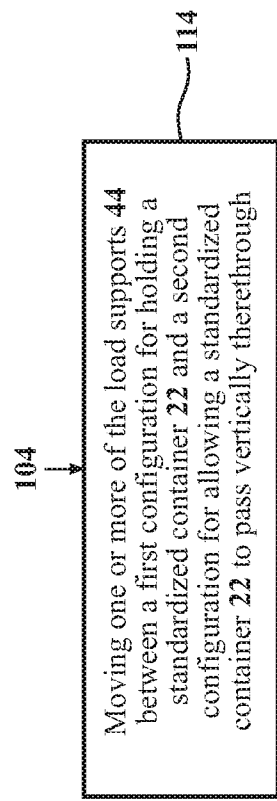


FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US18/25688

A. CLASSIFICATION OF SUBJECT MATTER

IPC - B65G 1/04, 1/10; B66B 7/02, 9/00; B66F 9/075, 9/12, 9/18, 11/00 (2018.01)

CPC - A47B 51/00; B65G 1/02, 1/023, 1/026, 1/04, 1/0407, 1/0436, 1/0457, 1/10; B66B 7/02, 7/023, 9/003, 9/16, 11/0005, 11/006, 11/0226, 9/12, 9/18, 9/19, 11/00

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)

See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2016/0214831 A1 (DAIFUKU CO., LTD.) 28 July 2016; figure 1; paragraph [0018], [0020], [0028] [0074]	10, 15
A	US 2009/0081010 A1 (JAYASURIYA, L.) 26 March 2009; entire document	1-15
A	US 2008/0075564 A1 (TACHIBANA, K.) 27 March 2008; entire document	1-15
A	US 2015/0004899 A1 (DAIFUKU CO., LTD.) 01 January 2015; entire document	1-15
A	US 2013/0270063 A1 (YOSHINAGA, K.) 17 October 2013; entire document	1-15
A	US 2008/0152466 A1 (BONORA, A. C. et al.) 26 June 2008; entire document	1-15
A	US 2016/0348843 A1 (DAIFUKU CO., LTD.) 01 December 2016; entire document	1-15

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"&" document member of the same patent family

Date of the actual completion of the international search

08 June 2018 (08.06.2018)

Date of mailing of the international search report

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Name and mailing address of the ISA/

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