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Johnston

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(54) **CONTAINERIZED TRANSPORTATION TRAILERS**

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B65D 90/00	(2006.01)
B65G 63/00	(2006.01)
B65G 65/08	(2006.01)
B65G 67/24	(2006.01)

(52) **U.S. Cl.**

CPC ***B65G 63/025*** (2013.01); ***B65D 88/127*** (2013.01); ***B65D 90/0073*** (2013.01); ***B65G 63/004*** (2013.01); ***B65G 65/08*** (2013.01); ***B65G 67/20*** (2013.01); ***B65G 67/24*** (2013.01); *B65D 2203/10* (2013.01); *B65G 2201/025* (2013.01); *B65G 2811/0678* (2013.01); *B65G 2814/0311* (2013.01)

(58) **Field of Classification Search**

CPC B65D 88/127; B65G 67/20

See application file for complete search history.

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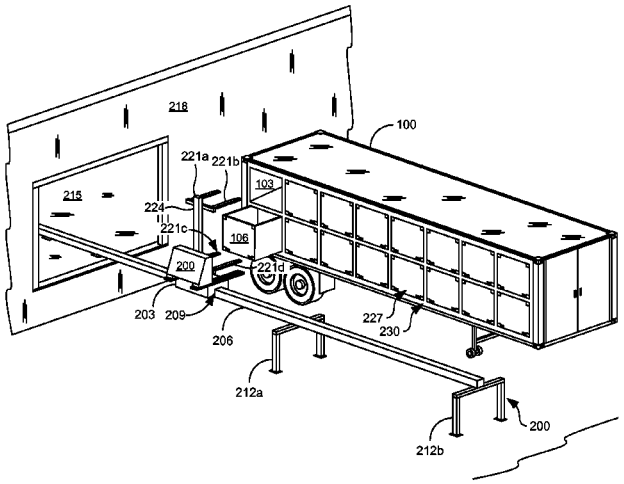
(57) **ABSTRACT**

Disclosed are various embodiments for a containerized shipping trailer and an automated module moving apparatus. A containerized shipping trailer may comprise a shipping container having a plurality of compartments configured to store a plurality of modules in an interior of the shipping container. An automated module moving apparatus may comprise a body configured to move horizontally along a rail from a first position to a second position to insert at least one projection into a portal of a module located in a compartment of the shipping container. The module may be removed and placed at a predefined location.

9 Claims, 8 Drawing Sheets



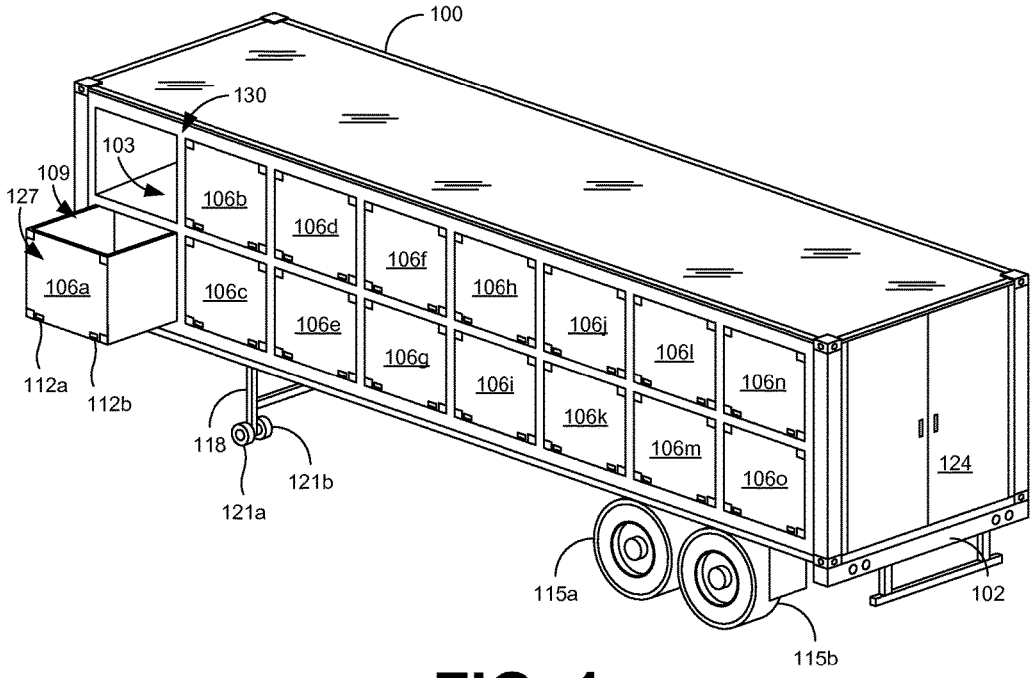

100
130
103
109
127
106a
106b
106c
106d
106e
106f
106g
106h
106i
106j
106k
106l
106m
106n
106o
124
112a
112b
118
121a
121b
115a
115b
102

FIG. 1

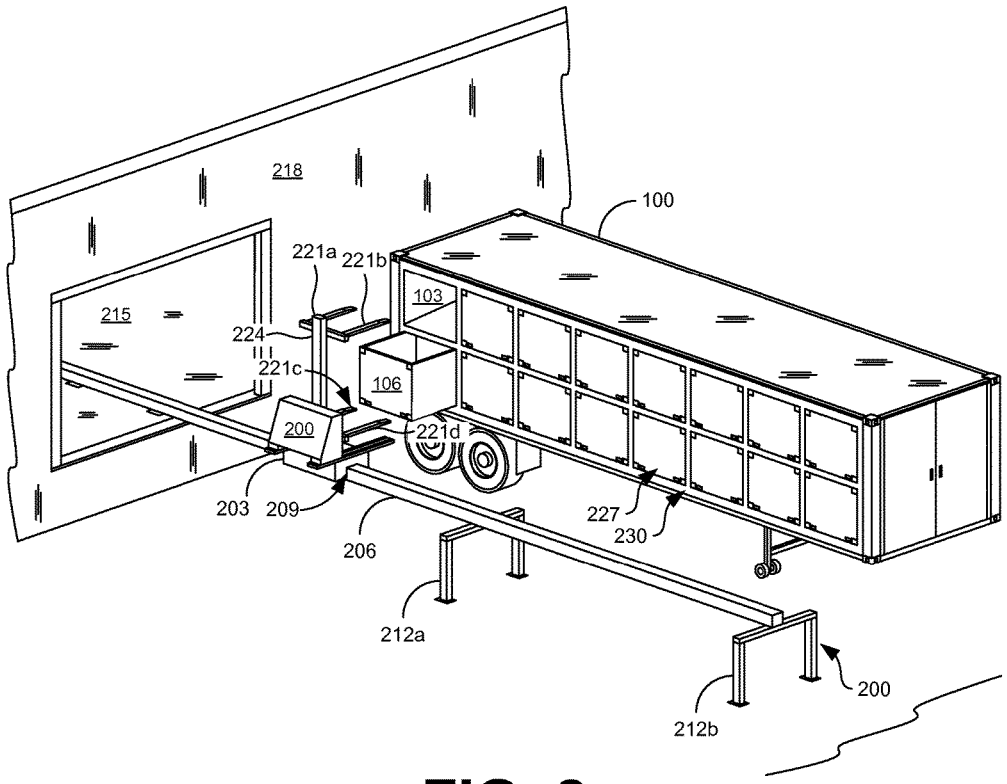

218
100
221a
221b
103
215
224
221c
106
200
221d
203
209
206
227
230
212a
200
212b

FIG. 2

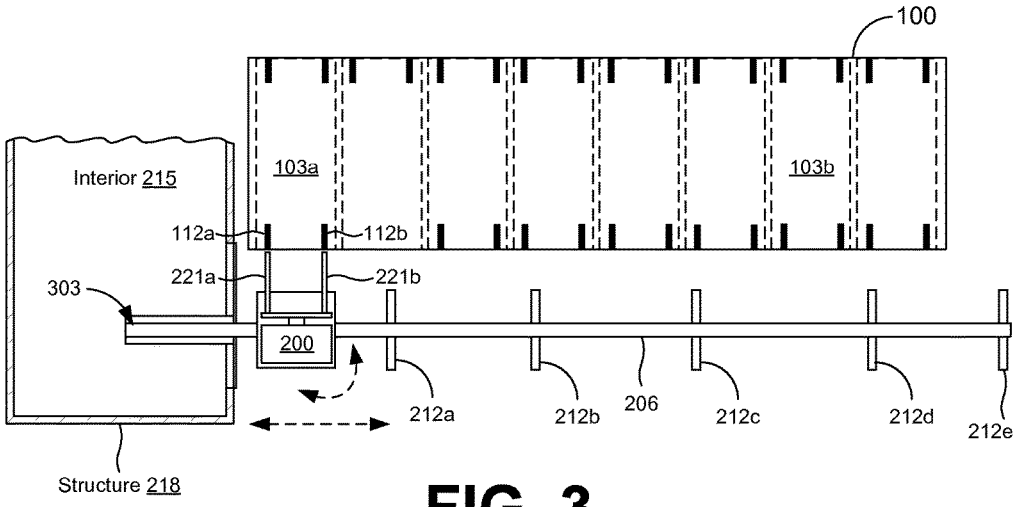

100
Interior 215
103a
103b
112a
112b
221a
221b
303
200
212a
212b
206
212c
212d
212e
Structure 218

FIG. 3

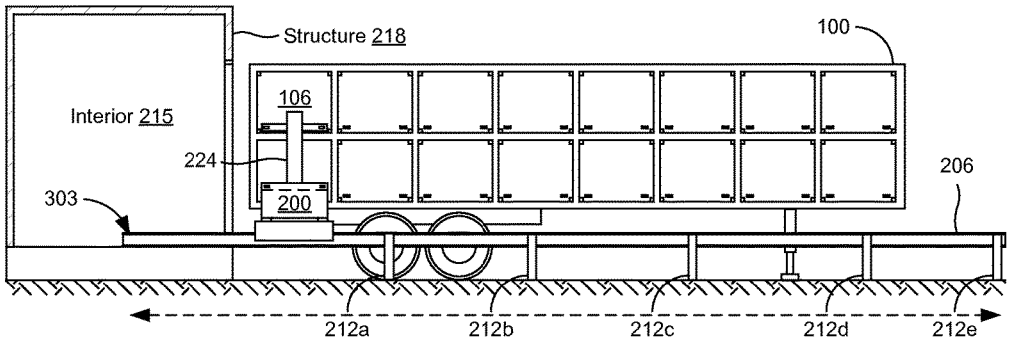

Structure 218
100
Interior 215
106
224
303
200
206
212a
212b
212c
212d
212e

FIG. 4

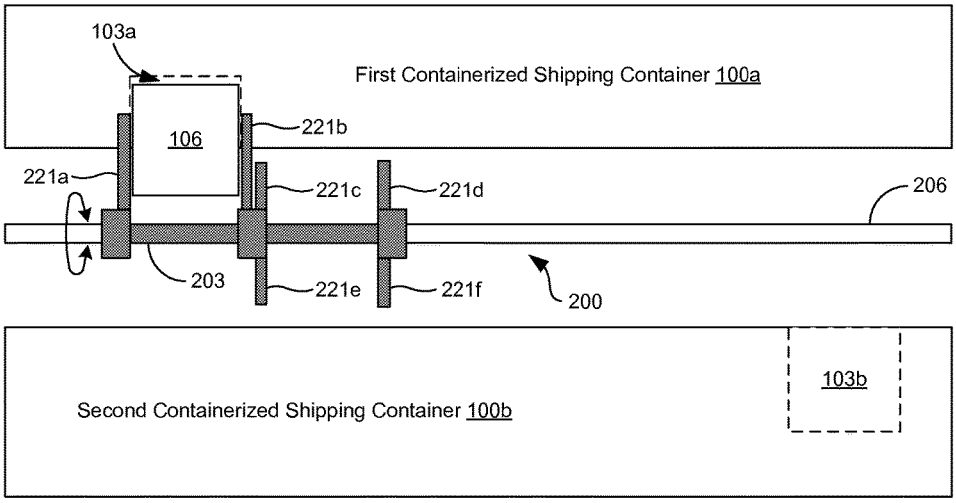

103a
First Containerized Shipping Container 100a
106
221b
221a
221c
221d
206
203
221e
221f
200
103b
Second Containerized Shipping Container 100b

FIG. 5

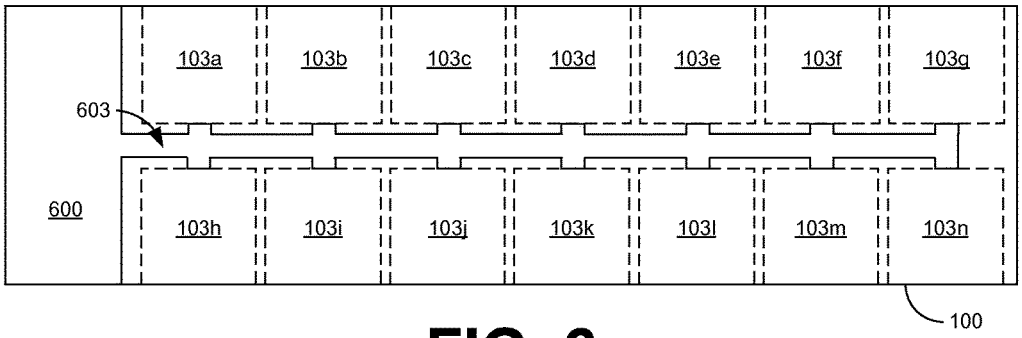

103a
103b
103c
103d
103e
103f
103g
603
600
103h
103i
103j
103k
103l
103m
103n
100

FIG. 6

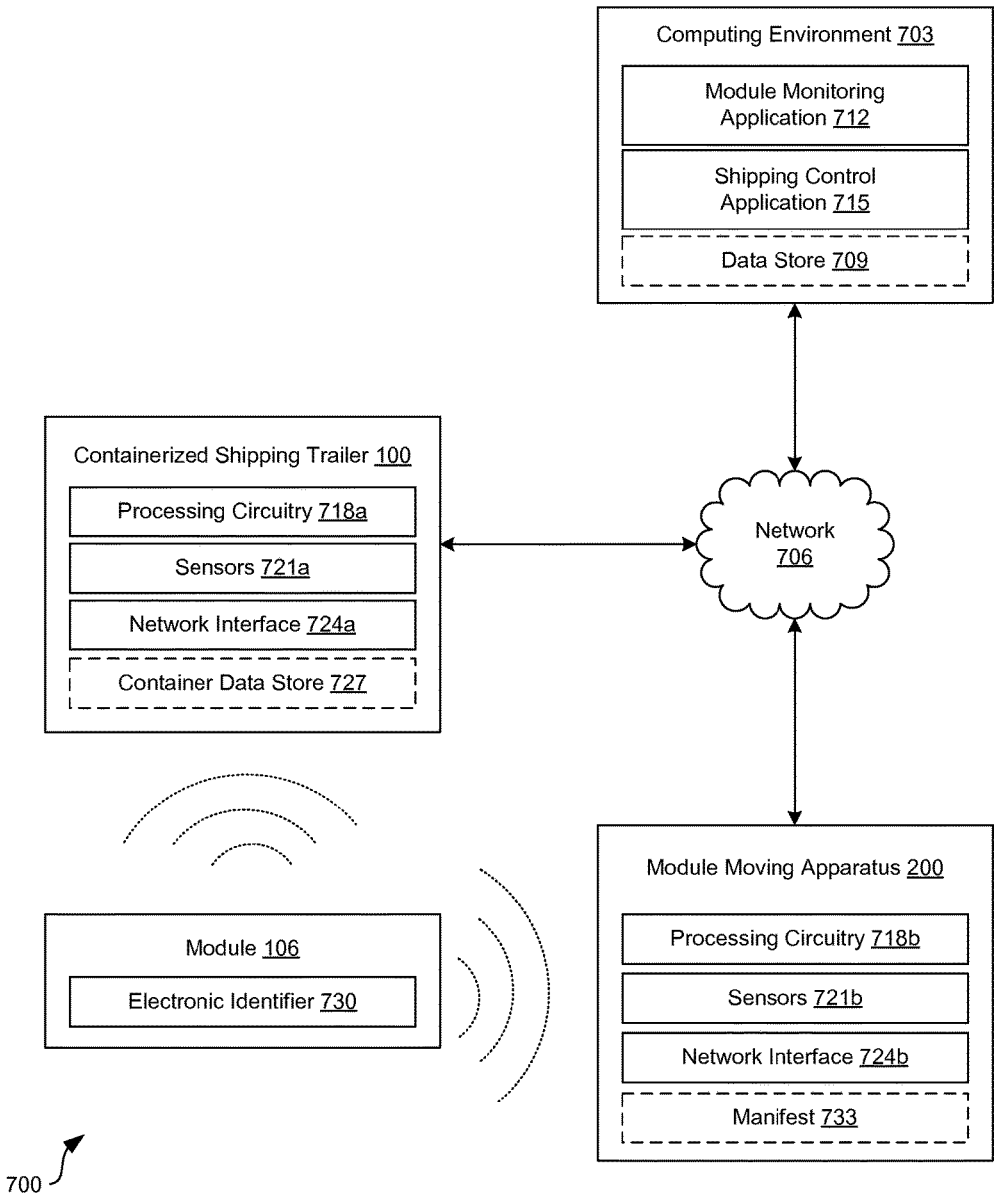

Computing Environment 703
Module Monitoring Application 712
Shipping Control Application 715
Data Store 709
Containerized Shipping Trailer 100
Processing Circuitry 718a
Sensors 721a
Network Interface 724a
Container Data Store 727
Network 706
Module 106
Electronic Identifier 730
Module Moving Apparatus 200
Processing Circuitry 718b
Sensors 721b
Network Interface 724b
Manifest 733
700

FIG. 7

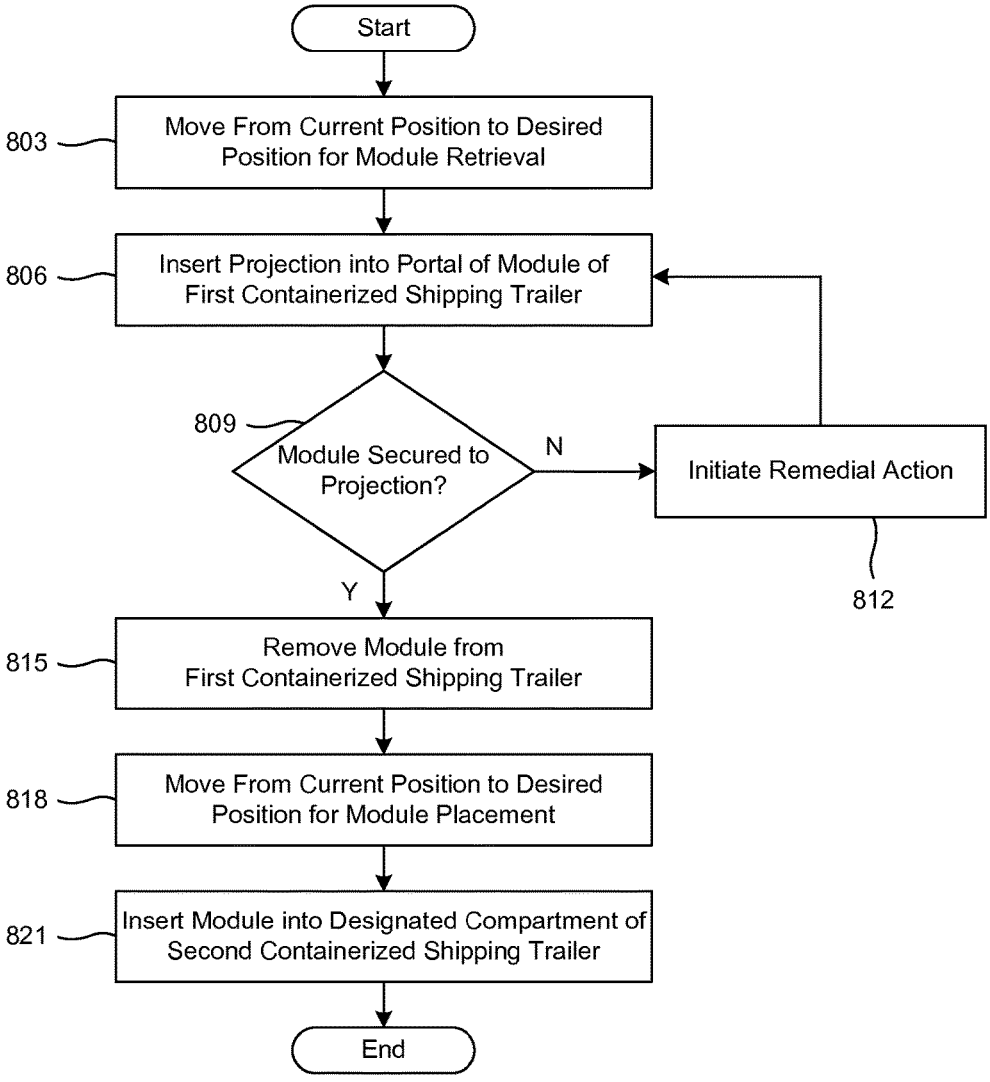

Start
803
Move From Current Position to Desired Position for Module Retrieval
806
Insert Projection into Portal of Module of First Containerized Shipping Trailer
809
Module Secured to Projection?
N
Initiate Remedial Action
812
Y
815
Remove Module from First Containerized Shipping Trailer
818
Move From Current Position to Desired Position for Module Placement
821
Insert Module into Designated Compartment of Second Containerized Shipping Trailer
End

FIG. 8

200

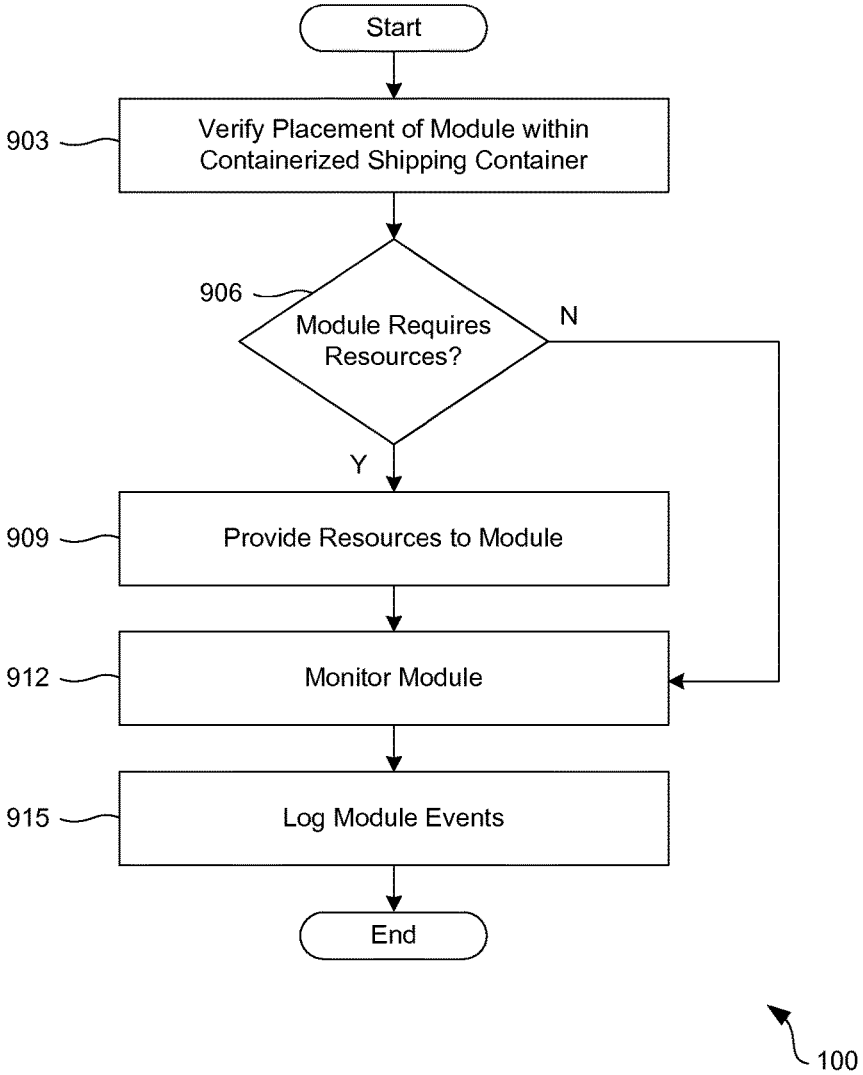

Start
903
Verify Placement of Module within Containerized Shipping Container
906
Module Requires Resources?
N
Y
909
Provide Resources to Module
912
Monitor Module
915
Log Module Events
End
100

FIG. 9

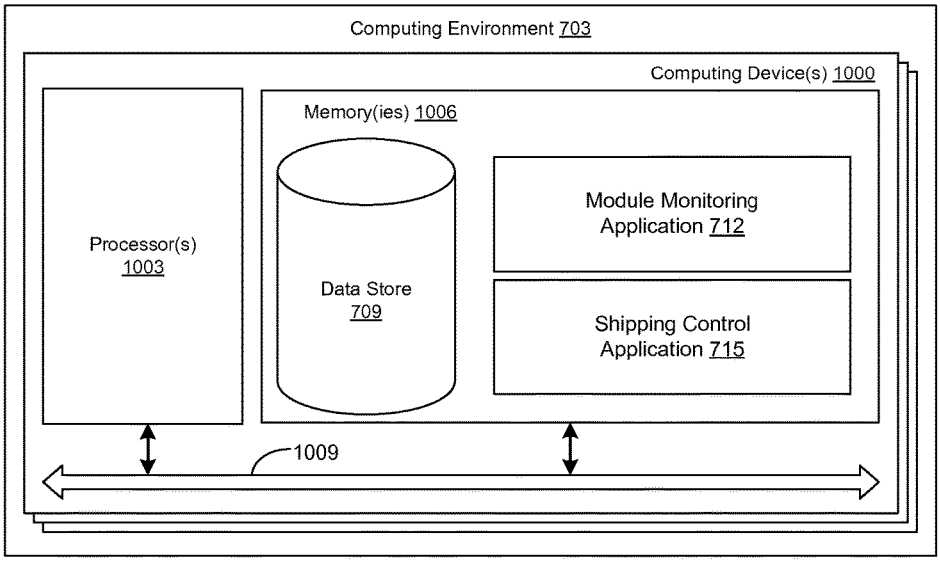

Computing Environment 703
Computing Device(s) 1000
Memory(ies) 1006
Processor(s) 1003
Data Store 709
Module Monitoring Application 712
Shipping Control Application 715
1009

FIG. 10

CONTAINERIZED TRANSPORTATION TRAILERS

BACKGROUND

A trailer is a multi-wheeled vehicle traditionally towed by a powered vehicle, such as a truck or a semi-trailer vehicle. Trailers are commonly employed to transport various items such as electronic goods, food products, raw materials, etc.

BRIEF DESCRIPTION OF THE DRAWINGS

Many aspects of the present disclosure can be better understood with reference to the following drawings. The components in the drawings are not necessarily to scale, with emphasis instead being placed upon clearly illustrating the principles of the disclosure. Moreover, in the drawings, like reference numerals designate corresponding parts throughout the several views.

FIG. **1** is a drawing of a containerized shipping trailer according to various embodiments of the present disclosure.

FIG. **2** is a drawing of a module moving apparatus employed in association with the containerized shipping trailer of FIG. **1** according to various embodiments of the present disclosure.

FIG. **3** is a top plan view of the module moving apparatus of FIG. **2** according to various embodiments of the present disclosure.

FIG. **4** is a side view of the module moving apparatus of FIG. **2** according to various embodiments of the present disclosure.

FIG. **5** is a top plan view of the module moving apparatus of FIG. **2** moving a module from a first containerized shipping trailer to a second containerized shipping trailer according to various embodiments of the present disclosure.

FIG. **6** is a top plan view of the containerized shipping trailer of FIG. **1** comprising a refrigeration unit according to various embodiments of the present disclosure.

FIG. **7** is a drawing of a networked environment according to various embodiments of the present disclosure.

FIG. **8** is a flowchart illustrating one example of functionality implemented by the module moving apparatus of FIG. **2** according to various embodiments of the present disclosure.

FIG. **9** is a flowchart illustrating one example of functionality implemented by the containerized shipping trailer of FIG. **1** according to various embodiments of the present disclosure.

FIG. **10** is a schematic block diagram that provides one example illustration of a computing environment employed in the networked environment of FIG. **7** according to various embodiments of the present disclosure.

DETAILED DESCRIPTION

The present disclosure relates to a containerized transportation trailer for efficient loading and unloading operations. A trailer is a multi-wheeled vehicle traditionally towed by a powered vehicle, such as a truck or a semi-trailer vehicle. Trailers are commonly employed to transport various items in shipping containers such as electronic goods, food products, raw materials, etc. Traditionally, items are loaded in a shipping container from the back of the container to the front, frequently described as a last-in-first-out (LIFO) operation. LIFO operations in transportation create increased labor costs and operational expenses, for example, because items must be removed from a front of a shipping container in order to access items stored in the middle or the back of the trailer. Hence, shipping operations are hindered as items at various locations of the trailer are inaccessible without performing unnecessary unload or load operations.

According to various embodiments, a containerized shipping trailer may be employed in the transportation of items. The containerized shipping trailer may include compartments where modules are stored. A module may include a container for storing goods or other items which may be removed independently from the containerized shipping trailer without first requiring a removal of other modules. The compartments may be located along at least one side of the containerized shipping trailer in various configurations of rows and columns. The modules may include electronic identifiers, such as radio-frequency identification (RFID) tags, that may be used for security, tracking, and/or refrigeration.

The modules may be removed from or inserted into compartments using a forklift or a similar device. In some embodiments, the modules may be moved using a module moving apparatus that performs automated removals and insertions of modules into a containerized shipping trailer. As described herein, a module moving apparatus includes a body configured to move horizontally along a rail to position the module moving apparatus at various locations for retrieval and/or insertion operations.

The module moving apparatus includes forks, such as those used on a forklift, which may be inserted into the modules in order to grip, lift, remove, and/or insert modules into the containerized shipper trailer. For example, the module moving apparatus may be configured to move along the rail to a position of a compartment housing a particular module in a containerized shipping trailer. The module moving apparatus inserts the forks into the module to secure the module to the forks. After securing the module, the module moving apparatus removes the module from the compartment and moves the module to a designated location, such as an inventory location in a warehouse or a compartment in another containerized shipping trailer.

In the following discussion, a general description of a containerized shipping trailer, a module moving apparatus, and their components is provided, followed by a discussion of the operation of the same.

With reference to FIG. **1**, shown is a non-limiting example of a containerized shipping trailer **100** according to various embodiments of the present disclosure. In the non-limiting example of FIG. **1**, the containerized shipping trailer **100** may comprise a shipping container (e.g., an intermodal shipping container) detachably attached to a trailer **102** comprising one or more compartments **103** configured to store one or more modules **106***a* . . . **106***o* (collectively modules **106**) at an interior of the containerized shipping trailer **100**. As shown in FIG. **1**, the one or more compartments **103** may be located longitudinally along at least one side of the containerized shipping trailer **100** in one or more rows and/or columns. At least one side of the modules **106** are exposed on at least one side of the containerized shipping trailer **100**. In the non-limiting example of FIG. **1**, the containerized shipping trailer **100** comprises eight compartments **103** on a first row and eight compartments **103** on a second row for a total of sixteen compartments **103**. As can be appreciated, other configurations of compartments **103** may be employed and there may be varying total numbers and sizes of compartments **103** and/or modules **106**.

In various embodiments of the present disclosure, a module **106** may comprise a modal and independently movable container which may be removed from the con-

tainerized shipping trailer **100** without requiring a removal of other modules **106**. For example, a centrally located one of the modules **106***g* may be removed from the middle of the containerized shipping trailer **100** without first requiring the removal of modules **106** located at the front or back of the containerized shipping trailer **100**. In some embodiments, the module **106** may comprise a substantially square-shaped or rectangular-shaped body made up of steel, aluminum, wood, plastic, or any other suitable material. In some embodiments, the module **106** may span a width of the containerized shipping trailer **100** such that one side of the module **106** is exposed on a first side of the containerized shipping trailer **100** and another side of the module **106** is exposed on a second side of the containerized shipping trailer **100**. As a result, the module **106** may be removed and/or inserted into the containerized shipping trailer **100** from either side.

In some embodiments, the module **106** may comprise an opening **109** at a top of the module **106**; however, in other embodiments, the module **106** may be closed on all sides with a door or removal cover on one or more sides. To facilitate removal or insertion of the module **106** into an interior of the containerized shipping trailer **100**, the module **106** may comprise one or more portals **112***a* . . . **112***b* (collectively portals **112**) configured to receive one or more projections of a moving device, such as a fork of a forklift or a fork of a module moving apparatus, as will be described below. Although the non-limiting example of FIG. **1** shows the portals **112***a* . . . **112***b* located at a bottom portion of the module **106**, in various embodiments, one or more of the portals **112** may be located at different locations of the module **106**. For example, the portals **112** may be located in a middle portion or a top portion of the module **106**. Further, in some embodiments, the module **106** may comprise a hand grip (not shown) that allows a person to manually remove the module **106** from the containerized shipping trailer **100**.

To facilitate movement using a semi-trailer or other suitable vehicle, the containerized shipping trailer **100** may comprise a plurality of wheels **115***a* . . . **115***b* (collectively wheels **115**) appropriate for supporting a weight of the containerized shipping trailer **100** as well as its contents. In the non-limiting example of FIG. **1**, the containerized shipping trailer **100** comprises a trailer stand **118** that may assist in supporting an end of the containerized shipping trailer **100** when the containerized shipping trailer **100** is not hitched or otherwise attached to a transportation vehicle or structure. In some embodiments, the trailer stand **118** may comprise a plurality of trailer stand wheels **121***a* . . . **121***b* (collectively trailer stand wheels **121**). Although shown in FIG. **1** detachably attached to a trailer, in various embodiments, the containerized shipping trailer **100** may be detachably attached to a rail car comprising a plurality of rail wheels for transportation on rail tracks, or may be detachably attached to any other suitable structure or support.

As may be appreciated, in some situations, it may be beneficial for personnel (e.g., truck drivers, warehouse operators, or other personnel) to access an interior of the containerized shipping trailer **100**. Accordingly, in some embodiments, the containerized shipping trailer **100** may comprise one or more doors **124** on either end that enable access to an interior of the containerized shipping trailer **100** by personnel.

In various embodiments, the containerized shipping trailer **100** may comprise a length of 28 feet, 48 feet, 53 feet, or any other suitable length. In some embodiments, the containerized shipping trailer **100** may comprise a height of 109 inches, or any other suitable height. In various embodiments, an exposed side **127** of the modules **106** is bounded on all sides by a surface **130** of the side of the containerized shipping trailer **100**. For example, a top, a bottom, a left side, and a right side of the exposed side **127** are bounded by the surface **130** of the side of the containerized shipping trailer **100**.

Referring next to FIG. **2**, shown is a non-limiting example of a module moving apparatus **200** according to various embodiments of the present disclosure. The module moving apparatus **200** may be employed to perform automated removals and insertions of modules **106** into one or more containerized shipping trailers **100**. In the non-limiting example of FIG. **2**, the module moving apparatus **200** may comprise a body **203** configured to move horizontally along a rail **206** to position the module moving apparatus **200** at various locations. In various embodiments, the body **203** of the module moving apparatus **200** may comprise one or more actuators, motors, powered cylinders, or other components capable of moving the module moving apparatus **200** horizontally along the rail **206** or about various axes of the rail **206** and/or the body **203** of the module moving apparatus **200**. For example, an actuator may be employed to move the module moving apparatus **200** towards or away from a side of a containerized shipping trailer **100**. Further, an actuator may be employed to rotate the module moving apparatus by a specified amount, e.g., 90, 180, 270 or 360 degrees. In some embodiments, a motor may be configured to move the body **203** of the module moving apparatus **200** about an axis to flip or rotate a module **106** from one side of the rail **206** to another side of the rail **206**.

In some embodiments, the containerized shipping trailer **100** is positioned parallel to the rail **206** such that the module moving apparatus can access the modules **106** on at least one side of the containerized shipping trailer **100**. For example, the module moving apparatus **200** may move to a first position to retrieve a module **106** from a compartment **103** of the containerized shipping trailer **100**. After retrieving the first module **106**, the module moving apparatus **200** may move along the rail **206** to a second position to insert the module **106** into a different compartment **103** of the first containerized shipping trailer **100** or into a compartment **103** of another containerized shipping trailer **100**.

To facilitate movement along the rail **206**, the body **203** of the module moving apparatus **200** may comprise a guide **209** that closely conforms to the rail **206**. Movement of the module moving apparatus **200** along the rail **206** may be employed using pneumatics, hydraulics, electrical motors, combustion engines, and/or other suitable mechanisms. The rail **206** may be supported by one or more rail support structures **212***a* . . . **212***b* (collectively rail support structures **212**), which may be detachably attached or secured to the ground for additional rigidity and support. In the non-limiting example of FIG. **2**, a portion of the rail **206** extends into an interior **215** of a structure **218**, such as a building or a warehouse. As a result, the module moving apparatus **200** may be employed to move modules **106** from the containerized shipping trailer **100** to the interior **215** of the structure **218**, and vice versa. At least a portion of the rail **206**, or an end of the rail **206**, may be detachably attached or secured to the structure **218** for support.

The structure **218** may include, but is not limited to, a materials handing center, a warehouse, residential building, commercial building, distribution center, crossdocking facility, train car, containerized shipping trailer **100**, order fulfillment center (also referred to as a fulfillment facility), packaging facility, shipping facility, distribution truck, cargo ship, or other facility or combination of facilities. In various

embodiments, the structure **218** may include a mobile cross-dock as described in U.S. patent application Ser. No. 14/496,301, entitled "MOBILE CROSSDOCK," filed on Sep. 25, 2014, which is hereby incorporated by reference in its entirety herein.

In various embodiments, the module moving apparatus **200** may comprise one or more projections **221***a* . . . **221***d* (collectively projections **221**) that may be used to detachably attach modules **106** to the module moving apparatus **200** or to otherwise grip, lift, move, remove, and/or insert modules **106**. In various embodiments, the projections **221** may comprise wheels, sliding components or other moving components that facilitate placement of the projections **221** into portals or other receptacles of the modules **106**.

As a non-limiting example, the module moving apparatus **200** may be configured to move along the rail **206** to a position corresponding to a compartment **103** of the containerized shipping trailer **100** housing a particular module **106**. While in this position, the module moving apparatus **200** may be configured to insert the one or more projections into portals **112** (FIG. **1**) of the particular module **106** located in the containerized shipping trailer **100**. After securing the module **106**, the module moving apparatus **200** may remove the module **106** from the compartment **103** of the containerized shipping trailer **100**. In various embodiments, the module moving apparatus may be configured to move the module **106** along the rail **206** to another position, for example, to insert the module **106** into a compartment **103** of another containerized shipping trailer **100**, move the module **106** into the interior **215** of the structure **218**, or move the module **106** into a different compartment **103** of the containerized shipping trailer **100**.

The module moving apparatus **200** of FIG. **2** is shown as having a first set of projections **221***a* . . . **221***b* at a first height and a second set of projections **221***c* . . . **221***d* located at a second height. As can be appreciated, the first set of projections **221***a* . . . **221***b*, extended vertically using a vertical support rail **224**, may be used to retrieve and/or insert modules **106** into a compartment **103** at a height above the second set of projections **221***a* . . . **221***b*. For example, the first set of projections **221***a* . . . **221***b* may be used to retrieve and/or insert modules **106** into compartments **103** on a top row of the containerized shipping trailer **100**. The second set of projections **221***c* . . . **221***d* may be used to retrieve and/or insert modules **106** into a compartment **103** at a height below the first set of projections **221***a* . . . **221***b*. For example, the second set of projections **221***c* . . . **221***d* may be used to retrieve and/or insert modules **106** into compartments **103** on a bottom row of the containerized shipping trailer **100**. Additionally or alternatively, any of the projections **221** may be configured to move vertically in order to facilitate movement or transfer of modules **106** between compartments **103** at different heights of the containerized shipping trailer **100**.

In various embodiments, an exterior-facing portion **227** of a module **106** may be configured such that the exterior-facing portion **227** of the module **106** is flush with an exterior **130** of the containerized shipping trailer **100** housing the module **106**. For example, the module **106** may be configured to comprise no additional cover plates, portals **112**, or facades to create a smooth, closed surface on the exterior **130** of the containerized shipping trailer **100**. In embodiments where the modules **106** comprise one or more portals **112**, the one or more of the portals **112** of the modules **106** may be closed, e.g., by hinged, spring-loaded cover plates, thereby creating a smooth surface on the exterior **130** of the containerized shipping trailer **100**. In various embodiments, the hinged, spring-loaded cover plates enable access to the portals **112** in response to placement of a predefined amount of force against the cover plates, e.g., by a projection **221**, as it is used to insert or retrieve the module **106**. As a result, the hinged, spring-loaded cover plates may be employed to access the portals **112** without requiring additional operations or steps to be performed.

Turning now to FIG. **3**, shown is a top plan view of the module moving apparatus **200** according to various embodiments of the present disclosure. The module moving apparatus **200** may move horizontally along a rail **206** to position the module moving apparatus **200** at various locations. For example, the module moving apparatus **200** may move to a first position to retrieve a module **106** (FIG. **1**) from a compartment **103***a* of the containerized shipping trailer **100**. After retrieving the first module **106**, the module moving apparatus **200** may move along the rail **206** to a second position to insert the module **106** into a different compartment **103***b* of the containerized shipping trailer **100** or into a compartment **103** of another containerized shipping trailer **100**. In various embodiments, the body **203** of the module moving apparatus **200** may rotate about an axis from a first orientation to a second orientation. For example, the module moving apparatus **200** may be configured to rotate 360 degrees, or any other predefined amount, about an axis of the body **203** of the module moving apparatus **200**. As a result, the module moving apparatus **200** may retrieve a module **106** while facing a side of a containerized shipping trailer **100** and rotate 180 degrees, for example, to place the module **106** in a different containerized shipping trailer **100**.

In various embodiments, the body **203** of the module moving apparatus **200** may comprise a flat top surface comprising a sliding mechanism (not shown), wherein the projections **221** are configured to slide across the sliding mechanism to access modules **106** from either side of the module moving apparatus **200** and/or to move a module **106** from a first side of the module moving apparatus **200** to a second side of the module moving apparatus **200**. For example, the module moving apparatus **200** may retrieve a module **106** from a side of a first containerized shipping trailer **100** and slide the module **106** across the sliding mechanism situated on a top of the body **203** to insert the module **106** into a second containerized shipping trailer **100** located on a different side of the module moving apparatus **200**.

As noted above, the rail **206** may be supported by one or more rail support structures **221***a* . . . **221***e*. In the non-limiting example of FIG. **3**, an end **303** of the rail **206** extends into the interior **215** of the structure **218**, which may comprise a materials handling center or a warehouse. As a result, the module moving apparatus **200** may be employed to move modules **106** from the containerized shipping trailer **100** to the interior **215** of the structure **218**, and vice versa. In various embodiments, the end **303** of the rail **206** may be detachably attached or secured to the structure **218** for support.

In various embodiments, the module moving apparatus **200** may comprise one or more projections **221***a* . . . **221***b* that may be used to detachably attach modules **106** to the module moving apparatus **200**. In various embodiments, the projections **221***a* . . . **221***b* comprise forks configured to insert into one or more portals **112***a* . . . **112***b* of a module **106**. In other embodiments, the projections **221***a* . . . **221***b* may comprise grippers used to move a module **106** by applying pressure to at least two sides of the module **106**. To this end, the module **106** may be gripped, lifted, moved,

removed, rotated, and/or inserted into compartments **103** or other locations, such as inventory locations in the structure **218**.

As a non-limiting example, the module moving apparatus **200** may be configured to move along the rail **206** to a position corresponding to a compartment **103***a* of the containerized shipping trailer **100** housing a particular module **106**. While in this position, the module moving apparatus **200** may be configured to insert the projections **221***a* . . . **221***b* into the portals **112***a* . . . **112***b* of the particular module **106** located in the compartment **103***a*. After securing the module **106** using the projections **221***a* . . . **221***b*, the module moving apparatus **200** may remove the module **106** from the compartment **103** of the containerized shipping trailer **100**. In various embodiments, the module moving apparatus **200** may be configured to move the module **106** along the rail **206** to another position to insert the module **106** into another compartment **103***b* of the containerized shipping trailer **100**. In other embodiments, the module moving apparatus **200** may be configured to move the module **106** into the interior **215** of the structure **218** or move the module **106** into a compartment **103** of a different containerized shipping trailer **100**.

In the non-limiting example of FIG. **3**, the compartments **103** are shown extending a width of the containerized shipping trailer **100**. As a result, modules **106** stored in the compartments **103** may be configured to extend the width of the containerized shipping trailer **100** such that a first side of a module **106** may be accessed from one side of the containerized shipping trailer **100** and a second side of the module **106** may be accessed from the other side of the containerized shipping trailer **100**. In various embodiments, a module moving apparatus **200** may access the modules **106** and/or the compartments **103** from either side of the containerized shipping trailer **100**. In some embodiments, the compartments **103** may extend a portion of the width of the containerized shipping trailer **100**, and may be removed from only one side of the containerized shipping container **100**.

Moving on to FIG. **4**, shown is a side view of the module moving apparatus **200** according to various embodiments of the present disclosure. As noted above, the module moving apparatus **200** may move horizontally along the rail **206** to position the module moving apparatus **200** at various locations. For example, the module moving apparatus **200** may move to a first position to retrieve a module **106** from a compartment **103** (FIG. **1**) of the containerized shipping trailer **100**. After retrieving the first module **106**, the module moving apparatus **200** may move along the rail **206** to a second position to insert the module **106** into a different compartment **103** of the containerized shipping trailer **100** or into a compartment **103** of another containerized shipping trailer **100**.

The rail **206** may be supported by one or more rail support structures **212***a* . . . **221***e*. In the non-limiting example of FIG. **4**, the end **303** of the rail **206** extends into the interior **215** of the structure **218**, which may comprise a materials handling center or a warehouse. As a result, the module moving apparatus **200** may be employed to move modules **106** from the containerized shipping trailer **100** to the interior **215** of the structure **218**, and vice versa. In various embodiments, the end **303** of the rail **206** may be detachably attached or secured to the structure **218** for support.

As noted above, the module moving apparatus **200** may comprise one or more projections **221** (FIG. **2**) that may be used to detachably attach modules **106** to the module moving apparatus **200**. For example, the projections **221** may comprise forks configured to insert into one or more portals **112** (FIG. **1**) of a module **106**. In other embodiments, the projections **221** may comprise grippers used to move a module **106** by applying pressure to at least two sides of the module **106**. To this end, the module **106** may be gripped, lifted, moved, removed, rotated, and/or inserted into compartments **103** or other locations, such as inventory locations in the structure **218**.

In an exemplary operation of the module moving apparatus **200**, the module moving apparatus **200** may be configured to move along the rail **206** to a position corresponding to a compartment **103** of the containerized shipping trailer **100** housing a particular module **106**. While in this position, the module moving apparatus **200** may be configured to insert a first set of projections **221** into the portals **112** of the particular module **106**. After securing the module **106** using the projections **221**, the module moving apparatus **200** may remove the module **106** from the compartment **103** of the containerized shipping trailer **100**. In some scenarios, the module **106** may need to be placed in a compartment **103** already housing another module **106**. The module moving apparatus **200** may use a second set of projections **221** to access the module **106** currently residing in the desired compartment **103**. As a result, the module moving apparatus **200** is able to hold or otherwise secure a plurality of modules **106** at a given time. Once the compartment **103** is available (e.g., the compartment **103** is no longer housing another module **106**), the appropriate module **106** may be inserted into the designated compartment **103** of the containerized shipping trailer **100**.

In the non-limiting example of FIG. **4**, the module moving apparatus **200** is shown as having a vertical support rail **224** used to retrieve and/or insert modules **106** into a compartment **103** at varying heights. The vertical support rail **224** may be coupled to one or more projections **221**, and/or any other suitable components, that may be moved to adjust a vertical height of the projections **221**, for example, to engage modules **106** located at various heights. As a result, the module moving apparatus **200** is able to move vertically to cope with trailers of different heights as well as extracting modules **106** from compartments **103** at different layers or rows of the containerized shipping trailer **100**.

Referring next to FIG. **5**, shown is a top plan view of the module moving apparatus **200** moving a module **106** from a first compartment **103***a* in a first containerized shipping trailer **100***a* to a second compartment **103***b* in a second containerized shipping trailer **100***b*. In the non-limiting example of FIG. **5**, the module moving apparatus **200** comprises a plurality of projections **221***a* . . . **221***f* that are used to grip sides of the module **106** for transport. In alternative embodiments, the projections **221***a* . . . **221***f* may comprise forks for insertion into one or more portals **112** of the module **106**. In various embodiments, the module moving apparatus **200** may be employed without a structure **218** (FIG. **2**) to allow for crossdock operations at various locations, e.g., flexible, temporary and/or on-demand crossdock operations. For example, the module moving apparatus **200** may be placed in a parking lot of an existing facility away from the existing dock doors to avoid additional construction costs. Further, this allows for the placement of module moving apparatus **200** in locations where distribution centers are not be feasible.

The module moving apparatus **200** may move to an appropriate position on the rail **206** to retrieve the module **106** from the first compartment **103***a* of the first containerized shipping trailer **100***a*. Once retrieved, the module moving apparatus **200** may rotate about an axis of the rail

206 from a first orientation (e.g., facing the first containerized shipping trailer 100*a*) to a second orientation (e.g., facing a second containerized shipping trailer 100*b*) to position the module 106 on the side of the second containerized shipping trailer 100*b*. The module 106 may be moved by the module moving apparatus 200 to an appropriate position on the rail 206 to insert the module 106 into the second compartment 103*b* of the second containerized shipping trailer 100*b*. Alternatively, instead of rotating the module 106, the module moving apparatus 200 may be configured to retrieve the module 106 from the first compartment 103*a* of the first containerized shipping trailer 100*a* and slide or otherwise linearly move the module 106 to another side of the module moving apparatus 200 closer to the second containerized shipping trailer 100*b* to insert the module into the second compartment 103*b*.

Referring next to FIG. 6, shown is a top plan view of an embodiment of a containerized shipping trailer 100 according to various embodiments of the present disclosure. In the non-limiting example of FIG. 6, the containerized shipping trailer 100 comprises a refrigeration unit 600 that is configured to refrigerate one or more compartments 103*a* . . . 103*n* and/or the modules 106 (FIG. 1) housed within the compartments 103*a* . . . 103*n*. To this end, the containerized shipping trailer 100 may comprise a refrigeration line 603 that delivers cool air to compartments 103*a* . . . 103*n* within the containerized shipping trailer 100.

As a non-limiting example, a module 106 may be inserted into at least one of the compartments 103*a* . . . 103*n*. The containerized shipping trailer 100 may comprise processing circuitry that recognizes whether the module 106 requires refrigeration. The module 106 may comprise a portal, a vent, or another opening that may couple to an output of the refrigeration line 603. Assuming the module 106 requires refrigeration, refrigeration may be provided to the module 106 by the refrigeration unit 600. If the module 106 does not require refrigeration, a vent, portal, or other opening to the corresponding one of the compartments 103*a* . . . 103*n* may be closed such that the module 106 will not be provided with refrigeration.

Although described with respect to refrigeration, other resources may be provided to the compartments 103 and/or modules 106 housed within the compartments 103. In various embodiments, the compartments 103 and/or modules 106 housed within those compartments 103 may be provided with heat, electrical power, networking resources (e.g., wireless fidelity (WiFi)), location-based resources (e.g., global positioning system (GPS)), or other resources. The processing circuitry of the containerized shipping trailer 100 may be configured to detect requested resources by communicating with the module 106. In various embodiments, the module 106 may comprise a passive or active RFID tag comprising identification of the resources requested.

In the non-limiting example of FIG. 6, the compartments 103 are shown extending a portion of a width of the containerized shipping trailer 100. As a result, modules 106 stored in these compartments 103 may only be accessed from one side of the containerized shipping trailer 100. In other embodiments, such as the non-limiting example of FIG. 3, the compartments 103 may extend an entire width of the containerized shipping trailer 100. As a result, the modules 106 stored therein may be accessed from either side of the containerized shipping container 100.

With reference to FIG. 7, shown is a networked environment 700 according to various embodiments. The networked environment 700 includes a computing environment 703, a containerized shipping trailer 100, a module moving apparatus 200, and/or a module 106, which are in data communication with each other via a network 706. The network 706 includes, for example, the Internet, intranets, extranets, wide area networks (WANs), local area networks (LANs), wired networks, wireless networks, or other suitable networks, etc., or any combination of two or more such networks. For example, such networks may comprise satellite networks, cable networks, Ethernet networks, and other types of networks.

The computing environment 703 may comprise, for example, a server computer or any other system providing computing capability. Alternatively, the computing environment 703 may employ a plurality of computing devices that may be arranged, for example, in one or more server banks or computer banks or other arrangements. Such computing devices may be located in a single installation or may be distributed among many different geographical locations. For example, the computing environment 703 may include a plurality of computing devices that together may comprise a hosted computing resource, a grid computing resource and/or any other distributed computing arrangement. In some cases, the computing environment 703 may correspond to an elastic computing resource where the allotted capacity of processing, network, storage, or other computing-related resources may vary over time.

Various applications and/or other functionality may be executed in the computing environment 703 according to various embodiments. Also, various data is stored in a data store 709 that is accessible to the computing environment 703. The data store 709 may be representative of a plurality of data stores 709 as can be appreciated. The data stored in the data store 709, for example, is associated with the operation of the various applications and/or functional entities described below.

The components executed on the computing environment 703, for example, include a module monitoring application 712, a shipping control application 715, and other applications, services, processes, systems, engines, or functionality not discussed in detail herein. The module monitoring application 712 is executed to maintain a database or other listing of data associated with modules 106 in the data store 709. The data associated with the modules 106 may include, for example, the items or inventory within the module 106, required resources for the module, a current location of the module 106, a destination location, an originating location, a unique identifier, handling information, compartment information, and/or other information.

The shipping control application 715 is executed to generate manifests for the module moving apparatus 200. A manifest may comprise directions for the module moving apparatus 200 to perform in association with one or more containerized shipping trailers 100. For example, the manifest may comprise directions regarding which modules 106 are to be placed into or removed from a particular compartment 103 of a containerized shipping trailer 100. In other words, the manifest may include instructions that can be performed automatically by the module moving apparatus 200 to automatically perform a retrieval of a specified module 106 from a first location as well as a placement of the specified module 106 at a second location. To this end, the manifest may be generated automatically based on orders. In other embodiments, the manifest may be generated manually by an administrator.

In various embodiments, the containerized shipping trailer 100 may comprise processing circuitry 718*a*, sensors 721*a*, network interfaces 724*a*, and/or a container data store 727. The processing circuitry 718*a* may comprise, for

example, a hardware processor, a microcontroller, one or more integrated circuits, and/or other components. The sensors **721***a* may comprise, for example, an RFID reader or other sensors that may detect the presence of a module **106** in a respective compartment **103**. For example, the sensors **721***a* may be configured to detect an electronic identifier **730** (e.g., an RFID tag) associated with a module **106**.

The electronic identifiers **730** may be used for security, tracking, refrigeration, and/or accessing other resources. To this end, in various embodiments, the electronic identifiers **730** may comprise a passive or active RFID tag, a WiFi beacon, and/or electronically stored information. The electronically stored information may comprise a listing of the items or inventory within the module **106**, required resources for the module, whether a lock of a module **106** has been opened or otherwise engaged, whether the module **106** has been opened, a list of those who have opened or accessed the module **106**, a current location of the module **106**, a destination location, an originating location, a unique identifier, a cargo manifest, handling information, compartment information, and/or other information. As a non-limiting example, the contents of the module **106** may not be accessed without authenticating proper credentials (e.g., personal identification (PIN) numbers) designated by the electronic identifier **730**. Similarly, the electronic identifier **730** may set forth resources required or requested by the module **106**. For example, the electronic identifier **730** may be used to notify the containerized shipping trailer **100** that the module **106** requires refrigeration to refrigerate perishable items in the module **106**. Further, the electronic identifier **730** may comprise a digital manifest to cross-check loading or unloading operations. As may be appreciated, in some scenarios, the digital manifest may be used for customs or regulatory compliance. In various embodiments, the module **106** may comprise other digital security mechanisms (as well as a physical lock) to prohibit access to or moving of the modules **106** into or from a containerized shipping trailer **100** and/or accessing the contents of the modules **106**. The digital manifest may comprise a key used to decrypt information stored on the module **106** and/or the containerized shipping trailer **100**. In various embodiments, the key may be used to electronically lock or unlock a module **106**.

The network interface **724***a* may comprise, for example, a global system for mobile communication (GSM) module, a code division multiple access (CDMA) module, a WiFi module, or another network interface. In various embodiments, the network interface **724***a* enables the modules **106** and/or the containerized shipping trailer **100** to communicate information to the computing environment **703**. The processing circuitry **718***a* may be configured to maintain a log of information associated with modules **106** housed within the containerized shipping trailer **100**, for example, in the container data store **727**.

In various embodiments, the module moving apparatus **200** may comprise processing circuitry **718***b*, sensors **721***b*, and/or network interfaces **724***b*. The processing circuitry **718***b* may comprise, for example, a hardware processor, a microcontroller, one or more integrated circuits, and/or other components. The sensors **721***b* may comprise, for example, an RFID reader or other sensors that may detect the presence of a module **106** in a respective compartment **103**. For example, the module moving apparatus **200** may confirm an identity of a module **106** before removing a module **106** from or inserting a module **106** into a compartment **103**. The network interface **724***b* may comprise, for example, a GSM module, a CDMA module, a WiFi module, or another network interface. In various embodiments, the network interface **724***b* enables the modules **106** and/or the containerized shipping trailer **100** to communicate information to the computing environment **703**. The processing circuitry **718***b* may be configured to cause the module moving apparatus **200** to perform a retrieval and/or insertion of modules **106** according to a manifest **733** generated by the shipping control application **715**.

Next, a general description of the operation of the various components of the networked environment **700** is provided. To begin, the shipping control application **715** is executed to generate a manifest **733** for a module moving apparatus **200** that directs a retrieval and/or insertion of one or more modules **106** into one or more containerized shipping trailers **100**. For example, the manifest **733** may direct the module moving apparatus **200** to retrieve a module **106** from a compartment **103** of a first containerized shipping trailer **100** and place the module **106** in a compartment **103** of a second containerized shipping trailer **100**.

Upon retrieval of the module **106**, the module moving apparatus **200** may confirm the identity of the module **106** by using a sensor **721***b* to read the electronic identifier **730**. Once the identity is confirmed, the module moving apparatus **200** may move the module **106** as designated by the manifest **733**. As a module **106** is placed in a containerized shipping trailer **100**, the containerized shipping trailer **100** may use sensors **721***a* to detect any requested or required resources set forth in the electronic identifier **730**. For example, in some embodiments, the module **106** may require refrigeration. The processing circuitry **718***a* may cause a refrigeration unit **600** (FIG. **6**) to provide the module **106** with refrigeration. Similarly, other resources may be provided to the module **106**. In various embodiments, the module **106** may be provided with heat, electrical power, networking resources (e.g., wireless fidelity (WiFi)), location-based resources (e.g., global positioning system (GPS)), or other resources, as set forth in the electronic identifier **730**.

Referring next to FIG. **8**, shown is a flowchart that provides one example of the operation of the module moving apparatus **200** according to various embodiments. It is understood that the flowchart of FIG. **8** provides merely an example of the many different types of functional arrangements that may be employed to implement the operation of the module moving apparatus **200** as described herein. As an alternative, the flowchart of FIG. **8** may be viewed as depicting an example of elements of a method implemented by the processing circuitry **718***b* (FIG. **7**) of the module moving apparatus **200** according to one or more embodiments.

Beginning with **803**, the module moving apparatus **200** may move from a current position to a desired position for retrieval of a module **106**. In various embodiments, the retrieval of the module **106** may be directed by a manifest **733** (FIG. **7**) generated by the shipping control application **715** (FIG. **7**) and communicated to the module moving apparatus **200** over the network **706** (FIG. **7**) via network interface **724***b*. Using pneumatics, hydraulics, electrical motors, combustion engines, and/or other suitable mechanisms, the processing circuitry **718***b* may direct the movement of the body **203** (FIG. **2**) of the module moving apparatus **200** to an appropriate position along the rail **206** (FIG. **2**).

In various embodiments, the position of the body **203** of the module moving apparatus **200** on the rail **206** may be determined by capturing digital images of distance markers or other fiducials on the rail **206** indicative of a position of the body **203** on the rail **206**. In other embodiments, the

module moving apparatus **200** may employ laser or sonar distance measurement that sends a visual or audio pulse, respectively, towards a predefined target and measures the time taken by the pulse to be reflected off the target and returned. In some embodiments, the module moving apparatus **200** may calculate a position of the body **203** of the module moving apparatus **200** by using a number of rotations of a motor, or appropriate actuation of an actuator, used to move the body **203** of the module moving apparatus **200**.

In various embodiments, an identity of the module **106** at the position of the module moving apparatus **200** may be confirmed prior to retrieval of the module **106**. In various embodiments, the module moving apparatus **200** may interrogate a sensor (e.g., an RFID tag) associated with the module **106** and/or the containerized shipping trailer **100** to compare a unique identifier associated with the module **106** to a unique identifier in a digital manifest. In other words, the module **106** is interrogated to verify that the module **106** is a correct module for retrieval or placement based on the manifest **733** and data received from the module **106** using a sensor **721***b* of the module moving apparatus. Further, the unique identifier, as well as any other electronically stored information onboard the module **106**, may be encrypted to prevent unauthorized access to the electronically stored information. In various embodiments, the module moving apparatus **200** may be configured to decrypt the information to confirm the identity of the module **106** prior to retrieval.

Next, in **806**, the module moving apparatus **200** may perform a retrieval of the module **106** by inserting one or more projections **221** (FIG. **1**) into one or more portals **112** (FIG. **1**) of the module **106**. In other embodiments, the projections **221** may comprise grippers used to move a module **106** by applying pressure to at least two sides of the module **106**. As a result, the module **106** may be gripped, lifted, moved, removed, rotated, and/or inserted into compartments **103** or other locations, such as inventory locations in the structure **218** (FIG. **2**).

In **809**, it is determined whether the module **106** to be retrieved is secured to the projections **221** to avoid potential damage of the module **106** or items within the module **106**. In various embodiments, a weight sensor may be used to determine whether a substantial amount of weight of the module **106** has been applied to the module **106** that may indicate that the module **106** is properly residing on the projections **221**. If the module **106** is not secured to the projections, the process may proceed to **812** where a remedial action may be performed, such as triggering an alarm, repositioning the body **203** of the module moving apparatus **200**, re-inserting the module **106** in the compartment **103**, re-inserting the projections **221** into the portals **112**, or any other appropriate action.

Assuming the module is properly secured to the projections **221**, the process proceeds to **815** where the module is fully removed from the first containerized shipping trailer **100**. Removal may include pulling an entirety of the module **106** from an interior of the first containerized shipping trailer **100**.

Next, in **818**, the module moving apparatus **200** moves from its current position on the rail **206** to a desired position on the rail **206** for placement of the module **106** in a suitable location, such as the interior **215** (FIG. **2**) of a structure **218** or in a compartment **103** of a second containerized shipping trailer **100**. In **821**, the module moving apparatus **200** may insert the module **106**, for example, into a designated compartment **103** of the second containerized shipping trailer **100**.

Moving on to FIG. **9**, shown is a flowchart that provides one example of the operation of the containerized shipping trailer **100** according to various embodiments. It is understood that the flowchart of FIG. **9** provides merely an example of the many different types of functional arrangements that may be employed to implement the operation of the containerized shipping trailer **100** as described herein. As an alternative, the flowchart of FIG. **9** may be viewed as depicting an example of elements of a method implemented by the processing circuitry **718***a* (FIG. **7**) of the containerized shipping trailer **100** according to one or more embodiments.

Beginning with **903**, the placement of a module **106** (FIG. **1**) within the containerized shipping trailer **100** is verified. To this end, one or more sensors **721***a* (FIG. **7**) of the containerized shipping trailer **100** may be employed to determine whether the module **106** has been placed in the containerized shipping trailer **100**. For example, an RFID reader may be used to read an electronic identifier **730** (FIG. **7**) (e.g., an RFID tag) of the module **106**. In other embodiments, a weight sensor, an image recognition device, sonar, or any other suitable device may be used to determine whether the module **106** has been placed within the containerized shipping trailer **100**.

Next, in **906**, it is determined whether the module **106** requires one or more resources provided by the containerized shipping trailer **100**. As noted above, in some embodiments, the containerized shipping trailer **100** may comprise a refrigeration unit **600** (FIG. **6**) configured to refrigerate one or more of the modules **106** within the containerized shipping trailer **100**. The containerized shipping trailer **100** may read data from the electronic identifier **730** to determine whether the module **106** requires refrigeration. Assuming the module **106** requires refrigeration, refrigeration may be provided to the module **106** by the refrigeration unit **600**. If the module **106** does not require refrigeration, a vent, portal, or other opening to the corresponding one of the compartments **103***a* . . . **103***n* may be closed such that the module **106** will not be provided with refrigeration.

Accordingly, in **909**, if the module requires (or requests) resources from the containerized shipping trailer **100**, the containerized shipping trailer **100** may provide the required resources to the module **106**. Although described with respect to refrigeration, other resources may be provided to the compartments **103** and/or modules **106** housed within the compartments **103**. In various embodiments, the compartments **103** and/or modules **106** housed within those compartments **103** may be provided with heat, electrical power, networking resources (e.g., wireless fidelity (WiFi)), location-based resources (e.g., global positioning system (GPS)), or other resources. The processing circuitry of the containerized shipping trailer **100** may be configured to detect requested resources by communicating with the module **106**. In various embodiments, the module **106** may comprise a passive or active RFID tag comprising identification of the resources requested.

Assuming the module **106** does not require resources, the process may proceed to **912** where the module **106** may be monitored. In various embodiments, monitoring of the module **106** may include periodically measuring a temperature of the module **106**, accessing data communicated from the module **106** to the containerized shipping trailer **100**, determining whether the module **106** has been removed from the containerized shipping trailer **100**, etc. In **915**, any events and/or measurements taken during a monitoring of the module **106** may be logged, e.g., in the container data store

727, for transmission to the computing environment **703** (FIG. **7**) over the network **706** (FIG. **7**) via network interface **724***a*.

With reference to FIG. **10**, shown is a schematic block diagram of the computing environment **703** according to an embodiment of the present disclosure. The computing environment **703** includes one or more computing devices **1000**. Each computing device **1000** includes at least one processor circuit, for example, having a processor **1003** and a memory **1006**, both of which are coupled to a local interface **1009**. To this end, each computing device **1000** may comprise, for example, at least one server computer or like device. The local interface **1009** may comprise, for example, a data bus with an accompanying address/control bus or other bus structure as can be appreciated.

Stored in the memory **1006** are both data and several components that are executable by the processor **1003**. In particular, stored in the memory **1006** and executable by the processor **1003** are the module monitoring application **712**, the shipping control application **715**, and potentially other applications. Also stored in the memory **1006** may be a data store **709** and other data. In addition, an operating system may be stored in the memory **1006** and executable by the processor **1003**.

It is understood that there may be other applications that are stored in the memory **1006** and are executable by the processor **1003** as can be appreciated. Where any component discussed herein is implemented in the form of software, any one of a number of programming languages may be employed such as, for example, C, C++, C#, Objective C, Java®, JavaScript®, Perl, PHP, Visual Basic®, Python®, Ruby, Flash®, or other programming languages.

A number of software components are stored in the memory **1006** and are executable by the processor **1003**. In this respect, the term "executable" means a program file that is in a form that can ultimately be run by the processor **1003**. Examples of executable programs may be, for example, a compiled program that can be translated into machine code in a format that can be loaded into a random access portion of the memory **1006** and run by the processor **1003**, source code that may be expressed in proper format such as object code that is capable of being loaded into a random access portion of the memory **1006** and executed by the processor **1003**, or source code that may be interpreted by another executable program to generate instructions in a random access portion of the memory **1006** to be executed by the processor **1003**, etc. An executable program may be stored in any portion or component of the memory **1006** including, for example, random access memory (RAM), read-only memory (ROM), hard drive, solid-state drive, USB flash drive, memory card, optical disc such as compact disc (CD) or digital versatile disc (DVD), floppy disk, magnetic tape, or other memory components.

The memory **1006** is defined herein as including both volatile and nonvolatile memory and data storage components. Volatile components are those that do not retain data values upon loss of power. Nonvolatile components are those that retain data upon a loss of power. Thus, the memory **1006** may comprise, for example, random access memory (RAM), read-only memory (ROM), hard disk drives, solid-state drives, USB flash drives, memory cards accessed via a memory card reader, floppy disks accessed via an associated floppy disk drive, optical discs accessed via an optical disc drive, magnetic tapes accessed via an appropriate tape drive, and/or other memory components, or a combination of any two or more of these memory components. In addition, the RAM may comprise, for example, static random access memory (SRAM), dynamic random access memory (DRAM), or magnetic random access memory (MRAM) and other such devices. The ROM may comprise, for example, a programmable read-only memory (PROM), an erasable programmable read-only memory (EPROM), an electrically erasable programmable read-only memory (EEPROM), or other like memory device.

Also, the processor **1003** may represent multiple processors **1003** and/or multiple processor cores and the memory **1006** may represent multiple memories **1006** that operate in parallel processing circuits, respectively. In such a case, the local interface **1009** may be an appropriate network that facilitates communication between any two of the multiple processors **1003**, between any processor **1003** and any of the memories **1006**, or between any two of the memories **1006**, etc. The local interface **1009** may comprise additional systems designed to coordinate this communication, including, for example, performing load balancing. The processor **1003** may be of electrical or of some other available construction.

Although the module monitoring application **712**, the shipping control application **715**, and other various systems described herein may be embodied in software or code executed by general purpose hardware as discussed above, as an alternative the same may also be embodied in dedicated hardware or a combination of software/general purpose hardware and dedicated hardware. If embodied in dedicated hardware, each can be implemented as a circuit or state machine that employs any one of or a combination of a number of technologies. These technologies may include, but are not limited to, discrete logic circuits having logic gates for implementing various logic functions upon an application of one or more data signals, application specific integrated circuits (ASICs) having appropriate logic gates, field-programmable gate arrays (FPGAs), or other components, etc. Such technologies are generally well known by those skilled in the art and, consequently, are not described in detail herein.

The flowcharts of FIGS. **8** and **9** show the functionality and operation of an implementation of the module moving apparatus **200** (FIG. **2**) and the containerized shipping trailer **100** (FIG. **1**), respectively. If embodied in software, each block may represent a module, segment, or portion of code that comprises program instructions to implement the specified logical function(s). The program instructions may be embodied in the form of source code that comprises human-readable statements written in a programming language or machine code that comprises numerical instructions recognizable by a suitable execution system such as a processor **1003** in a computer system or other system. The machine code may be converted from the source code, etc. If embodied in hardware, each block may represent a circuit or a number of interconnected circuits to implement the specified logical function(s).

Although the flowcharts of FIGS. **8** and **9** show a specific order of execution, it is understood that the order of execution may differ from that which is depicted. For example, the order of execution of two or more blocks may be scrambled relative to the order shown. Also, two or more blocks shown in succession in FIGS. **8** and **9** may be executed concurrently or with partial concurrence. Further, in some embodiments, one or more of the blocks shown in FIGS. **8** and **9** may be skipped or omitted. In addition, any number of counters, state variables, warning semaphores, or messages might be added to the logical flow described herein, for purposes of enhanced utility, accounting, performance measurement, or

providing troubleshooting aids, etc. It is understood that all such variations are within the scope of the present disclosure.

Also, any logic or application described herein, including the module monitoring application **712** and the shipping control application **715**, that comprises software or code can be embodied in any non-transitory computer-readable medium for use by or in connection with an instruction execution system such as, for example, a processor **1003** in a computer system or other system. In this sense, the logic may comprise, for example, statements including instructions and declarations that can be fetched from the computer-readable medium and executed by the instruction execution system. In the context of the present disclosure, a "computer-readable medium" can be any medium that can contain, store, or maintain the logic or application described herein for use by or in connection with the instruction execution system.

The computer-readable medium can comprise any one of many physical media such as, for example, magnetic, optical, or semiconductor media. More specific examples of a suitable computer-readable medium would include, but are not limited to, magnetic tapes, magnetic floppy diskettes, magnetic hard drives, memory cards, solid-state drives, USB flash drives, or optical discs. Also, the computer-readable medium may be a random access memory (RAM) including, for example, static random access memory (SRAM) and dynamic random access memory (DRAM), or magnetic random access memory (MRAM). In addition, the computer-readable medium may be a read-only memory (ROM), a programmable read-only memory (PROM), an erasable programmable read-only memory (EPROM), an electrically erasable programmable read-only memory (EEPROM), or other type of memory device.

Further, any logic or application described herein, including the module monitoring application **712** and the shipping control application **715**, may be implemented and structured in a variety of ways. For example, one or more applications described may be implemented as modules or components of a single application. Further, one or more applications described herein may be executed in shared or separate computing devices or a combination thereof. For example, a plurality of the applications described herein may execute in the same computing device **1000**, or in multiple computing devices in the same computing environment **703**. Additionally, it is understood that terms such as "application," "service," "system," "engine," "module," and so on may be interchangeable and are not intended to be limiting.

Disjunctive language such as the phrase "at least one of X, Y, or Z," unless specifically stated otherwise, is otherwise understood with the context as used in general to present that an item, term, etc., may be either X, Y, or Z, or any combination thereof (e.g., X, Y, and/or Z). Thus, such disjunctive language is not generally intended to, and should not, imply that certain embodiments require at least one of X, at least one of Y, or at least one of Z to each be present.

It should be emphasized that the above-described embodiments of the present disclosure are merely possible examples of implementations set forth for a clear understanding of the principles of the disclosure. Many variations and modifications may be made to the above-described embodiment(s) without departing substantially from the spirit and principles of the disclosure. All such modifications and variations are intended to be included herein within the scope of this disclosure and protected by the following claims.

Therefore, the following is claimed:

1. A system, comprising:

a shipping container, comprising:

a first side and a second side;

a plurality of compartments positioned longitudinally along the shipping container, the plurality of compartments being defined by a plurality of openings between the first side and the second side of the shipping container;

a plurality of modules positioned in the plurality of compartments, individual ones of the plurality of compartments being configured to receive the plurality of modules at an interior of the shipping container such that a first side of the plurality of modules is exposed on the first side of the shipping container during transport, and a second side of the plurality of modules is exposed on the second side of the shipping container during transport;

a sensor;

processing circuitry coupled to the sensor comprising at least one hardware processor that, through execution of program instructions, is configured to:

detect a placement of one of the plurality of modules in one of the plurality of compartment using the sensor;

in response to the placement of the one of the plurality of modules in the one of the plurality of compartments, determine that the one of the plurality of modules requires a resource based at least in part on data corresponding to the one of the plurality of modules; and

provide the resource to the one of the plurality of modules;

wherein individual ones of the plurality of modules are independently insertable into or removable from a corresponding one of the plurality of compartments of the shipping container, and

wherein the first side and the second side of the individual ones of the plurality of modules comprise at least one portal configured to receive at least one projection to insert or remove a corresponding one of the plurality of modules into or from a corresponding one of the plurality of compartments from either the first side or the second side of the shipping container.

2. The system of claim **1**, wherein the at least one projection further comprises a fork of a forklift, or a fork of a module moving apparatus.

3. The system of claim **1**, wherein the individual ones of the plurality of modules comprise a lock and a device having memory with electronically stored information thereon comprising whether the lock has been engaged.

4. The system of claim **1**, further comprising a refrigeration unit configured to provide cool air to at least a portion of the plurality of modules.

5. The system of claim **1**, wherein the processing circuitry is further configured to:

identify the resource required by the one of the plurality of modules from an electronic identifier of the one of the plurality of modules using the sensor; and

provide the at least one resource to the one of the plurality of modules in response to the electronic identifier being identified.

6. The system of claim **5**, wherein the resource is at least one of refrigeration, heat, electrical power, networking resources, or location-based resources.

7. The system of claim 1, wherein:

the individual ones of the plurality of modules comprise a tag having a unique identifier stored thereon interpretable by the sensor;

the shipping container further comprises a memory device having a digital manifest stored thereon; and

the processing circuitry is further configured to interrogate the sensor to verify a placement of the one of the plurality of modules in the one of the plurality of compartments of the shipping container in accordance with the digital manifest by comparing the unique identifier obtained from the sensor to the digital manifest.

8. The system of claim 7, wherein the tag comprises a radio-frequency identification (RFID) tag.

9. The system of claim 1, wherein the shipping container is detachably attached to a trailer or a rail car comprising a plurality of wheels.

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