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SYSTEM AND METHOD FOR GRAVITATIONAL UNLOADING OF ITEMS FROM A CONTAINER

Abstract

System and method for unloading a container of its content, comprising an automated storage and retrieval system, wherein the system comprises a rail system comprising a first set of parallel rails arranged to guide movement of a container handling vehicle in a first direction across the top of a framework structure, and a second set of parallel rails arranged perpendicular to the first set of rails to guide movement of the container handling vehicle in a second direction which is perpendicular to the first direction, the first and second sets of parallel rails dividing the rail system into a plurality of grid cells, the framework structure comprises upright members and horizontal members, at least one container handling vehicle configured to operate on the rail system, wherein the at least one container handling vehicle is provided with at least one orientation sensor configured to measure at least one orientation parameter of the sensor in a three-dimensional cartesian reference system, a central control unit configured to receive, transmit and process data signals of the container handling vehicle and to receive and process data signals of the sensor, at least one container comprised of four side walls and a bottom creating an open box structure, means for transporting the container to an unloading station where the content of the container is emptied by gravity wherein the unloading station comprises a container tipping device that tips the container around at least one axis, emptying the content.

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Background/Summary

BENEFIT CLAIM [0001] This application claims the benefit under 35 U.S.C. 120 as a continuation of application Ser. No. 18/687,512, filed 28 Feb. 2024, which is a 371 national stage entry of PCT/EP2022/074633 filed 5 Sep. 2022, which claims priority to European Patent Office application 21195243.7, filed 7 Sep. 2021, the entire contents of which are hereby incorporated by reference for all purposes as if fully set forth herein.

FIELD OF THE INVENTION

[0002] The present invention relates to an automated storage and retrieval system for storage and retrieval of containers, in particular to a system and method for using gravity for unloading items from a container.

BACKGROUND AND PRIOR ART

[0003] FIG. **1** discloses a typical prior art automated storage and retrieval system **1** with a framework structure **100**, and FIG. **2**, FIG. **3**, and FIG. **4** disclose three different prior art container handling vehicles **201**, **301**, **401** suitable for operating on such a system **1**.

[0004] The framework structure **100** comprises upright members **102** and a storage volume comprising storage columns **105** arranged in rows between the upright members **102**. In these storage columns **105**, storage containers **106**, also known as bins, are stacked one on top of one another to form stacks **107**. The members **102** may typically be made of metal, e.g., extruded aluminum profiles.

[0005] The framework structure **100** of the automated storage and retrieval system **1** comprises a rail system **108** arranged across the top of framework structure **100**, on which rail system **108** a plurality of container handling vehicles **201**, **301**, **401** may be operated to raise storage containers **106** from, and lower storage containers **106** into, the storage columns **105**, and also to transport the storage containers **106** above the storage columns **105**. The rail system **108** comprises a first set of parallel rails **110** arranged to guide movement of the container handling vehicles **201**, **301**, **401** in a first direction X across the top of the frame structure **100**, and a second set of parallel rails **111** arranged perpendicular to the first set of rails **110** to guide movement of the container handling vehicles **201**, **301**, **401** in a second direction Y which is perpendicular to the first direction X. Containers **106** stored in the columns **105** are accessed by the container handling vehicles **201**, **301**, **401** through access openings **112** in the rail system **108**. The container handling vehicles **201**, **301**, **401** can move laterally above the storage columns **105**, i.e., in a plane parallel to the horizontal X-Y plane.

[0006] The upright members **102** of the framework structure **100** may be used to guide the storage

containers during raising of the containers out from and lowering of the containers into the columns **105**. The stacks **107** of containers **106** are typically self-supportive.

[0007] Each prior art container handling vehicle **201**, **301**, **401** comprises a vehicle body **201***a*, **301***a*, **401***a* and first and second sets of wheels **201***b*, **301***b*, **201***c*, **301***c*, **401***b*, **401***c* which enable the lateral movement of the container handling vehicles **201**, **301**, **401** in the X direction and in the Y direction, respectively. In FIG. **2**, FIG. **3**, and FIG. **4**, two wheels in each set are fully visible. The first set of wheels **201***b*, **301***b*, **401***b* is arranged to engage with two adjacent rails of the first set **110** of rails, and the second set of wheels **201***c*, **301***c*, **401***c* is arranged to engage with two adjacent rails of the second set **111** of rails. At least one of the sets of wheels **201***b*, **301***b*, **201***c*, **301***c*, **401***b*, **401***c* can be lifted and lowered, so that the first set of wheels **201***b*, **301***b*, **401***b* and/or the second set of wheels **201***c*, **301***c*, **401***c* can be engaged with the respective set of rails **110**, **111** at any one time.

[0008] Each prior art container handling vehicle **201**, **301**, **401** also comprises a lifting device for vertical transportation of storage container **106**, e.g., raising a storage container **106** from and lowering a storage container **106** into a storage column **105**. The lifting device comprises one or more gripping/engaging devices which are adapted to engage a storage container **106**, and which gripping/engaging devices can be lowered from the vehicle **201**, **301**, **401** so that the position of the gripping/engaging devices with respect to the vehicle **201**, **301**, **401** can be adjusted in a third direction Z which is orthogonal the first direction X and the second direction Y. Parts of the gripping device of the container handling vehicles **301**, **401** are shown in FIG. **3** and FIG. **4** indicated with reference numbers **304**, **404**. The gripping device of the container handling device **201** is located within the vehicle body **201***a* in FIG. **2**.

[0009] Conventionally, and also for the purpose of this application, Z=1 identifies the uppermost layer of storage containers, i.e., the layer immediately below the rail system **108**, Z=2 the second layer below the rail system **108**, Z=3 the third layer etc. In the exemplary prior art disclosed in FIG. **1**, Z=8 identifies the lowermost, bottom layer of storage containers. Similarly, X=1 . . . n.n and Y=1 . . . n identifies the position of each storage column **105** in the horizontal plane. Consequently, as an example, and using the Cartesian coordinate system X, Y, Z indicated in FIG. **1**, the storage container identified as **106**′ in FIG. **1** can be said to occupy storage position X=10, Y=2, Z=3. The container handling vehicles **201**, **301**, **401** can be said to travel in layer Z=O, and each storage column **105** can be identified by its X and Y coordinates. Thus, the storage containers shown in FIG. **1** extending above the rail system **108** are also said to be arranged in layer Z=**0**.

[0010] The storage volume of the framework structure **100** has often been referred to as a grid **104**, where the possible storage positions within this grid are referred to as storage cells. Each storage column may be identified by a position in an X- and Y-direction, while each storage cell may be identified by a container number in the X-, Y- and Z-direction.

[0011] Each prior art container handling vehicle **201**, **301**, **401** comprises a storage compartment or space for receiving and stowing a storage container **106** when transporting the storage container **106** across the rail system **108**. The storage space may comprise a cavity arranged internally within the vehicle body **201***a* as shown in FIGS. **2** and **4** and as described in e.g., WO2015/193278A1 and WO2019/206487A1, the contents of which are incorporated herein by reference.

[0012] FIG. **3** shows an alternative configuration of a container handling vehicle **301** with a cantilever construction. Such a vehicle is described in detail in, e.g., NO317366, the contents of which are also incorporated herein by reference.

[0013] The cavity container handling vehicles **201** shown in FIG. **2** may have a footprint that covers an area with dimensions in the X and Y directions, which is generally equal to the lateral extent of a storage column **105**, e.g., as is described in WO2015/193278A1, the contents of which are incorporated herein by reference. The term ‘lateral’ used herein may mean ‘horizontal’.

[0014] Alternatively, the cavity container handling vehicles **401** may have a footprint which is larger than the lateral area defined by a storage column **105** as shown in FIG. **1** and FIG. **4**, e.g., as is disclosed in WO2014/090684A1 or WO2019/206487A1.

[0015] The rail system **108** typically comprises rails with grooves in which the wheels of the vehicles run. Alternatively, the rails may comprise upwardly protruding elements, where the wheels of the vehicles comprise flanges to prevent derailing. These grooves and upwardly protruding elements are collectively known as tracks. Each rail may comprise one track, or each rail may comprise two parallel tracks.
[0016] WO2018/146304A1, the contents of which are incorporated herein by reference, illustrates a typical configuration of rail system **108** comprising rails and parallel tracks in both X and Y directions.
[0017] In the framework structure **100**, a majority of the columns **105** are storage columns **105**, i.e., columns **105**, where storage containers **106** are stored in stacks **107**. However, some columns **105** may have other purposes. In FIG. **1**, columns **119** and **120** are such special-purpose columns used by the container handling vehicles **201**, **301**, **401** to drop off and/or pickup storage containers **106** so that they can be transported to an access station (not shown) where the storage containers **106** can be accessed from outside of the framework structure **100** or transferred out of or into the framework structure **100**. Within the art, such a location is normally referred to as a "port," and the column in which the port is located may be referred to as a "port column" **119**, **120**. The transportation to the access station may be in any direction that is horizontal, tilted and/or vertical. For example, the storage containers **106** may be placed in a random or dedicated column **105** within the framework structure **100**, then picked up by any container handling vehicle and transported to a port column **119**, **120** for further transportation to an access station. Note that the term "tilted" means transportation of storage containers **106** having a general transportation orientation somewhere between horizontal and vertical.
[0018] In FIG. **1**, the first port column **119** may, for example, be a dedicated drop-off port column where the container handling vehicles **201**, **301** can drop off storage containers **106** to be transported to an access or a transfer station, and the second port column **120** may be a dedicated pick-up port column where the container handling vehicles **201**, **301**, **401** can pick up storage containers **106** that have been transported from an access or a transfer station.
[0019] The access station may typically be a picking or a stocking station where product items are removed from or positioned into the storage containers **106**. In a picking or a stocking station, the storage containers **106** are normally not removed from the automated storage and retrieval system **1** but are returned into the framework structure **100** again once accessed. A port can also be used for transferring storage containers to another storage facility (e.g., to another framework structure or to another automated storage and retrieval system), to a transport vehicle (e.g., a train or a lorry), or to a production facility.
[0020] A conveyor system comprising conveyors is normally employed to transport the storage containers between the port columns **119**, **120** and the access station.
[0021] If the port columns **119**, **120** and the access station are located at different levels, the conveyor system may comprise a lift device with a vertical component for transporting the storage containers **106** vertically between the port column **119**, **120** and the access station.
[0022] The conveyor system may be arranged to transfer storage containers **106** between different framework structures, e.g., as is described in WO2014/075937A1, the contents of which are incorporated herein by reference.
[0023] When a storage container **106** stored in one of the columns **105** disclosed in FIG. **1** is to be accessed, one of the container handling vehicles **201**, **301**, **401** is instructed to retrieve the target storage container **106** from its position and transport it to the drop-off port column **119**. This operation involves moving the container handling vehicle **201**, **301** to a location above the storage column **105** in which the target storage container **106** is positioned, retrieving the storage container **106** from the storage column **105** using the container handling vehicle's **201**, **301**, **401** lifting device (not shown), and transporting the storage container **106** to the drop-off port column **119**. If the target storage container **106** is located deep within a stack **107**, i.e., with one or a plurality of other

storage containers **106** positioned above the target storage container **106**, the operation also involves temporarily moving the above-positioned storage containers prior to lifting the target storage container **106** from the storage column **105**. This step, which is sometimes referred to as "digging" within the art, may be performed with the same container handling vehicle that is subsequently used for transporting the target storage container to the drop-off port column **119** or with one or a plurality of other cooperating container handling vehicles. Alternatively, or in addition, the automated storage and retrieval system **1** may have container handling vehicles **201**, **301**, **401** specifically dedicated to the task of temporarily removing storage containers **106** from a storage column **105**. Once the target storage container **106** has been removed from the storage column **105**, the temporarily removed storage containers **106** can be repositioned into the original storage column **105**. However, the removed storage containers **106** may alternatively be relocated to other storage columns **105**.

[0024] When a storage container **106** is to be stored in one of the columns **105**, one of the container handling vehicles **201**, **301**, **401** is instructed to pick up the storage container **106** from the pick-up port column **120** and transport it to a location above the storage column **105** where it is to be stored. After any storage containers **106** positioned at or above the target position within the stack **107** have been removed, the container handling vehicle **201**, **301**, **401** positions the storage container **106** at the desired position. The removed storage containers **106** may then be lowered back into the storage column **105** or relocated to other storage columns **105**.

[0025] For monitoring and controlling the automated storage and retrieval system **1**, e.g., monitoring and controlling the location of respective storage containers **106** within the framework structure **100**, the content of each storage container **106**; and the movement of the container handling vehicles **201**, **301**, **401** so that a desired storage container **106** can be delivered to the desired location at the desired time without the container handling vehicles **201**, **301**, **401** colliding with each other, the automated storage and retrieval system **1** comprises a control system **500** which typically is computerized and which typically comprises a database for keeping track of the storage containers **106**.

[0026] Unloading the contents of a container can be time-consuming. The right container has to be brought to a picking station and a person or a picking robot has to pick the right item and the right amount of items, if the order is for a plurality of different items, the picker or the picking robot has to wait for the next container with the next item on the list.

[0027] This solution is not favorable if the list of ordered items needs to be picked quickly, or if a lot of orders need to be picked fast, like, e.g., in a grocery shopping situation. If you, for instance, need to pick 100 shopping lists in a reasonable time, the shop would need a lot of pickers to be able to cope with the task. This again will lead to the shop having to hire a large staff just to handle the picking of the items. This again will be costly and result in the price of shopping going up.

[0028] It is therefore a need for a solution that allows for the picking of items from containers stored in a storage and retrieval system.

SUMMARY OF THE INVENTION

[0029] The present invention is set forth and characterized in the independent claims, while the dependent claims describe other characteristics of the invention.

[0030] In one aspect, the invention is related to a system for unloading a container of its content, comprising an automated storage and retrieval system, wherein the system comprises a rail system comprising a first set of parallel rails arranged to guide movement of a container handling vehicle in a first direction (X) across the top of a framework structure, and a second set of parallel rails arranged perpendicular to the first set of rails to guide movement of the container handling vehicle in a second direction (Y) which is perpendicular to the first direction (X), the first and second sets of parallel rails dividing the rail system into a plurality of grid cells, the framework structure comprises upright members and horizontal members, at least one container handling vehicle configured to operate on the rail system, wherein the at least one container handling vehicle is

provided with at least one orientation sensor configured to measure at least one orientation parameter of the sensor in a three-dimensional cartesian reference system, a central control unit configured to receive, transmit and process data signals of the container handling vehicle and to receive and process data signals of the sensor, at least one container comprised of four side walls and a bottom creating an open box structure, means for transporting the container to an unloading station where the content of the container is emptied by gravity wherein that the unloading station comprises a container tipping device that tips the container around at least one axis, emptying the content.

[0031] Further, the container rotating device can comprise a guide surface that guides the container along a helical path. The guide surface must also have an opening to allow the container's contents to empty.

[0032] The container rotating device can comprise a set of rails that may define a path for the container and can guide it as it travels through the unloading station and may be configured to turn the container at least partially around said axis.

[0033] Also, the container rotating device can comprise a mechanical arm, or the container rotating device can comprise a set of wheels pushed up against the container and said wheels rotate, turning the container around where the set of wheels can be biased towards the container by springs to allow the wheels to follow the side walls of the container.

[0034] The means for transporting the container to the unloading station can comprise a conveyor belt, chains with hooks, rollers, roller balls or a gravity-driven system.

[0035] The container itself can be made up of several compartments, wherein each compartment of the container can have its own lid and each lid can be individually unlocked allowing only the content of a compartment with an unlocked lid to be emptied.

[0036] In a second aspect, the invention concerns a method for unloading a container of its content, comprising at least one container comprised of four side walls and a bottom creating an open box structure, means for transporting the container to an unloading station where the content of the container can be emptied by gravity: collecting a container from a storage and retrieval system, transporting the container to the unloading station using a means for transportation, tipping the container at least partially around at least one axis allowing the content to be unloaded, turning the container the right way up, transporting the container back to a storage and retrieval system, transporting the container to the unloading station using a conveyor belt, chains with hooks, rollers, roller balls or a gravity-driven system.

[0037] In an alternative solution the lids can be part of the unloading station. In the unloading station, there can be a lid for any compartment combination a container might have. The compartment combination in a specific container can be registered together with the ID of the container. When the container enters the unloading station the central computer system opens the correct lid(s) and the content of that compartment is unloaded.

[0038] In yet another embodiment of the invention, the lids can be in the cradle the container is placed in when it enters the unloading station. The cradle can open whatever lids are necessary to unload the correct content into a collecting station.

[0039] In an alternative solution, the container can be pushed through the unloading system by the containers entering after it. When a container enters the unloading system, a pusher gives the container an initial push. The push propels the container and every container in front one position forward by every container pushing on the container in front. When the container has passed through the unloading system, the container is transported back into the grid, or it can be sent for refilling.

[0040] By using these solutions to solve the problems with the cost and speed of picking from containers stored in a storage and retrieval system.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0041] Following drawings are appended to facilitate the understanding of the invention. The drawings show embodiments of the invention, which will now be described by way of example only, where:

[0042] FIG. **1** is a perspective view of a framework structure of a prior art automated storage and retrieval system.

[0043] FIG. **2** is a perspective view of a prior art container handling vehicle having an internally arranged cavity for carrying storage containers therein.

[0044] FIG. **3** is a perspective view of a prior art container handling vehicle having a cantilever for carrying storage containers underneath.

[0045] FIG. **4** is a perspective view from underneath of a central cavity container handling vehicle where a lifting platform for handling containers is visible.

[0046] FIG. **5**A and FIG. **5**B is a perspective view of an embodiment of the present invention wherein a helix screw is enclosed in a box shape wherein one of the containers enters one side and is turned around by the helix screw allowing the contents to be poured from the container into a collecting station.

[0047] FIG. **6** is an alternative embodiment of the present invention where a framework of rails guides the container and allows it to be turned around and the content of the container to be emptied into a collecting station.

[0048] FIG. **7** is yet another embodiment of the present invention wherein a set of biased wheels press against the sides of the container spinning the container around allowing the items in the container to empty into a collecting station.

DETAILED DESCRIPTION

[0049] In the following, embodiments of the invention will be discussed in more detail with reference to the appended drawings. It should be understood, however, that the drawings are not intended to limit the invention to the subject matter depicted in the drawings.

[0050] The framework structure **100** of the automated storage and retrieval system **1** is constructed in accordance with the prior art framework structure **100** described above in connection with FIGS. **1**-**3**, i.e., a number of upright members **102** and a number of horizontal members **103**, which are supported by the upright members **102**, and further that the framework structure **100** comprises a first, upper rail system **108** in the X direction and Y direction.

[0051] The framework structure **100** further comprises storage compartments in the form of storage columns **105** provided between the members **102**, **103**, where storage containers **106** are stackable in stacks **107** within the storage columns **105**.

[0052] The framework structure **100** can be of any size. In particular it is understood that the framework structure can be considerably wider and/or longer and/or deeper than disclosed in FIG. **1**. For example, the framework structure **100** may have a horizontal extent of more than 700×700 columns and a storage depth of more than twelve containers.

[0053] FIG. **4** is a perspective view from underneath of a central cavity container handling vehicle where a lifting platform for handling containers are visible.

[0054] FIGS. **5**A and **5**B are a perspective view of an embodiment of the present invention wherein a helix screw enclosed in a box shape wherein one of the containers enters one side and are turned around by the helix screw allowing the contents to be poured from the container into a collecting station.

[0055] The box shape has an opening in either end in the form of a tunnel running through the box for guiding the container. The tunnel has a shape that is similar to the shape of a container. The container can be propelled through the tunnel by gravity working on the box. In this scenario the

box is at an incline falling controlled through the tunnel in the box. Alternatively, the box can be propelled through the tunnel by a propelling mechanism This propelling mechanism can be either rollers, roller balls, conveyor belts, chains and hooks, or any other type of propelling solution that will allow a container to move through a tunnel.

[0056] In an alternative solution the container can be pushed through the unloading system by the containers entering after it. When a container enters the unloading system a pusher gives the container an initial push. The push propels the container and every container in front one position forward by every container pushing on the container in front. When the container has passed through the unloading system the container is transported back into the grid or it can be sent for refilling.

[0057] The tunnel is twisted in the form of a helix screw. This allows the container to turn as the tunnel turns. The box is enclosed and ensures that the content of the items does not spill out of the container as it moves through the helix screw in the box. However, in order to be able to collect the items in the container, it is essential that the items leave the container at the right time. The box therefore has at least one opening in the side that allows the items in the container to be emptied. The opening in the side of the box is at least smaller than the container itself. The opening can be so large that it allows all the content of the container to be emptied into a collecting station.

[0058] Alternatively, the hole in the side of the box can be long allowing the content of the container to be emptied over a longer area. Further there can be more than one hole. If there are more than one hole the at intervals of the holes allow can be spaced apart in such a way that the content of the container can be emptied into several collecting stations.

[0059] The helix screw in the box can turn the container around **360** degrees. Alternatively, the screwing motion can turn the box any degree and back again. This would e.g., allow the container to tilt around one axis a certain number of degrees and then back again allowing the container to e.g., not empty its entire content in one go.

[0060] Alternatively, the container can be divided into compartments. In this scenario each compartment has one lid. This lid can be closed and opened at the instructions from the central computer system. this would allow the content of only one or more specified compartments to be emptied at a time.

[0061] In yet another solution each opening in the side of the box can have a shutter solution that allows a specified amount of the content to be emptied, this shutter solution can be controlled by the central computer system that keeps track of which container is at the collecting station at any one time and also know what items to collect at the collecting station at any one time and what amount of the item to be collected.

[0062] When the items that it in the compartments are powders or liquids, or any type of material that cannot be counted, like e.g., powders or liquids, thy can be weighed or measured at the collecting station. The shutter device can ensure that the right amount of powders and liquids are pored from the container.

[0063] When unloading bigger items that are not weighed or measured, but are counted, the shutter system can open and close allowing only one item to exit the container at a time. Alternatively, sensors can be placed around the opening of the unloading station counting the number of items that falls out of the container. The sensors in question can be e.g., cameras

[0064] The collecting station can be in the form of a container that the items drops into or it can be in the form of a plastic bag or any other form of solution that allows for collecting items.

[0065] The collecting station can be boxes on a conveyor belt transporting collected items to a pick-up point.

[0066] In FIG. **5**A, the arrow B indicates the traveling direction of the container into the tunnel in the box. The arrow A indicated the shape of the tunnel forming a helix screw through the box.

[0067] FIG. **6** is an alternative embodiment of the present invention where a framework of rails guides the container and allows it to be turned around and the content of the container being

emptied into a collecting station.
[0068] The rails guide the container through the system. There can be two or more rails for guiding the container through the system. The container is held in place by the rails and is moved forward through the system by a propelling mechanism. This propelling mechanism can be either rollers, roller balls, conveyor belts, chains and hooks, or any other type of propelling solution that will allow a container to move through the rails.
[0069] Alternatively, the container can be inverted by a mechanism that grabs hold of the container and turns the container around poring the content out. The container can have different compartments containing different content. The mechanism can therefore have lids that are capable of closing of certain compartments and only pour out the content of specific compartments.
[0070] This mechanism can be a robotic arm. The robotic arm can be controlled by the central computer system.
[0071] In a two-rail solution, the container can be placed in a cradle that is propelled using rollers, roller balls, conveyor belts, chains and hooks or any similar solution. The rails follow a similar helix screw shape. The helix shape of the two rails inverts the container. By inverting the container, the items in the container are emptied out into a collection station.
[0072] By using a cradle, it is also possible to use a monorail system. The cradle is attached to the monorail, and the container is placed in the cradle. The monorail system transports the cradle with the container through the unloading system, and the container is picked up and transported back into the grid when the system is
[0073] In a four-rail solution, the container can be held in place by the rails and propelled through the unloading system by e.g., a conveyor belt, rollers, roller balls or similar attached to either rail pushing on the container while at the same time propelling the container forward. The helix shape of the four rails allows the container to be inverted as it travels through the rails. The inverting of the container empties the content of the container into a collection station.
[0074] The two and four rail solution can be either with or without a cradle. Further there can be two cradles handling the container. There can be one cradle at the top and one cradle at the bottom. The cradle covering the top of the container can have lid(s) that cover the compartments in the container. The lid(s) can be unlocked, uncovering the compartments of interest.
[0075] In either of these two solutions the tracks and rails can either rotate the container all the way around or it can rotate the container any number of degrees and then back again. By rotating the container a predetermined degrees and then back again it allows for a better control of the emptying of the container.
[0076] Depending on the material inside the container, by rotating the container a predetermined number of degrees this allows for the possibility of controlling the speed of the unloading.
[0077] In an alternative embodiment, the container can be divided into compartments. In this scenario each compartment can have one lid. This lid can be closed and opened at the instructions from the central computer system. this would allow the content of only one or more specified compartments to be emptied at a time.
[0078] The collecting station can be boxes on a conveyor belt transporting collected items to a pick-up point.
[0079] The arrow C indicates how the shape of the rails is capable of rotating the container making it possible to empty the content into a collecting station.
[0080] FIG. **7** presents an alternative embodiment of the present invention. In this embodiment there are a set of wheels that are biased pressing against the container. When the wheels turn around the same way the container is turned around. By rotating the container around the items stored therein can be emptied from the container.
[0081] In this solution the container can be turned any number of degrees depending on how much of the items that needs to be emptied from the container. By inverting the container, all the contents of the container are emptied. However, by rotating the container a predetermined number of

degrees it is possible to control the amount of content that is emptied from the container.
[0082] The spring function of the biased wheels allows the wheels to follow the contours of the container as it rotates.
[0083] The collecting station can be in the form of a container that the items drops into or it can be in the form of a plastic bag or any other form of solution that allows for collecting items.
[0084] In an embodiment there is also possible to turn the container by using a robotic arm. The robotic arm can be used to turn the container around in order to empty the content of the container in a collecting station.
[0085] The collecting station can be boxes on a conveyor belt transporting collected items to a pick-up point.
[0086] In the preceding description, various aspects of the delivery vehicle and the automated storage and retrieval system according to the invention have been described with reference to the illustrative embodiment. For purposes of explanation, specific numbers, systems and configurations were set forth in order to provide a thorough understanding of the system and its workings. However, this description is not intended to be construed in a limiting sense. Various modifications and variations of the illustrative embodiment, as well as other embodiments of the system, which are apparent to persons skilled in the art to which the disclosed subject matter pertains, are deemed to lie within the scope of the present invention.
List of Reference Numbers
Prior Art (FIG. **1**-**4**)
[0087] **1** Prior art automated storage and retrieval system [0088] **100** Framework structure [0089] **102** Upright members of framework structure [0090] **103** Horizontal members of framework structure [0091] **104** Storage grid [0092] **105** Storage column [0093] **106** Storage container [0094] **106**′ Particular position of storage container [0095] **107** Stack [0096] **108** Rail system [0097] **110** Parallel rails in first direction (X) [0098] **110***a* First rail in first direction (X) [0099] **110***b* Second rail in first direction (X) [0100] **111** Parallel rail in second direction (Y) [0101] **111***a* First rail of second direction (Y) [0102] **111***b* Second rail of second direction (Y) [0103] **112** Access opening [0104] **119** First port column [0105] **120** Second port column [0106] **201** Prior art container handling vehicle [0107] **201***a* Vehicle body of the container handling vehicle **201** [0108] **201***b* Drive means/wheel arrangement, first direction (X) [0109] **201***c* Drive means/wheel arrangement, second direction (Y) [0110] **301** Prior art cantilever container handling vehicle [0111] **301***a* Vehicle body of the container handling vehicle **301** [0112] **301***b* Drive means in first direction (X) [0113] **301***c* Drive means in second direction (Y) [0114] **401** Prior art container handling vehicle [0115] **401***a* Vehicle body of the container handling vehicle **401** [0116] **401***b* Drive means in first direction (X) [0117] **401***c* Drive means in second direction (Y) [0118] Y Second direction [0119] Z Third direction [0120] **1** Container [0121] **2** Box with a tunnel in a helix screw [0122] **3** Spring biased wheels. [0123] **4** Rails [0124] **5** Opening for unloading the items from the container

Claims

1. A method, executed using a storage and retrieval system, of unloading a container of its contents, wherein the container comprises four side walls and a bottom in an open box structure, wherein the storage and retrieval system comprises means for transporting the container to an unloading station to empty the contents of the container by gravity, the method comprising: collecting a container from the storage and retrieval system; transporting the container to the unloading station using a means of transportation; unloading the contents by tipping the container at least partially around at least one axis; turning the container to an upright position; and transporting the container back to the unloading station using the means of transportation.
2. The method of claim 1 wherein the means of transportation comprises a conveyor belt, chains with hooks, rollers, roller balls or a gravity-driven system.

3. The method of claim 1, wherein the container comprises a plurality of compartments of one or more compartment combinations, wherein the unloading station comprises a plurality of lids, each of the lids corresponding to a compartment combination of the container, the method further comprising: registering the compartment combination of a specific container with an identifier of the container; and in response to the container entering the unloading station, opening a particular lid and unloading the contents of a particular compartment corresponding to the particular lid.
4. The method of claim 3, wherein the lids are in a cradle on which the container is placed when the container enters the unloading station.
5. The method of claim 1, further comprising: in response to a container entering the unloading station, a pusher giving the container an initial push to propel the container and every container in front one position forward by every container pushing on another container; and in response to the container passing through the unloading station, transporting the container back into the storage and retrieval system or sending the container for refilling.
6. A method of unloading a container in an automated storage and retrieval system, wherein the automated storage and retrieval system comprises a rail system comprising a first set of parallel rails arranged to guide movement of a container handling vehicle in a first direction across a top of a framework structure, and a second set of parallel rails arranged perpendicular to the first set of parallel rails to guide movement of the container handling vehicle in a second direction which is perpendicular to the first direction, the first set of parallel rails and the second set of parallel rails dividing the rail system into a plurality of grid cells, the framework structure comprising upright members and horizontal members, at least one container handling vehicle being configured to operate on the rail system, wherein the at least one container handling vehicle comprises at least one orientation sensor configured to measure at least one orientation parameter of the at least one orientation sensor in a three-dimensional cartesian reference system, wherein the automated storage and retrieval system comprises a central control unit configured to receive, transmit and process data signals of the container handling vehicle and to receive and process data signals of the at least one orientation sensor, wherein the automated storage and retrieval system comprises at least one container comprised of four side walls and a bottom creating an open box structure, the method comprising: transporting the container to an unloading station; using a container rotating device of the unloading station, rotating the container around at least one axis; emptying a contents of the container by gravity; and guiding the container along a helical path.
7. The method of claim 6, wherein the unloading station has an opening for allowing the contents of the container to empty.
8. The method of claim 6, wherein the container rotating device comprises at least one rail defining a path for the container, the method further comprising, using the at least one rail, guiding the container as it travels through the unloading station and turning the container at least partially around said at least one axis.
9. The method of claim 6, wherein the container rotating device comprises a tube with a tunnel, the method further comprising, using the tube, guiding the container through the unloading station and turning the container at least partially around said at least one axis.
10. The method of claim 6, wherein the container rotating device comprises a set of wheels pushed up against the container, the method further comprising rotating the set of wheels to turn the container around.
11. The method of claim 6, wherein the means for transporting the container to the unloading station comprises a conveyor belt, chains with hooks, rollers, roller balls or a gravity-driven system or a mechanical arm pushing the container.
12. The method of claim 6, wherein the container comprises several compartments, wherein each compartment of the container has its own lid.
13. The method of claim 12, further comprising covering a particular compartment of the container using a lid connected to the opening in the unloading station.

14. The method of claim 12, further comprising covering a particular compartment of the container using a lid in a cradle of the unloading station.
15. The method of claim 14, wherein each lid can be individually unlocked allowing only the contents of a particular compartment with an unlocked lid to be emptied.
16. The method of claim 14, wherein the unloading station comprises a measuring device allowing it to control a shutter device in the lid to control an amount of the contents to be unloaded from the container.
17. A method of unloading a container using an unloading system of an automated storage and retrieval system, the unloading system comprising a central control unit configured to receive, transmit and process data signals of a container handling vehicle and to receive and/or process data signals of an orientation sensor configured to measure at least one orientation parameter of the orientation sensor in a three-dimensional cartesian reference system, and an unloading station comprising a container rotating device, the method comprising: using the container rotating device, rotating the container around at least one axis; and emptying a required amount of contents of the container; wherein the container rotating device comprises a guide surface which guides the container along a helical path.
18. The method of claim 17, wherein the container rotating device further comprises at least one rail defining a path for the container, the method further comprising, using the at least one rail, guiding a container as it travels through the unloading station and turning the container at least partially around said at least one axis.
19. The method of claim 17, wherein the container rotating device comprises a tube with a tunnel, the method further comprising, using the tube, guiding the container through the unloading station and turning the container at least partially around said at least one axis.
20. The method of claim 17, further comprising turning the container around using, in the container rotating device, a set of wheels pushed up against the container by said set of wheels rotating to turn the container around.