

## A CONTAINER RETURN SYSTEM AND METHOD

### Technical field

5 The present inventive concept relates to a method and a system for receiving a bulk of used deposit return containers for recycling or reuse. More specifically, the inventive concept is directed to the field of container return systems arranged to single out individual used containers from said bulk and to classify said individual used container as acceptable or not acceptable.

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### Background

Devices for receiving, identifying and/or sorting objects, such as used beverage or food containers, may be used in reverse vending machines in e.g. super markets. Many times, these devices receive the  
15 containers one by one, and a user therefore has to feed the containers one by one to the device.

Examples of devices adapted for receiving objects, such as used beverage or food containers in bulk, and forwarding them for individual  
20 processing is disclosed in EP 3 481 753 A1, which describes a device comprising: · a first receiving area arranged for simultaneously receiving and keeping a plurality of containers; a second receiving area positioned at a higher vertical level than the first receiving area, the device having a singulation transporting device comprising a container  
25 elevating member for transporting a container from the first receiving area to the second receiving area. The elevating member is attached to said transporting device, moves along and is locked to a circumferential path around a first axis (x) upon activation of the transporting device, and the first axis (x) is inclined at an angle of 1° to  
30 45° relative the horizontal plane. The objects are thereby separated into individual objects and can be transported further for e.g. recording, counting, evaluating, sorting, storing or recycling.

However, these devices may be perceived as a bit noisy by the users, due to the rumbling and clattering sound from the bulk of containers e.g. when handled by the singulation transporting device. A further  
5 problem by the rumbling and clattering of the containers is that they may be deformed and thereby more difficult to handle.

It would be desirable to dampen the noise from the machine as perceived by the users. There is hence a need for a less noisy device  
10 which is adapted for receiving more than one container at the time.

### Summary

In view of the above, it is an object of the present inventive concept to provide a method and a device wherein the above-mentioned  
15 disadvantages of the prior art are addressed.

The inventive concept is defined by the appended independent claims, with embodiments being set forth in the appended dependent claims, in the following description and in the drawings.

According to a first aspect of the inventive concept, there is provided a  
20 container return system configured to receive a bulk of deposit return containers, such as used food or beverage containers through an infeed opening, the container return system comprising a first transporting arrangement comprising infeed transporting means, redirection means, and singulator transporting means, wherein:

- 25 - said infeed transporting means is configured to transport said used containers along an infeed path from said infeed opening to a redirection area,
- said redirection means is configured to redirect said used containers at said redirection area, and
- 30 - said singulator transporting means is configured to transport said used containers from said redirection area to an uptake

area, which uptake area is adapted to collect used containers in bulk,  
a singulation arrangement configured to single out individual used containers from said bulk and transport said individual used containers  
5 from said uptake area to a receiving area, said receiving area positioned at a higher vertical level than said uptake area, and a second transporting arrangement configured to transport said used containers from said receiving area to a classification unit, which classification unit is configured to classify said individual used  
10 containers into a category selected among the group comprising at least accepted and not accepted, wherein said classification unit is further configured to initiate a transport of only the used containers classified as accepted for further processing or storage as accepted containers,  
15 wherein  
said redirection area is arranged at a first distance from said infeed opening in a first direction, and wherein said infeed transporting means is configured to transport said used containers from said infeed opening to said redirection area past said uptake area, as seen from  
20 above.

According to a second aspect, there is provided a container return system configured to receive a bulk of used deposit return containers, such as used food or beverage containers, through an infeed opening,  
25 the container return system comprising:

an active infeed conveyor,  
a first path for providing said used containers from said infeed opening to said active infeed conveyor,  
a singulation arrangement comprising a reservoir having an  
30 uptake area adapted to collect used containers in bulk, which singulation arrangement is configured to single out individual used containers from said bulk and transport said individual used containers from said uptake

area to a receiving area, said receiving area positioned at a higher vertical level than said uptake area,

a reservoir path for providing said used containers from said active infeed conveyor to said reservoir, and

5 a transporting arrangement configured to transport said individual used containers from said receiving area to a classification unit, which classification unit is configured to classify said individual used containers into a category selected among the group comprising at least accepted and not accepted, and to initiate a transport for further processing  
10 or storage of only the used containers classified as accepted,

wherein the container return system further comprises a redirection gate movable between a redirecting position and an open position, in which redirecting position said redirection gate is arranged across said active infeed conveyor, wherein said active infeed conveyor is  
15 operable in a first direction to transport said used containers received from said first path towards said redirection gate, and which redirection gate, when in its redirecting position, deflects used containers from said active infeed conveyor to said reservoir path upon said used containers reaching said redirection gate.

20 According to a third aspect, there is provided a container return system for processing used deposit return containers, such as used food or beverage containers, received in bulk, the container return system comprising:

a singulation arrangement for singulation of said used  
25 containers received in bulk into individual objects,

a conveying arrangement comprising at least a first conveyor,  
and

an object classification arrangement comprising a classification unit and a transporter for transporting objects from said singulation  
30 arrangement to said classification unit,

wherein said container return system is operable at least in:

a receiving mode, in which said conveying arrangement is configured to receive said used containers at an infeed area of the conveying arrangement and transport said used containers to a buffer area of the conveying arrangement via at least said first conveyor, and

5 a singulation mode, in which said conveying arrangement is configured to transport said used containers from said buffer area to said singulation arrangement via at least said first conveyor,

wherein

said first conveyor is a bi-directional conveyor, which bi-  
10 directional conveyor is configured to operate in a first direction in said receiving mode and in a second direction in said singulation mode, said second direction being opposite to said first direction.

In the context of this application, a container return system may be any system adapted to collect, sort, crush, compact and/or convey used  
15 deposit return containers for recycling or reuse, including used food or beverage containers, such as empty beverage bottles and cans, or glasses and/or cups such as coffee cups, of any size and material, such as PET, aluminium, tin, or glass. A deposit return container, may be a container which upon its return is eligible for a refund such as a  
20 "pfand" from the Deutsche Pfandsystem GmbH (DPG). Such a system may be used by professional operators, for example in recycling centers collecting used beverage containers from the restaurant industry. An example of such a system is the device for singulation of used beverage containers received in bulk described in EP  
25 3481753A1. A container return system may also be a reverse vending machine (RVM) located, for example, in a supermarket, where an end-consumer feeds used food and beverage containers into the container return system. Typically, only the front of the container return system, including the infeed area, is visible and accessible to the end-  
30 consumer, with a backroom facility only accessible to store employees or other authorized personnel. In each system there is a first conveyor that said used containers make contact with after having passed said

infeed opening, this first conveyor is active or passive. The infeed area is the part of this first conveyor that said used containers make contact after having passed said infeed opening. The infeed area is therefore typically designed to receive and support said used containers.

5 In each system there is a first active conveyor that said used containers make contact with after having passed said infeed opening, this first active conveyor is e.g. mono-directional or bi-directional. The active infeed area is the part of this first active conveyor that said used containers make contact after having passed said infeed opening. The  
10 active infeed area is therefore typically designed to receive and support said containers.

The term used container should be interpreted as empty container, e.g.  
15 after (most of) the contents of the container has been drunk, eaten, disposed of or otherwise used. Sometimes the used container is completely empty when fed into the container return system, sometimes it is not but contains some liquid and/or amount of the previous content. Many times the container content has been e.g.  
20 poured out and only some residues remain which was not easily poured out at the time..

A container return system as described herein may also be used to receive other types of recyclable or reusable containers. As non-limiting examples, a container return system according to the present  
25 inventive concept may be configured to receive used containers for cosmetics such as shampoo bottles and/or, paint, and/or chemicals, and/or any other type of consumer or professional product.

The present inventive concept is at least partly based on the realization that a longer path from the infeed area to the uptake area enables a  
30 more orderly and reliable feeding of used containers to the uptake area and the singulation arrangement. The used containers may be more spread out on the first transporting arrangement. Thereby, the bulk of

used containers which is received by the container return system at the infeed area does not reach the uptake area all at once. Thus, there may be fewer used containers in the uptake area simultaneously compared to configurations in which used containers are received directly in the uptake area. This reduces the risk of congestion of used containers in the uptake area and/or in the singulation arrangement. Further, the long path provides for reduced noise from the singulation arrangement, as fewer used containers in the uptake area results in less scrambling of containers during singulation.

Container return systems according to the first, second or third aspects enable such a long path to the singulator arrangement while allowing for a limited footprint of the system. This is advantageous for allowing personnel easy access to different parts of the system for maintenance or cleaning.

By *bulk* it is meant that more than one used container can be received by the container return system simultaneously, and preferably that the used containers can be of various shapes and sizes, such as cans, substantially cylindrical, square or odd-shaped bottles or containers, TetraPak containers, etc. Furthermore, the used containers may be made of different materials, such as plastic, paper, metal or glass, or a combination thereof. The container return system may be adapted to handle all or some of the different standard sizes of containers in different countries; and preferably configured to only handle a predetermined list of containers, if other containers are entered they will after inspection preferably be treated as an foreign object. It may e.g. be able to handle a mix of 33 cl and 50 cl aluminium cans, as well as 33 cl, 50 cl and 1.5 L PET bottles.

In relation to this inventive concept the expression "The container return system is adapted or configured to **handle** a *certain type of container*" means that the container return system is adapted or configured to receive, transport and process this certain type of container. It is understood that a container return system which

handles a *certain type of container* is adapted or configured to receive, transport and process this certain type of container.

According to one example, the diameter, or width, of a used container which the container return system is configured to handle, and which is received and transported by the container return system is at least 20 mm or at least 50 mm, and/or at most 150 mm, or at most 200 mm, or at most 350 mm. Additionally or alternatively, the height (i.e. the longest side) of a used container which the container return system is configured to handle, and which is received and transported by the container return system is at least 50 mm, or at least 75 mm and/or at most 200 mm, or at most 380 mm, or at most 500 mm. Additionally or alternatively, the weight of a which the container return system is configured to handle, and which is used container that is received and transported by the container return system is at least 10 g, and/or at most 500 g, or at most 3 kg, or at most 5 kg. Additionally or alternatively, the volume of a used container which the container return system is configured to handle, and which is received and transported by the container return system is at least 10 ml, or at least 50 ml, or at least 100 ml and/or at most 3 L, or at most 5 L, or at most 8 L.

In some embodiments, the height (i.e. the longest side) of the smallest used container handled by the return system is smaller than the diameter of the largest used container handled by the container return system.

The expression “transport said used containers from said infeed area to said redirection area past said uptake area, as seen from above” means that the uptake area, when orthogonally projected onto a vertical plane passing through the infeed area and the redirection, is between the infeed area and the redirection area. In other words, the orthogonal projection of the uptake area onto a line passing through the infeed area and the redirection area is between the infeed area and the redirection area. In other words, when transported from the infeed area to the redirection area, the used containers pass through a

vertical plane which passes through the uptake area and is orthogonal to the first direction.

It should be noted that while the infeed path may partly or fully coincide with the first direction, the infeed path may also be distinct from the first direction, and at least a portion of the infeed path may depart from said first direction. The infeed path may be straight, curved or take any other shape.

By the receiving area being positioned at a higher vertical level than the uptake area, it is meant that a major portion of the receiving area is arranged above the uptake area. Hence, the used containers are transported from a lower vertical level to a higher vertical level when transported by the singulation arrangement from the uptake area to the receiving area. The height difference between the uptake area and the receiving area may be at least 0.2 m, or at least 0.4 m, or at least 0.6 m, or at least 0.8 m, or at least 1.2 m, or at least 1.5 m. Additionally or alternatively, the height difference between the uptake area and the receiving area may be at most 0.6 m, or at most 0.8 m, or at most 1 m, or at most 1.2 m, or at most 1.5 m, or at most 1.7 m, or at most 2 m.

Additionally or alternatively, the height difference between the uptake area and the receiving area may be 900 mm – 1100 mm, or 800 mm – 1200 mm, or 500 mm – 2000 mm. Additionally or alternatively, the receiving area may be arranged at least 0.8 m, or at least 1.0 m, or at least 1.1 m, or at least 1.2 m, or at least 1.4 m, or at least 1.6 m, or at least 1.8 m above the floor. Additionally or alternatively, the receiving area may be arranged at most 2.2 m, or at most 2.0 m, or at most 1.8 m, or at most 1.6 m, or at most 1.4 m, or at most 1.2 m above the floor.

In general, the used containers are fed into/received by the container return system at a certain height, which is typically chosen to be easily reachable for the public. The height of the infeed area may be suitable to be reached by wheelchair bound persons.

The used containers classified as accepted by the classification unit may be transported to storage containers. Optionally, the used containers classified as accepted by the classification unit may be transported to different storage containers depending on the material and/or type of the used containers. Optionally, the used containers may be devaluated before being transported to storage containers. For example, the used containers may be compacted and/or crushed before being transported to storage containers. Thus, a container return system according to the first, second or third aspect may optionally comprise devaluation means for devaluating used containers.

In the following, some embodiments and further advantages in relation to the first, second and third aspects of the present inventive concept will be discussed. Unless otherwise stated and as far as they are compatible, the embodiments and advantages apply to all aspects of the inventive concept.

In some embodiments, the infeed transporting means, the redirection means, and/or the singulator transporting means each comprises conveying means selected from a group comprising an active conveyor, a slide, a free fall path, and combinations thereof. Examples of active conveyors are band conveyors such as V-conveyors (where two bands are arranged in a V) and flat conveyors (where the items may be transported by a movable belt or the like). A bi-directional conveyor is one example of an active conveyor, there are also mono-directional active conveyors as showed herein. The conveying means may be arranged at substantially the same height (vertical level) or at different heights; and the feeding may be performed on substantially the same height; or from one height to a substantially different height, wherein the height difference is at least 0.2 m, or at least 0.4 m, or at least 0.6 m, or at least 0.8 m, or at least 1.2 m, or at least 1.5 m.

Additionally or alternatively, the height difference between may be at most 0.6 m, or at most 0.8 m, or at most 1 m, or at most 1.2 m, or at most 1.5 m, or at most 1.7 m, or at most 2 m.

5 In some embodiments, said infeed transporting means is configured to transport said used containers from said infeed opening to said redirection area past said singulation arrangement, as seen from above. Additionally or alternatively, the infeed transporting means is configured to transport said used container from said infeed opening, via said infeed area to said redirection area.

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In some embodiments, the first transporting arrangement comprises an active conveyor arrangement having at least one active conveyor, wherein said active conveyor arrangement forms part of at least said infeed transporting means.

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In some embodiments, the infeed transporting means comprises a conveyor or a first conveyor having an infeed area for receiving and supporting said used containers received through said infeed opening.

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In some embodiments, said transport of said used containers along an infeed path further comprises transporting said containers from said infeed opening to said redirection area via an active infeed area, and said infeed transporting means comprises an active conveyor arrangement having at least one active conveyor, which active conveyor arrangement is configured to transport said containers along said infeed path or along at least a portion of said infeed path, and is configured to transport said containers from said active infeed area to said redirection area.

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In some embodiments, said classification unit is configured to classify said individual used containers into a category selected among the group comprising accepted, rejected and unrecognized.

Said classification unit is further configured to:

- initiate a transport of used containers classified as rejected to a rejection area via a buffer area, which rejection area is optionally partly or fully the same as said infeed area, or said active infeed area, and
- initiate a transport of used containers classified as unrecognized to said uptake area, optionally via said buffer area.

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Used containers may be positively identified by the classification unit as used containers not handled by the container return system. These used containers are classified as rejected by the classification unit and transported to a rejection area. According to one example, the rejected used containers are transported back to the user; alternative the rejected used containers are transported back to a storage area.

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A configuration in which the rejection area is partly or fully the same as the infeed area may allow for a simpler and/or more compact system. In contrast, a configuration in which the rejection area is separate from the infeed area requires additional transporting means to transport the used containers to the separate rejection area.

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The rejection area may be accessible by the user to allow the user to pick up used containers classified as rejected from said rejection area. For example, in configurations where the rejection area is the same as the infeed area, or said active infeed area, the rejection area may be accessible by the user through the infeed opening. In configurations where the rejection area is not the same as the infeed area, or said active infeed area, the rejection area may be accessible by the user by a different opening of the container return system, separate from the infeed opening.

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By transporting the used containers classified as rejected to the rejection area via a buffer area, continued operation of the reverse

vending machine is enabled before the rejected used containers are transported to the rejection area.

Some used containers may not be identified by the classification unit. That is, the classification unit is unable to positively identify the used  
5 container as either accepted or rejected and instead classify it as unrecognized. The unrecognized used container is then transported back to the uptake area to once again be transported up to the receiving area and further to the classification unit.

The classification may optionally comprise establishing the return value  
10 of each accepted container, which return value is rewarded to the user in return for the container being collected by the container return system. The return value may e.g. be established by reading a code printed on or emitted from the container.

In some embodiments, said uptake area is arranged at a second  
15 distance from said redirection area in a second direction, which second direction is substantially opposite the first direction and/or wherein said second direction forms an acute angle with said first direction.

It should be noted that while path between said redirection area and  
20 said uptake area may, substantially or fully coincide with the second direction, the redirection area to uptake area path may also be distinct from the second direction and at least a portion of the redirection area to uptake area path may depart from said second direction. The redirection area to uptake area path may be straight, curved or take any other shape.

25 Optionally, the singulator transporting means may be configured to transport said used containers from said redirection area to said uptake area along a path following said second direction.

Said second direction being substantially opposite the first direction  
30 and/or said second direction forming an acute angle with said first direction is advantageous as it reduces the footprint of the system, at least in a horizontal direction orthogonal to the first direction. This may

also provide personnel with easier reach of different components of the system for cleaning and/or maintenance purposes.

According to one example, said first transporting arrangement comprises an active conveyor arrangement, which active conveyor arrangement comprises at least one bi-directional conveyor operable in a forward and a backward direction,

wherein said active conveyor arrangement is arranged to receive used containers transported along said infeed path and said active conveyor arrangement is further configured to:

transport said used containers to said redirection area by operating said bi-directional conveyor in said forward direction and transport said used containers from said redirection area to said uptake area by operating said bi-directional conveyor in said backward direction.

This provides for a simple and easy to implement system.

An active conveyor that is only operable in a one direction, may be referred to as a mono-directional conveyor.

In some embodiments, said active conveyor arrangement comprises at least one bi-directional conveyor operable in a forward and a backward direction, wherein said active conveyor arrangement further forms part of said redirection means and said singulator means, such that said active conveyor arrangement is arranged to receive used containers transported along said infeed path upstream of said redirection area, and said active conveyor arrangement is further configured to: transport said used containers to said redirection area by operating said bi-directional conveyor in said forward direction, redirect said used containers at said redirection area by switching operation of said bi-directional conveyor from said forward direction to said backward direction, and

transport said used containers from said redirection area to said uptake area by operating said bi-directional conveyor in said backward direction.

5 In other words, the bi-directional conveyor may at least partly perform the function of the infeed transporting means when operated in the forward direction, perform the function of the redirection means when switching operation from the forward direction to the backward direction, and perform the function of the singulator transporting means  
10 when operated in the backward direction.

In some embodiments, the container return system comprises a redirecting bi-directional conveyor operable in a forward and a backward direction, which redirecting bi-directional conveyor forms part  
15 of said redirection means, said infeed transporting means, and said singulator transporting means; said active conveyor arrangement of said infeed transporting means is configured to transport said containers from said active infeed area to said redirection area when said redirecting bi-directional conveyor is operated in said forward  
20 direction, and said singulator transporting means comprises an active conveyor arrangement configured to transport said containers from said redirection area to said uptake area or to a passive conveyor configured to transport said containers to said uptake area when said redirecting bi-directional conveyor is operated in said  
25 backward direction. The active conveyor arrangement of said infeed transporting means and the active conveyor arrangement of said singulator transporting means is optionally one and the same.

In some embodiments, said active conveyor arrangement comprises at  
30 least one preceding conveyor, which preceding conveyor is configured to receive used containers transported along said infeed path and to transport said used containers to said bi-directional conveyor.

This provides for better control of the used beverage containers along the infeed path.

5 In some embodiments, said active conveyor arrangement comprises at least one preceding conveyor, which preceding conveyor forms part of said infeed transporting means and is configured to receive used containers transported along said infeed path upstream of said bi-directional conveyor, and to transport said used containers to said bi-directional conveyor.

10 In some embodiments, said active conveyor arrangement of said infeed transporting means comprises at least one preceding conveyor, which preceding conveyor comprises said active infeed area and is configured to transport said used containers from said active infeed area to said redirecting bi-directional conveyor.

15 According to one example, the preceding conveyor may operate at a first speed while the bi-directional conveyor operates at a second speed. The second speed may be higher than the first speed, in order to increase the spread out the used containers on the bi-directional conveyor.

The preceding conveyor and the bi-directional conveyor may be arranged at the same height (vertical level) or at different heights.

25 In some embodiments, said infeed transporting means comprises an active conveyor arrangement having at least one active conveyor, said singulator transporting means comprises at least one active or passive conveyor, and the path of said at least one active conveyor of the active conveyor arrangement and the path of said at least one active or passive conveyor of the singulator transporting means are spatially separated from each other, such that said first transporting arrangement is

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adapted to simultaneously transport used containers from said infeed area to said redirection area and from said redirection area to said uptake area.

5 Such a configuration enables continuous feeding of used containers to the container return system. As compared to the bi-directional system described above, where a user of the container return system, has to wait for the conveyor to move in the forward direction before he can feed more containers into the receiving area, for example as the machine indicates that it is busy processing the containers that have  
10 already been received, and/or that it currently is not capable of receiving more containers via the inlet area as e.g. an input fill-level has been reached.

15 In some embodiments, said first transporting arrangement comprises an active conveyor arrangement having at least one active conveyor, wherein said active conveyor arrangement forms part of at least said infeed transporting means, said singulator transporting means comprises at least one active or passive conveyor, and the path of said at least one active conveyor of the active conveyor arrangement and  
20 the path of said at least one active or passive conveyor of the singulator transporting means are spatially separated from each other, such that said first transporting arrangement is adapted to simultaneously transport used containers from said infeed area to said redirection area and from said redirection area to said uptake area.

25 In some embodiments, said first transporting arrangement comprises a return conveyor arrangement configured to receive used containers at said buffer area and to transport said received used containers to said rejection area,  
30 wherein said return conveyor arrangement optionally comprises a bi-directional conveyor, and said active conveyor arrangement and said return conveyor arrangement are optionally fully or partly the same.

5 In configurations where the return conveyor arrangement and the active conveyor arrangement are partly or fully the same, fewer conveyors are needed. This allows used containers to be returned to the user at a rejection area which partly or fully coincides with the infeed area. By this, a simpler front and/or interface with the user is enabled. The container return system may receive and further handle used containers until the user has no more used containers to feed into the system, and only thereafter return rejected used containers to the user.

10 In configurations where the return conveyor arrangement and the active conveyor arrangement are partly or fully the same, the return conveyor arrangement/active conveyor arrangement may comprise at least one bi-directional conveyor.

15 In some embodiments, the return conveyor arrangement and the active conveyor arrangement are not the same. Thus, the return conveyor arrangement may be a separate conveyor arrangement comprising a buffer area. Used containers classified as rejected may thus be pushed, routed, or otherwise transported, to a buffer area of the return conveyor arrangement. The return conveyor arrangement may be arranged on the same vertical level as the active conveyor arrangement, for example next to and/or parallel to the active conveyor arrangement. The return conveyor arrangement may be arranged on the same side of the singulation arrangement as the active conveyor arrangement, or on the opposite side of the active conveyor arrangement as the active conveyor arrangement. The return conveyor arrangement may be arranged at a different vertical level from the active conveyor arrangement, e.g., above or below the active conveyor arrangement.

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In some embodiments, said first transporting arrangement comprises a set of bi-directional conveyors arranged in sequence.

5 In some embodiments, said active conveyor arrangement of said first transporting arrangement comprises a set of bi-directional conveyors arranged in sequence.

In some embodiments, said active conveyor arrangement of said infeed transporting means comprises a set of bi-directional conveyors arranged in sequence.

10 In some embodiments, said active conveyor arrangement of said singulator transporting means comprises a set of bi-directional conveyors arranged in sequence.

By this, good control of the flow of used containers is provided in both directions of the bi-directional conveyors, e.g. both in the forward and in the backward direction.

15 Consecutive bi-directional conveyors of said active conveyor arrangement may be operated at different speeds, for example to control the spread of used containers on the conveyors.

20 In some embodiments, said first transporting arrangement further comprises a singulator gate movable between at least a first position and a second position,  
in which first position of said singulator gate the transport of said used containers is unrestricted between said infeed area and said  
25 redirection area, and said gate blocks said used containers from reaching said uptake area, and  
in which second position of said singulator gate the transport of said used containers is unrestricted between said redirection area and said uptake area, and wherein said gate blocks said used containers from  
30 reaching said infeed area from said redirection area.

In some embodiments, said singulator transporting means further comprises a singulator gate movable between at least a first and a second position, in which first position of said singulator gate the transport of said used containers is unrestricted between said active  
5 infeed area and said redirection area, and said gate blocks said used containers from reaching said uptake area, and in which second position of said singulator gate the transport of said used containers is unrestricted between said redirection area and said uptake area, and wherein said gate blocks said used containers from reaching said  
10 infeed area from said redirection area

Thereby, precise control over when used containers are transported to the uptake area is provided. Used containers are also prevented from mistakenly being transported back to the infeed area. Such a  
15 singulator gate may further facilitate when the used containers to be transported from the redirection area to the uptake area are transported partly along the same path as they are transported from the infeed area to the redirection area. For example, the first transporting arrangement may comprise one, two or a plurality of bi-  
20 directional conveyor for transporting the used containers from the infeed area to the redirection area in a forward direction while the singulator gate is in its first position. In its second position, the singulator gate may be arranged across the bi-directional conveyor such that used container transported by the bi-directional conveyor in  
25 the backward direction from the redirection area are deflected to the uptake area upon contact with the singulator gate. The singulator gate is typically arranged across the last bi-directional conveyor of the singulation transporting means, i.e. the bi-directional conveyor arranged closest to the up-take area.

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In some embodiments, said first transporting arrangement further comprises a buffer gate having at least a first and a second position,

in which first position of the buffer gate used containers arranged in said buffer area are blocked from leaving said buffer area, and in which second position of the buffer gate a movement of said used containers is unrestricted from said buffer area to said uptake area and/or said rejection area.

Thereby, precise control over when used containers are transported to or from the buffer area is provided. Such a buffer gate may further enable a higher control of the transported containers. For example, the buffer area may be arranged at one end of infeed transporting means comprising one or a sequence of conveyors (with the infeed area being arranged at another end of the infeed transporting means). Optionally, all or some of the not accepted containers may be fed from the inspection area to the buffer area for a further inspection. A buffer gate may be arranged, in its first position, across a conveyor of the infeed transporting means, with the buffer area on one side of the buffer gate. This has the double effect of preventing used containers from being transported by the infeed transporting means from the infeed area to to the buffer area, as well as blocking any used containers present in the buffer area from leaving the buffer area. Provided that the buffer gate in this position allows the containers in the infeed area to reach the redirection area, more recently received containers may be processed while less recently received containers, which preferably have already been inspected once, is contained at the buffer area.

In some embodiments, the buffer gate forms part of said redirection means. For example, the buffer gate may be arranged, in its first position, across a conveyor of the infeed transporting means, such that used containers transported along said infeed path are redirected towards said singulator transporting means upon reaching said buffer gate. Such a buffer gate may be referred to as a redirection gate.

In some embodiments, the buffer gate does not form part of said redirection means. For example, the first transporting arrangement may comprise a buffer gate and a separate redirection gate. This may be advantageous in configurations where said return conveyor arrangement and said active conveyor arrangement are not the same.

In some embodiments, said singulation arrangement comprises at least one container elevating member for transporting a used container from said uptake area to said receiving area along a curved singulation path, wherein said container elevating member is preferably arranged on the inner side of said curved singulation path.

The dimensions of the container elevating member may be adapted to transport used containers of various sizes and shapes.

A curved singulation path enables good control of the used container being transported by the singulation arrangement, while maintaining a low footprint of the reverse vending machine.

In some embodiments, said first path and said reservoir path each comprises conveying means, which conveying means is selected from a group comprising an active conveyor, a slide, a free fall path, and combinations thereof.

In some embodiments, the conveying means of the reservoir path is made of the same material as the reservoir. The conveying means may partly or fully form an integral part of the reservoir.

In some embodiments, the resulting displacement of said individual used containers when transported from said uptake area to said receiving area has a vertical component and at least a first lateral component, said first lateral component being substantially orthogonal to said first direction, and said reservoir path is arranged to provide said used containers to said reservoir at an input side of the reservoir, which input side is arranged

in front of said uptake area along the direction of said first lateral component.

5 In other words, the input side and the receiving area are on different sides of a vertical plane passing through the uptake area and parallel to the first direction (i.e. orthogonal to the first lateral component).

In some embodiments, the resulting displacement of said individual used containers when transported from said uptake area to said receiving area has a vertical component and at least a first lateral component, said first lateral component being substantially orthogonal to said first direction, and

10 said reservoir path is arranged to provide said used containers to said reservoir at an input side of the reservoir, which input side is arranged behind said uptake area along the direction of said first lateral component.

In other words, the input side and the receiving area are on the same side of a vertical plane passing through the uptake area and parallel to the first direction (i.e. orthogonal to the first lateral component).

20 In some embodiments, said conveying arrangement comprises a set of bi-directional conveyors arranged in sequence, wherein said bi-directional conveyors optionally are flat conveyors, preferably 250 to 500 mm wide.

This provides good control of the used containers. It further allows used containers to be spread out by operating consecutive bi-directional conveyors at different speeds.

25 In some embodiments, said conveying arrangement comprises a set of bi-directional conveyors arranged at different elevations.

30 By this, the container return system may receive used containers while in singulation mode.

In some embodiments, each conveyor in said set of bi-directional conveyors is independently operable.

5 This allows for freedom in the design, and e.g. enables a design of a system where the spread out of the containers is facilitated both when the conveyor runs forwards and when the conveyor runs backwards, by running at least two conveyors in the same direction but at different speed. Further, it enables the transport of objects in one direction at one speed, and a simultaneous transport of the objects in an opposite  
10 direction at another speed.

In some embodiments, said singulation arrangement is configured to transport said individual objects to said object classification arrangement,  
15 said object classification unit is configured to classify said individual objects into a category selected among the group comprising at least accepted and not accepted, and said classification arrangement is further configured to initiate a transport of said individual objects classified as not accepted to the  
20 buffer area of said conveyor arrangement.

In more detail, said classification arrangement may be configured to initiate a transport of some or all of the objects classified as not accepted to the buffer area. The classification not accepted may e.g.  
25 comprise one, two or all of the subgroups rejected, to be reject, unrecognized and similar,  
A configuration according to the above has the advantage that instead of the container being directly fed to a return opening or return bin, the container may be fed to the buffer area and thereafter to the sigulator  
30 for a retry at the classification unit, if e.g. the image of the container was not sufficiently sharp for the camera to determine whether the container is valid and the user is to be given a reward provided

optional further checks also are affirmative, or the container is to be seen as invalid and returned to the user or stored as invalid or unrecognized or similar.

5 According to one example, the items classified as accepted are stored as accepted containers, while items not classified as accepted are removed, stored as unrecognised items or returned to the user.

10 In some embodiments, said singulation arrangement and optionally said transporter is configured to transport said used containers to said classification unit at a higher elevation than said buffer area of the conveying arrangement.

In other words, said classification unit is arranged at a higher level compared to said buffer area of the classification arrangement.

15 In some embodiments, said container return system is further operable in a rejection mode, in which said conveyor arrangement is configured to transport said used containers to a rejection area, which rejection area is optionally partly or fully the same as said infeed area.

20 In some embodiments, said container return system is configured to start a time counter upon entering said singulation mode, said time counter is reset each time said object classification unit classifies an object as accepted, and said container return system is configured to switch from said singulation mode to said rejection mode upon said time counter  
25 exceeding a predetermined threshold.

In other words, if a predetermined time span has passed without the classification unit classifying an object as accepted, it may be assumed that only not accepted objects remain.

30 The above configuration is advantageous as it enables the system to stop processing the received items if too many foreign objects have been fed to the system.

In some embodiments, the conveying arrangement further comprises a singulator gate having at least a first and a second position, in which first position of said singulator gate a movement of said used containers is unrestricted between said infeed area and said buffer area, and wherein said singulator gate blocks said used containers from reaching said singulation arrangement, and

5 in which second position of said singulator gate a movement of said used containers is unrestricted between said conveyor arrangement and said singulation arrangement, and wherein said singulator gate

10 blocks said used containers from reaching said infeed area from said buffer area of the conveyor arrangement.

In some embodiments, the container return system further comprises a control unit configured to control the speed and/or direction of each bi-

15 directional conveyor of said conveyor arrangement.

In some embodiments, the container return system further comprises a control unit configured to control the speed and/or direction of each conveyor of the transporting arrangement, first transporting arrangement and/or second transporting arrangement.

20

In some embodiments, said set of bi-directional conveyors comprises a first bi-directional conveyor and a second bi-directional conveyor, and said second bi-directional conveyor is configured to operate at a higher speed than said first bi-directional conveyor in said receiving mode

25 and/or said singulation mode, such that used containers conveyed from said first bi-directional conveyor to said second bi-directional conveyor are spaced further apart from each other on the second bi-directional conveyor than on the first bi-directional conveyor.

30 According to a fourth aspect of the present inventive concept, there is provided a method for processing deposit return containers, such as

used food or beverage containers, by a container return system comprising:

a first transporting arrangement comprising infeed transporting means, redirection means, and singulator transporting means,

5 a singulation arrangement,

a second transporting arrangement, and

a classification unit,

the method comprising the steps of:

- receiving used containers in bulk at an infeed area,

10 - transporting, by said infeed transporting means, said used containers along an infeed path from said infeed area to a redirection area,

- redirecting, by said redirection means, said used containers at said redirection area,

15 - transporting, by said singulator transporting means, said used containers from said redirection area to an uptake area, which uptake area is adapted to collect used containers in bulk,

- singling out, by said singulation arrangement, individual used containers from said bulk and transporting, by said singulation arrangement, said individual used containers from said uptake area to  
20 a receiving area, said receiving area positioned at a higher vertical level than said uptake area,

- transporting, by said second transporting arrangement, said used containers, to said classification unit,

25 - classifying, by said classification unit, said individual used containers into a category selected among the group comprising at least accepted and not accepted,

- initiating, by said classification unit, a transport of only used containers classified as accepted for further processing or storage.

wherein

30 said redirection area is arranged at a first distance of said infeed area in a first direction, and

said step of transporting, by said infeed transporting means, said used containers along an infeed path from said infeed area to said redirection area, comprises transporting said used containers past said uptake area, as seen from above.

5

In some embodiments, the method comprises receiving used containers in bulk at said infeed area through an infeed opening, and transporting, by said infeed transporting means, said used containers along said infeed path from said infeed opening to said redirection area.

10

In some embodiments of the method, the first transporting arrangement may comprise an active conveyor arrangement having at least one active conveyor, wherein said active conveyor arrangement forms part of at least said infeed transporting means.

15

In some embodiments of the method, the method comprises receiving used containers in bulk at said infeed area through an infeed opening, and transporting, by said infeed transporting means, said used containers along an infeed path from said infeed opening to said redirection area via an active infeed area, wherein said infeed transporting means comprises an active conveyor arrangement having at least one active conveyor, which active conveyor arrangement is configured to transport said containers along said infeed path or along at least a portion of said infeed path, and is configured to transport said containers from said active infeed area to said redirection area.

20

25

According to a fifth aspect, there is provided a method for controlling a container return system, the method comprising:

30

a receiving step comprising controlling said conveyor arrangement to transport used containers received in bulk at said infeed area towards

said buffer area of the conveyor arrangement, including driving said first conveyor in said first direction, and

a singulation step comprising:

controlling said conveyor arrangement to transport said used

5 containers to said singulation arrangement to be singulated into individual objects, including driving said first conveyor in said second direction opposite said first direction, and

controlling said singulation arrangement to transport said individual objects to said transporter.

10

What is described above in relation to containers return systems of the first second and third aspects may also be applied to the methods according to the fourth and fifth aspects. Thus, the method according to the fourth and fifth aspects may suitably be carried out with a

15 container return system as described in connection with the first, second and/or third aspects. It should be understood that any features, embodiments and advantages of the first, second and third aspects may, as far as it is compatible with the method, be implemented in the method according to the fourth or fifth aspect of the inventive concept.

20

In some embodiments, the method further comprises the steps of

- classifying, by said classification unit, said individual used containers into a category selected among the group comprising accepted, rejected and unrecognized,

25

- initiating, by said classification unit, a transport of used containers classified as rejected to a rejection area via a buffer area, which rejection area is optionally partly or fully the same as said infeed area, or said active infeed area, and

30

- initiating, by said classification unit, a transport of used containers classified as unrecognized to said uptake area, optionally via said buffer area,

In some embodiments, said infeed transporting means comprises an active conveyor arrangement having at least one active conveyor, said singulator transporting means comprises at least one active or passive conveyor, and

5 the path of said at least one active conveyor of the active conveyor arrangement and the path of said at least one active or passive conveyor of the singulator transporting means are spatially separated from each other,  
and the method further comprises the step of simultaneously  
10 transporting used containers from said infeed area to said redirection area and transporting used containers from said redirection area to said uptake area.

In some embodiments, said first transporting arrangement comprises  
15 an active conveyor arrangement, which active conveyor arrangement comprises at least one bi-directional conveyor operable in a forward and a backward direction, the method further comprising the steps of:  
receiving, by said active conveyor arrangement, used containers transported along said infeed path,  
20 operating said bi-directional conveyor in said forward direction to transport said used containers to said redirection area, and  
operating said bi-directional conveyor in said backward direction to transport said used containers from said redirection area to said uptake area.

25  
In some embodiments, said active conveyor arrangement comprises at least one bi-directional conveyor operable in a forward and a backward direction, wherein said active conveyor arrangement further forms part of said redirection means and said singulator transporting means, the  
30 method further comprising the steps of:  
-receiving, by said active conveyor arrangement, used containers transported along said infeed path upstream of said redirection area,

-operating said bi-directional conveyor in said forward direction to transport said used containers to said redirection area,  
-redirecting said used containers at said redirection area by switching operation of said bi-directional conveyor from said forward to said  
5 backward direction, and  
-operating said bi-directional conveyor in said backward direction to transport said used containers from said redirection area to said uptake area.

10 In some embodiments, the container return system comprises a redirecting bi-directional conveyor operable in a forward and a backward direction, which redirecting bi-directional conveyor forms part of said redirection means, said infeed transporting means, and said singulator transporting means, and  
15 said singulator transporting means comprises an active conveyor arrangement,  
wherein the method further comprises transporting, by said active conveyor arrangement of said infeed transporting means, said containers from said active infeed area to  
20 said redirection area when operating said redirecting bi-directional conveyor in said forward direction, and transporting, by said active conveyor arrangement of said singulator transporting means, said containers from said redirection area to said uptake area or to a passive conveyor configured to transport said  
25 containers to said uptake area when operating said redirecting bi-directional conveyor in said backward direction,  
wherein the active conveyor arrangement of said infeed transporting means and the active conveyor arrangement of said singulator transporting means is optionally one and the same.

30 In some embodiments, the method further comprises a classification step comprising:

controlling said transporter to transport said individual objects to said object classification unit,  
controlling said classification unit to classify said individual objects into a category selected among the group comprising at least accepted and not accepted, and  
5 controlling said classification arrangement to initiate a transport of said individual objects classified as not accepted to said buffer area of said conveyor arrangement.

In some embodiments, the method further comprises  
10 a step of determining a time elapsed since an individual objects was classified, by said object classification unit, as accepted, and upon said time elapsed exceeding a predetermined threshold, controlling said conveyor arrangement to transport said used containers to a rejection area, which rejection area is optionally partly  
15 or fully the same as said infeed area.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The inventive concept, some non-limiting embodiments, and further advantages of the inventive concept will now be described with  
20 reference to the drawings in which:

Figure 1a is a perspective view showing some parts of a container return system involved in the transport and processing of a used deposit return containers, which perspective view mainly shows the  
25 backside and a first lateral side of the machine.

Figure 1b is a perspective view showing some parts of the same container return system as shown in Figure 1a, which perspective view mainly shows the second lateral side of the machine and also the backside the machine.

30 Figure 1c is a top view showing some parts of the container return system shown in Figures 1a and 1b.

Figure 1d is a perspective view showing the working principle of the same container return system as shown in Figs 1a-1c, the perspective is identical to that of Figure 1a.

5 Figure 1e is a perspective view showing the same container return system as shown in Figs 1a-1d, where e.g. the front panel of the reservoir is not shown in this view.

10 Fig. 2 schematically illustrates the relative positions, as seen from above, of the infeed area or infeed opening 3, the redirection area 8 and the uptake area 9 in a system 1 according to the present inventive concept.

Fig. 3 shows a perspective view of a second embodiment of a system according to the present inventive concept.

Fig. 4 shows a perspective view of a third embodiment of a system according to the present inventive concept.

15 Fig. 5 shows a perspective view of a fourth embodiment of a system according to the present inventive concept.

Fig. 6 shows a perspective view of a system according to the present inventive concept.

20 Fig. 7 shows a perspective view of a further embodiment of a system according to the present inventive concept.

Fig. 8 shows a perspective view of a further embodiment of a system according to the present inventive concept.

## 25 DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The present inventive concept will now be described in further detail with reference to the drawings, in which some embodiments of the inventive concept are shown. The inventive concept may, however, be  
30 implemented in many different forms and should not be construed as limited to the embodiments set forth herein. The skilled person realizes

that features of different embodiments may, as far as they are compatible, be combined to advantage.

5 Figs. 1a-e are shows different views of a container return system 1 configured to receive a bulk of used deposit return containers or used containers through an infeed opening 15. The container return system comprises a first transporting arrangement 4, which first transporting arrangement comprises infeed transporting means 3, 5, 16 redirection means 20, and singulator transporting means 7, 18. The infeed transporting means 3, 16 is configured to transport said used containers along an infeed path (A, B in Fig. 1d) from said infeed opening 15, via a infeed area 3, to a redirection area 8. The active infeed area is arranged at the upstream end of the active infeed conveyor 16, i.e. at the left end of the active infeed conveyor as seen 10 in Fig 1b, as this is where the objects first make contact with an active conveyor.

15 The redirection means 20 is configured to redirect said used containers at said redirection area 8, and said singulator transporting means 7, 18 is configured to transport said used containers from said redirection area 8 to an uptake area 9, which uptake area is adapted to collect used containers in bulk.

20 The container return system further comprises a singulation arrangement 10 configured to single out individual used containers from said bulk, and configured to transport said individual used containers from said uptake area 9 to a receiving area 11, and the receiving area 11 is positioned at a higher vertical level than said uptake area.

25 The second transporting arrangement 12 is configured to transport said used containers from said receiving area 11 to a classification unit 13, which classification unit 13 is configured to classify said individual used containers into a category selected among the group comprising at least accepted and not accepted, wherein said classification unit is 30

further configured to initiate a transport of only the used containers classified as accepted for further processing or storage as accepted containers.

5 Moreover, the redirection area 8 is arranged at a first distance from said infeed area 3 in a first direction 14, and the infeed transporting means 3, 16 is configured to transport said used containers from said infeed opening 15 to said redirection area 8 past said uptake area 9, as seen from above.

10 In a typical installation, the system 1 is installed, for example in a supermarket, with a user-facing front panel 25, including an infeed opening 15, being the only part of the system 1 visible to the end-user. The rest of the system is located in a backroom facility only accessible to authorized personnel. The wall 26 separating the user-facing front of  
15 the system 1 and the backroom facility is shown schematically in Fig. 1c.

The end-user may feed empty containers 2 into the system 1, for example by emptying a bag filled with empty containers 1 into the infeed opening 15. Once the user has fed all the empty containers 2  
20 into the system 1, (s)he may receive a receipt noting the return value, or redemption value, of the empty containers 2 as calculated by the system 1 or a processing device connected thereto. The receipt may for example be exchanged for cash or a discount at the check-out of the supermarket in which the system is located or at another physical  
25 or virtual location. The receipt may be a printed receipt. Alternatively, the registration and/or transfer or redemption value may be done digitally.

In more detail, the system such as the one shown in Figs. 1a-e may be configured to receive a bulk of used containers through an infeed  
30 opening 15. The system comprises an active infeed conveyor 16, a first path 3 for providing said used containers from said infeed opening 15, via said infeed area 3, to said active infeed conveyor 16, a

singulation arrangement 10 comprising a reservoir 18 having an uptake area 9 adapted to collect used containers 2 in bulk. The singulation arrangement 10 may be configured to single out individual used containers 2 from said bulk and transport said individual used containers 2 from said uptake area 9 to a receiving area 11, which receiving area 11 is positioned at a higher vertical level than said uptake area 9. A reservoir path 7 for providing said used containers 2 from said active infeed conveyor 16 to said reservoir 18, and a transporting arrangement 12 configured to transport said individual used containers 2 from said receiving area 11 to a classification unit 13, which classification unit 13 is configured to classify said individual used containers 2 into a category selected among the group comprising at least accepted and not accepted, and to initiate a transport for further processing or storage of only the used containers 2 classified as accepted.

The container return system 1 may further comprise a redirection gate 20 movable between a redirecting position and an open position, in which redirecting position said redirection gate 20 is arranged across said active infeed conveyor 16, wherein said active infeed conveyor 16 is operable in a first direction 14 to transport said used containers 2 received from said first path 3 towards said redirection gate 20, and which redirection gate 20, when in its redirecting position, deflects used containers 2 from said active infeed conveyor 16 to said reservoir path 7 upon said used containers 2 reaching said redirection gate 20.

The system 1 is e.g. supported by a frame structure 21. Typically, the system is enclosed, or at least partially enclosed, by a housing. The housing is removed in the figures to better show the different elements and features of the system 1.

Arrows A-F in Fig. 1d illustrate the main flow of used containers in the system 1 as follows:

- arrow A: used containers 2 received through the infeed opening 15 slide and/or fall down along the first path 3 towards the active infeed conveyor 16;
  - arrow B: used containers 2 are transported on the active infeed  
5 conveyor 16 from the infeed area 3 towards the redirection gate 20;
  - arrow C: upon contact with the redirection gate 20, the used container 2 is deflected to exit the active infeed conveyor 16 and enter the reservoir 18,
  - arrow D: the used container 2 or flow of used containers 2 is guided  
10 by the shape of the reservoir 18 towards the uptake area 9 of the reservoir,
  - arrow E: one or a few used containers 2 is/are pushed by an elevating member 22 of the singulation arrangement 10 in a curved singulation path 23 from the uptake area 9 to the receiving area 11  
15 where it is transferred to a conveyor, e.g. a V-conveyor 12,
  - arrow F: the used container 2 is transported on the V-conveyor 12 from the receiving area 11 to the classification unit 13.
- Turning back to Fig. 1a, the classification unit 13 has an opening 81 arranged around an end of the V-conveyor 12, such that a used  
20 container 2 transported by the V-conveyor 12 from the receiving area 11 passes through said opening 81. The used container 2 is then received by a conveyor 82.
- Generally, in any container return system, a classification unit may for example be of the type described in WO2012/177148A1 and/or  
25 comprise a camera viewing device described in WO2006/080851A2, as two non-limiting examples.
- In the embodiment shown in Figs. 1a-e, the classification unit may comprise a camera, scanner, or other sensor for obtaining information of the used container 2 needed to make the classification. Several  
30 cameras, scanners, and/or other sensors may be arranged in series or in parallel. The classification unit 13 may comprise a OneRing system. The classification unit 13 is configured to obtain information of the used

container 2 and classify the used container 2 while the used container 2 is on conveyor 82. Thereafter, the used container 2 is transported to forwarding conveyor 83.

Having reached the forwarding conveyor 83, the flow of used containers 2 illustrated in Fig. 1d may continue in one of three ways (arrows I-H), depending on the classification given to the used container 2 by the classification unit 13.

- arrow I: used containers 2 classified as accepted are transported out of the system 1 for further transport or storage as accepted containers;

- arrow G: used containers 2 classified as rejected are diverted laterally to exit the forwarding conveyor 83. The rejected used containers 2 then fall and/or slide to a buffer area 63 of the active infeed conveyor 16. The buffer area 63 is separated from the rest of the active infeed conveyor 16 by the redirection gate 20, provided the redirection gate 20 is in its redirecting position. The used containers classified as rejected may be transported from the buffer area 63 to a rejection area.

For example, the infeed area may be used as a rejection area at the end of a session, when a user has no more used containers to feed into the system 1. The rejected used containers may be transported to the infeed/rejection area by operating the infeed conveyor 16 in the opposite direction to the first direction, while the redirection gate 20 is in the open position. Additionally or alternatively, rejected used containers may be transported to a separate rejection area (not shown in the figures).

- arrow H: used containers 2 classified as unrecognized are diverted laterally to exit the forwarding conveyor 83. The unrecognized used containers 2 then fall and/or slide back into the reservoir 18. Thereby, the unrecognized used containers will thus be transported back to the classification unit 13 along arrows D-E-F. The subsequent pass through the classification unit 13 may allow the classification unit 13 to positively classify the used container as either accepted or rejected.

Diverting means for diverting used containers from the forwarding conveyor along arrows G or H are not shown in the figures.

It should be noted that for the used containers 2 to be redirected from the active infeed conveyor 16 to the reservoir 18, it is sufficient that the flow of used containers reaches the redirection gate 20 and not necessary that each individual object 2 enters into contact with the redirection gate 20. In other words, if several used containers 2 are transported on the infeed conveyor 16, one object 2 may be deflected to the reservoir 18 through contact with the redirection gate 20, while the next object 2 is deflected to the reservoir 18 through contact with the previous object 2, without touching the redirection gate 20.

To facilitate the feeding of a bulk of empty containers 2 into the system 1, the infeed area 3 may comprise a portion protruding from the user-facing front panel of the system 1. In more detail the infeed area 3 illustrated in Fig. 1a comprises vertical side-walls 27 and an inclined bottom surface 28. The infeed area 3 is designed to receive and support the used container(s), or bulk of empty containers. In this example the one or more containers are supported while sliding down along the first path 3. Respective portions of the front panel and the side walls together define an infeed opening, the visible parts of these respective portions are marked by thicker lines in Fig. 1a. Further, the infeed area 3 forms a path to the active infeed conveyor 16, and used containers 2 dropped through the infeed opening 15 by a user thus fall or slide by gravity towards the infeed conveyor 16.

In the following, the system 1 will be described with reference to the x, y, and z directions marked on the drawings.

The user-facing front panel 25 is arranged parallel to the xz plane. The infeed conveyor 16 extends in the y direction from the infeed area 3 substantially the entire length of the system 1 in the y-direction. In the present embodiment, the infeed conveyor 16 is an active bi-directional conveyor.

The infeed conveyor 16 of Fig. 1a is substantially horizontal and is generally flat.

5 The infeed conveyor 16 may have a width of 330 mm. Additionally or alternatively, the width of the infeed conveyor 16 may be 300 mm – 400 mm, or 250 mm – 500 mm. Generally, any conveyor of a system according to the present inventive concept may be 330 mm wide, or may be 300 mm – 400 mm wide, or may be 250 mm – 500 mm wide. The infeed conveyor 16 may be provided with side walls 29 to prevent used containers 2 transported thereon to fall off to the side of the conveyor 16. One section of such a side wall 29 is illustrated in Fig. 1a, while other sections of the side wall have been omitted for clarity of the figure.

15 The redirection gate 20 is movable between an open position and a redirecting position. The redirection gate 20 may be pivotable about an axis extending perpendicular to the surface of the infeed conveyor 16 and located in proximity to a side of the conveyor 16. Thereby, the redirection gate 20 is pivotable between an open position, in which it forms part of the side wall of the infeed conveyor 16, as shown in Fig. 1b, and a redirection position shown in Fig. 1a. In its redirecting position, the redirection gate 20 is arranged across the infeed conveyor 20 16 at an angle with respect to the extension of the infeed conveyor. The angle between the redirection gate 20 and the infeed conveyor 16 is such that used containers 2 being transported on the infeed conveyor 16 are deflected to the side of the infeed conveyor 16 upon contact with the redirection gate 20. As illustrated, the angle between the redirection gate 20 in its redirecting position and the infeed conveyor 16 may be approximately 45°. The angle will depend on the length of the redirection gate.

25 In the embodiment of Figs. 1a-e, the used containers fall or slide into the reservoir 18 upon exit from the infeed conveyor 16. In other words, 30 in the present embodiment, the used containers are transported from

the infeed conveyor 16 into the reservoir 18 in a freefall path and/or a slide surface forming part of the reservoir 18.

The reservoir 18 has an elongated shape, extending generally parallel with the infeed conveyor 16 in the y-direction. The reservoir 18 is thus  
5 narrower in the x-direction than in the y-direction. The bottom surface 30 of the reservoir 18 is curved, such that the lowest point of the reservoir 18 is located in a central portion of the reservoir 18 with respect to the y-direction. The uptake area 9 generally corresponds to the lowest point of the reservoir. The reservoir 18 has a front side,  
10 farthest from the infeed conveyor 16 in the x-direction, and a back side, closest to the infeed conveyor 16 in the x-direction. It is provided with a front panel 31 and a back panel 32. The front panel 31 and bottom surface 30 of the reservoir have been removed in Fig. 1e. The infeed conveyor 16 is also not visible in Fig. 1e. The back panel 32 is shaped  
15 such that used containers 2 that are misaligned when reaching the receiving area and/or the V-conveyor 12 may, if they fall to either side of the receiving area/V-conveyor (in the x-direction), may be caught by the back panel 32 and thus guided back to the uptake area 9.

The shape of the reservoir 18, i.e. the shape of the bottom surface 30, front panel 31, and back panel 32 of the reservoir 18, is adapted to  
20 guide the used containers 2 received from the infeed conveyor 16 towards the uptake area 9. Further, the shape of the reservoir 18 helps align the used containers 2 such that they are arranged longitudinally in the uptake area 9, i.e. with their longest dimension parallel to the  
25 front panel 31 of the reservoir 18.

The singulation arrangement 10 comprises container elevating members 22 for transporting the used containers from the uptake area 9 to the receiving area 11. The container elevating members 22 move along the curved singulation path 23 driven by a chain 33. The  
30 singulation path 23 is defined by a slot 34 in the inner surface of the reservoir. The chain 33 is thus arranged on the outside of the reservoir 18. The container elevating members 22 may be attached to the chain

33 such that, when moving along the singulation path 23, the container elevating members are on the inside of the reservoir 18, at least in a lower part of the singulation path..

5 The singulation arrangement 10 may comprise 1-20, 1-15, 2-25, or 5-15, or 5-10 elevating members 22. The number of elevating members 22 may depend on the size of the singulation arrangement i.e. on the length of the singulation path 23. The elevating members 22 may be equally spaced or non-equally spaced.

10 The elevating members 22 may have a size and shape adapted to transport used containers of different sizes and shapes from the uptake area 9 to the receiving area 11. If there are more than one elevating member 22, the size and/or shape of the elevating members 22 may be the same, although this is not required.

15 As illustrated in Fig. 1, the elevating members 22 may for example take the form of a plate or paddle. Additionally or alternatively, the elevating members 22 may extend perpendicular to the bottom surface 30 of the reservoir 18, during at least part of the movement along the singulation path 23. The elevating member may have a supporting surface 35 for pushing the used containers 2 along the singulation path 23. The  
20 elevating member 22 and/or the supporting surface 35 may be rectangular, elliptical, flat, cup-shaped, or be any combination of these such as rectangular and flat. It may be solid or have small openings.

25 Fig. 2 exemplifies the expression "past said uptake area, as seen from above" as used according to the present inventive concept. As seen in Fig. 2, the redirection area 8 or B is arranged at a first distance from the infeed opening 3 or A in the first direction 14. Here, the infeed transporting means 5 is a flat active conveyor for transporting used  
30 containers from the infeed opening 3 to the redirection area 8 along an infeed path parallel with the first direction 14. The redirection means 20 take the form of a redirection gate arranged across the infeed

transporting means 5, such that used containers transported on the infeed transporting means are deflected towards the singulator transporting means 7. In turn, the singulator transporting means 7 is arranged to transport used containers 2 from the redirection area 8 to the uptake area 9 or C. Arrow 23 represents the singulation path along which used containers 2 are transported from the uptake area 9 to the receiving area 11.

The dashed line 50 passes through central portions of the infeed area 3 or A and the redirection area 8 or B, respectively. As clearly shown in Fig. 2, the orthogonal projection 51 or D of the uptake area 9 onto this line 50 is between the infeed area 3 or A and the redirection area 8 or B.

According to preferred embodiments of this inventive concept: when the orthogonal projection D of the uptake area C onto a line passing through the central portions of the infeed area and the redirection area is arranged between the infeed area A and the redirection area B, the containers are transported past said uptake area as seen from above; when transported from said infeed opening to said redirection area, which line is parallel with said first direction.

In the following, further embodiments of the system 110, 120, 130, 140, 150, 160 will be discussed with reference to Figs. 3-8.

Elements of the system 110, 120, 130, 140, 150, 160 that are the same or directly correspond to elements of the system 1 of the first embodiment are referred to by the same reference numbers in the drawings.

A second embodiment of the system 110, which is similar to the system 1 described above, is shown in Fig. 3. Similarly to the system 1, the system 110 comprises an infeed opening 15 through which a bulk of used containers is received, an active infeed conveyor 16, and a first path for providing the used containers from the infeed opening

15 to the active infeed conveyor (arrow A). The active infeed conveyor 16 transports the used containers in the first direction 14 (arrow B). The system 110 of the second embodiment is also provided with a redirection gate 20 which is movable between a redirecting position and an open position.

5 The system 110 of the second embodiment differs from the system 1 of the first embodiment in that the reservoir path comprises an active conveyor 60 for providing the used containers 2 from the active infeed conveyor 16 to the reservoir 18. The active conveyor 60 is arranged parallel to the active infeed conveyor 16 and at a slightly lower elevating. Thereby, the used containers that are redirected by the redirection gate 20 are deflected onto the active conveyor 60 (arrow C'). Further, the active conveyor 60 operates in a second direction 61, substantially opposite to the first direction 14'.

15 A further difference between system 110 and system 1 is the configuration of the singulation arrangement. In the system 110 of the second embodiment, the elevating members 22 of the singulation arrangement 10' are arranged on a hollow disk 62. The hollow disk 62 is rotatable about an axis, such that the elevating members are locked to a circular path. The active conveyor 60 is arranged to transport the used containers to the reservoir 18 through the hollow disk 62 (arrow D').

25 Once a used container 2 has been transported by the singulation arrangement 10' to the receiving area 11, the used container 2 is handled by system 110 in a similar way as system 1. First, the used containers are transported to the classification unit 13 (arrow F). Used containers 2 classified as accepted by the classification unit 13 are further transported on conveyor 83 along arrow I, for further processing or storage. Used containers 2 classified as not accepted by the classification unit 13 may be diverted along arrow G' or arrow H'. In more detail, used containers 2 classified as rejected may be diverted along arrow G' after which they are received at a buffer area 63 of the

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active infeed conveyor. The redirection gate 20, when in its redirecting position, separates the buffer area 63 of the active infeed conveyor 16 from the flow of used containers 2 being transported from the infeed opening to the redirection gate 20. Used containers classified as rejected may be transported to a rejection area as described in relation Figs. 1a-e. Used containers 2 classified as unrecognized may be diverted along arrow H', after which they are received by the active conveyor 60. The unrecognized used containers are then transported back to the reservoir 18.

10 A separation wall, not shown in the figure, may be provided between the active infeed conveyor 16 and active conveyor 60 to ensure that used containers diverted along arrows G' and H' are received by the correct conveyor. It should also be noted that several sections of the side wall and end walls surrounding active infeed conveyor 16 and active conveyor 60 have been omitted for clarity of the figure.

Fig. 4 shows a third embodiment of the system 120, which differs from the second embodiment of the system 110 in that the active conveyor 60' towards which the used containers 2 are deflected by the redirection gate 20 is arranged at an acute angle with respect to the active infeed conveyor 16, instead of being parallel with the active infeed conveyor 16.

The flow of used containers in the system 120 along arrows A-C' and F-I is analogue to what is described in connection to Fig. 3.

25 The configuration of the singulation arrangement 10' of the third embodiment of the system 120 is similar to that of the second embodiment of the system 110. Attachment points 22a for the elevating members 22 are shown in Fig. 4, whereas the elevating members 22 are not shown.

30 A guide element 64 is further provided at the end of the active conveyor 60' to deflect used containers transported by the active

conveyor 60' into the reservoir 18, through the hollow disk 62 of the singulation arrangement 10' (arrow D').

Used containers 2 classified as rejected by the classification unit 13 may be diverted along arrow G''. Thereafter, the rejected used  
5 containers 2 slide or bounce on a first guide surface 65 before being received in the buffer area 63 of the active infeed conveyor 16. Used containers classified as rejected may be transported to a rejection area as described in relation Figs. 1a-e.

Used containers 2 classified as unrecognized by the classification unit  
10 13 may be diverted along arrow H''. Thereafter, the unrecognized used containers 2 fall onto a second guide surface 66 which guides the unrecognized used containers onto the active conveyor 60'. The arrow from indicates a drop from guide surface 66 to conveyor 60'.

Thereafter, the unrecognized used containers are first transported  
15 back into the singulation arrangement 10', which in turn transports the used containers to the receiving area for further transport to the classification unit.

The fourth embodiment of the system 130 shown in Fig. 5 differs from  
20 the second and third embodiments in that the singulation arrangement 10'' comprises elevating members 22 arranged on a rotating plate instead of a hollow disk. As in Fig. 4, only attachment points 22a are shown in Fig. 5, not the elevating members 22.

The infeed opening 15 is not visible in Fig. 5 as it is hidden behind the  
25 singulation arrangement 10''. Used containers 2 received through the infeed opening are transported on the active infeed conveyor 16 towards the redirection gate 20 (arrow B). Upon contact with the redirection gate 20, the flow of used containers 2 is deflected towards active conveyor 67 which is arranged perpendicular to the active infeed  
30 conveyor 16. The perpendicular conveyor 67 in turn transports the used containers to active conveyor 68 (arrow C'), which is arranged perpendicular to conveyor 67 and parallel to the active infeed conveyor

16. Active conveyor 68 is configured to transport the used containers 2 towards guide element 69, which is arranged across active conveyor 68 to deflect used containers transported on active conveyor 68 to the reservoir of the singulation arrangement 10'' (arrow D').

- 5 As in previous embodiments, used containers may be forwarded along arrow I, or diverted along arrow G or H, depending on the classification provided by the classification unit 13. Rejected used containers diverted along arrow G may be received in the buffer area 63 of the active infeed conveyor 16. Used containers classified as rejected may
- 10 be transported to a rejection area as described in relation Figs. 1a-e. Unrecognized used containers diverted along arrow H may be received on active conveyor 68, and thereby transported back into the singulation arrangement 10'', and thereafter to the classification unit 13 again.
- 15 In Fig. 5, guide elements and/or surfaces necessary to guide the used containers diverted along arrows G and H to the active infeed conveyor 16 and the active conveyor 68, respectively, have been omitted.

- 20 The container return system shown in e.g. Figures 6 comprises a set of bi-directional conveyors 16', 70, each bi-directional conveyor operable in a forward and a backward direction; wherein one bi-directional conveyor in said set of bi-directional conveyors is a redirecting bi-directional conveyor 70 which redirecting bi-directional conveyor forms
- 25 part of said redirection means, said infeed transporting means, and said singulator transporting means. Further, said infeed transporting means comprises an active conveyor arrangement 16', 70, configured to transport said containers along a long a portion of said infeed path, wherein said active conveyor arrangement of said infeed transporting
- 30 means is configured to transport said containers from said active infeed area A to said redirection area 71 when said redirecting bi-

directional conveyor 70 and preferably any preceding bi-directional conveyor is operated in said forward direction, and wherein said singulator transporting means comprises an active conveyor arrangement 70, 16' configured to transport said containers from said redirection area 71 to said uptake area or to a passive conveyor configured to transport said containers to said uptake area when said redirecting bi-directional conveyor and preferably any following bi-directional conveyor 16' is operated in said backward direction. As shown in Fig. 6, the active conveyor arrangement of said infeed transporting means and said singulator transporting means is one and the same, i.e. comprises the same bi-directional conveyors. Optionally the infeed transporting means may comprise one or more preceding conveyors, which preceding conveyors may be active or passive; and which preceding conveyors do not form part of the said singulator transporting means.

The system 140 of Fig. 6 comprises a singulation arrangement 10'' which is similar to the singulation arrangement described in connection with Fig. 5. The system 140 has a conveying arrangement comprising an active infeed conveyor 16' being a bi-directional conveyor, and a second bi-directional conveyor 70 comprising a buffer area 71. The active infeed conveyor 16' and the second bi-directional conveyor 70 are arranged in sequence.

An object classification arrangement comprises a classification unit 13 and a transporter 12 for transporting used containers from the singulation arrangement 10'' to the classification unit 13.

The system 140 is further provided with a singulator/redirection gate 20 movable between a first and a second position. In its first position, not shown in Fig. 6, the singulator/redirection gate is aligned with the edge of the active infeed conveyor 16' in front of the singulator arrangement

10". Thereby, used containers are blocked from reaching the singulator arrangement 10" from the active infeed conveyor 16'. The flow of used containers is however unrestricted on the active infeed conveyor 16' and the buffer area 71.

5 The singulator/redirection gate 20 is shown in Fig. 6 in its second position, arranged across the active infeed conveyor 16'. In its second position, the singulator/redirection gate 20 blocks the flow of used containers between the infeed area and the buffer area 71. The flow of used containers is unrestricted between the buffer area 71 and the  
10 singulation arrangement 10".

When operating the system 140 in the receiving mode, the singulator/redirection gate 20 is in its first position. The active infeed conveyor 16' and the second bi-directional conveyor 70 operate in the first direction 14. Thus, the used containers 2 are received through the  
15 infeed opening 15 (arrow A) and transported by the active infeed conveyor 16' towards the second-bi-directional conveyor 70. The second bi-directional conveyor 70 transports the used containers to the buffer area 71 (arrow B').

When operating the system 140 in the singulation mode, the  
20 singulator/redirection gate 20 is in its second position. Thus, no more used containers 2 can be received when operating the system 140 in singulation mode and the end-user must wait for the batch of used containers 2 present in the system 140 to be processed. The conveyors 16', 70 operate in the second direction 61, opposite the first  
25 direction 14. Thus, the used containers 2 located in the buffer area 71 are transported towards the singulator/redirection gate 20 (arrow C"). In other words, conveyor 70 acts as redirecting means. Upon contact with the singulator/redirection gate 20, the used containers are deflected into the reservoir of the singulation arrangement 10" (arrow  
30 D").

The singulation arrangement 10" transports the used containers to the receiving area 11. V-conveyor 12 then transports the used containers

to the classification unit 13 (arrow F). Used containers classified as accepted may be further transported by conveyor 83 along arrow I as described in relation to previous embodiments. Used containers classified as rejected and/or unrecognized containers may be diverted  
5 along arrow G'' towards conveyor 70. The rejected and/or unrecognized containers may then be transported back to the singulation arrangement 10''. Additionally or alternatively, rejected and/or unrecognized used containers may be transported back to the user.

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A further embodiment of the system 150 is shown in Fig. 7. This embodiment is similar to the system 140 described in connection to Fig. 6. However, in system 150, used containers received through the infeed opening at arrow A (the infeed opening is not shown in Fig. 7)  
15 are received by a preceding conveyor 72 which is arranged directly above and parallel to the first and second conveyors 16' and 70. With this configuration, the preceding conveyor 72 may operate in the first direction 14, while the first and second conveyors 16' and 70 operate in the second direction. The preceding conveyor 72 transports used  
20 containers to conveyor 70 (arrow B'). Conveyors 70, 16' transport used containers towards the singulator/redirection gate 20. With the singulator/redirection gate 20 in its second position, arranged across conveyor 16' as described in connection to Fig. 6, the system 150 thereby allows continuous feeding of used container 2. Used  
25 containers are deflected into the reservoir of the singulation arrangement 10'' at arrow D''. In other words, an end-user needs not wait until a batch of used containers 2 is process by the system 150 before feeding new used containers into the system 150. Used containers having been transported to the receiving area 11 by  
30 the singulation arrangement 10'', the flow of used containers may continue along arrows F, G'', I, as described in relation to Fig. 6.

Generally, in any embodiment of the system, guide surfaces may be provided to guide used containers, e.g. to slide onto the correct conveyor after having been diverted. Not all these guide surfaces are shown in the drawings.

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Fig. 8 shows a system 160 which is similar to the system 1 shown in Figs. 1a-e. A difference is that the active infeed conveyor 16 is shorter in the system 160, such that the active infeed conveyor fits within the frame structure 21. Thus, the active infeed conveyor 16 may be given any suitable length to fit/interconnect with the rest of the system. The system 160 of Fig. 8 also comprises an optional sensor 200 for determining a fill level of the reservoir 18. The sensor 200 may be an optical sensor, including e.g. a matrix detector and optionally being a time-of-flight sensor, having a field of view 201 of the reservoir 18. The sensor 18 is configured to determine a distance between a container present in the reservoir 18 and the sensor 200. Thereby, the fill-level of the reservoir 18 may be determined by comparing the determined distance with a reference measurement obtained e.g. with an empty reservoir 18. The field of view 201 of the sensor 200 may be adapted or modified by use of a lense (not shown in the figure). The sensor 200 may be configured to simultaneously measure a distance at a plurality of points with the field of view 201, for example in a grid of 8x8 points. The principle of a time-of-flight sensor will be familiar to a person skilled in the art. To improve accuracy of the measurement, the sensor 200 may be configured to filter out elevating members 22 of the singulation arrangement 10.

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the reservoir 18 has reach the predetermined threshold. Operation of the singulation arrangement 10 continues while the active infeed conveyor 16 is stopped, until the fill-level of the reservoir 18 is once again below the predetermined threshold. The active infeed conveyor  
5 16 may then be started again.

The person skilled in the art realises that the present disclosure by no means is limited to the preferred embodiments described above. On the contrary, many modifications and variations are possible within the  
10 scope of the appended claims. The word “comprising” does not exclude the presence of other elements or steps than those listed in the claim. The word “a” or “an” preceding an element does not exclude the presence of a plurality of such elements. Additionally, variations to the disclosed embodiments can be understood and effected by the  
15 skilled person in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims.

ITEMIZED LIST OF EMBODIMENTS

- Item 1: A container return system configured to receive a bulk of used deposit return containers, such as used food or beverage containers,
- 5 through an infeed opening, the container return system comprising:
- an active infeed conveyor,
  - a first path for providing said used containers from said infeed opening to said active infeed conveyor,
  - 10 a singulation arrangement comprising a reservoir having an uptake area adapted to collect used containers in bulk, which singulation arrangement is configured to single out individual used containers from said bulk and transport said individual used containers from said uptake area to a receiving area, said receiving area positioned at a higher vertical level than said uptake area,
  - 15 a reservoir path for providing said used containers from said active infeed conveyor to said reservoir, and
  - a transporting arrangement configured to transport said individual used containers from said receiving area to a classification unit, which classification unit is configured to classify said individual used
  - 20 containers into a category selected among the group comprising at least accepted and not accepted, and to initiate a transport for further processing or storage of only the used containers classified as accepted,
  - wherein the container return system further comprises a redirection gate movable between a redirecting position and an open
  - 25 position, in which redirecting position said redirection gate is arranged across said active infeed conveyor, wherein said active infeed conveyor is operable in a first direction to transport said used containers received from said first path towards said redirection gate, and which redirection gate, when in its redirecting position, deflects used containers from said active
  - 30 infeed conveyor to said reservoir path upon said used containers reaching said redirection gate.

Item 2: The container return system according to item 1, wherein said first path and said reservoir path each comprises conveying means, which conveying means is selected from a group comprising an active conveyor, a slide, a free fall path, and combinations thereof.

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Item 3: The container return system according to item 1 or 2, wherein the resulting displacement of said individual used containers when transported from said uptake area to said receiving area has a vertical component and at least a first lateral component, said first lateral component being substantially orthogonal to said first direction, and wherein said reservoir path is arranged to provide said used containers to said reservoir at an input side of the reservoir, which input side is arranged in front of said uptake area along the direction of said first lateral component.

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Item 4: The container return system according to item 1 or 2, wherein the resulting displacement of said individual used containers when transported from said uptake area to said receiving area has a vertical component and at least a first lateral component, said first lateral component being substantially orthogonal to said first direction, and wherein said reservoir path is arranged to provide said used containers to said reservoir at an input side of the reservoir, which input side is arranged behind said uptake area along the direction of said first lateral component.

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Item 11: A container return system for processing used deposit return containers, such as used food or beverage containers, received in bulk, the container return system comprising:

a singulation arrangement for singulation of said used

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containers received in bulk into individual objects,

a conveying arrangement comprising at least a first conveyor,

and

an object classification arrangement comprising a classification unit and a transporter for transporting objects from said singulation arrangement to said classification unit,

wherein said container return system (1) is operable at least in:

5 a receiving mode, in which said conveying arrangement is configured to receive said used containers at an infeed area of the conveying arrangement and transport said used containers to a buffer area of the conveying arrangement via at least said first conveyor, and

10 a singulation mode, in which said conveying arrangement is configured to transport said used containers from said buffer area to said singulation arrangement via at least said first conveyor,

wherein

said first conveyor is a bi-directional conveyor, which bi-directional conveyor is configured to operate in a first direction in said  
15 receiving mode and in a second direction in said singulation mode, said second direction being opposite to said first direction.

Item 12: The container return system according to Item 11, wherein said conveying arrangement comprises a set of bi-directional conveyors  
20 arranged in sequence, wherein said bi-directional conveyors optionally are flat conveyors, preferably 250 to 500 mm wide.

Item 13: The container return system according to Item 11 or 12, wherein said conveying arrangement comprises a set of bi-directional conveyors  
25 arranged at different elevations.

Item 14: The container return system according to Item 12 or 13, wherein each conveyor in said set of bi-directional conveyors is independently operable.  
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Item 15: The container return system according to any one of items 11 to 14, wherein

said singulation arrangement is configured to transport said individual objects to said object classification arrangement,

said object classification unit is configured to classify said individual objects into a category selected among the group comprising at least accepted and not accepted, and

said classification arrangement is further configured to initiate a transport of said individual objects classified as not accepted to the buffer area of said conveyor arrangement.

10 Item 16: The container return system according to any one of items 11 to 15, wherein said singulation arrangement and optionally said transporter is configured to transport said used containers to said classification unit at a higher elevation than said buffer area of the conveying arrangement.

15 Item 17: The container return system according to any one of item 11 to 16, wherein said container return system is further operable in a rejection mode, in which said conveyor arrangement is configured to transport said used containers to a rejection area, which rejection area is optionally partly or fully the same as said infeed area.

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Item 18. The container return system according to item 17, wherein said container return system is configured to start a time counter upon entering said singulation mode,

said time counter is reset each time said object classification unit classifies an object as accepted, and

said container return system is configured to switch from said singulation mode to said rejection mode upon said time counter exceeding a predetermined threshold.

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30 Item 19: The container return system according to any one of the preceding items, wherein the conveying arrangement further comprises a singulator gate having at least a first and a second position,

in which first position of said singulator gate a movement of said used containers is unrestricted between said infeed area and said buffer area, and wherein said singulator gate blocks said used containers from reaching said singulation arrangement, and

5 in which second position of said singulator gate a movement of said used containers is unrestricted between said conveyor arrangement and said singulation arrangement, and wherein said singulator gate blocks said used containers from reaching said infeed area from said buffer area of the conveyor arrangement.

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Item 20: The container return system according to any one of the preceding items, further comprising a control unit configured to control the speed and/or direction of each bi-directional conveyor of said conveyor arrangement.

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Item 21: The container return system according to any one of items 12 to 20, wherein said set of bi-directional conveyors comprises a first bi-directional conveyor and a second bi-directional conveyor, and wherein said second bi-directional conveyor is configured to operate at a higher speed than said first bi-directional conveyor in said receiving mode and/or said singulation mode, such that used containers conveyed from said first bi-directional conveyor to said second bi-directional conveyor are spaced further apart from each other on the second bi-directional conveyor than on the first bi-directional conveyor.

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Item 22: The container return system according to any one of the preceding items, wherein said container return system is a reverse vending machine.

30 Item 23. A method for controlling a container return system according to any one of items 11 to 22, the method comprising:

a receiving step comprising controlling said conveyor arrangement to transport used containers received in bulk at said infeed area towards said buffer area of the conveyor arrangement, including driving said first conveyor in said first direction, and

5 a singulation step comprising:

controlling said conveyor arrangement to transport said used containers to said singulation arrangement to be singulated into individual objects, including driving said first conveyor in said second direction opposite said first direction, and

10 controlling said singulation arrangement to transport said individual objects to said transporter.

Item 24: The method according to item 23, further comprising a classification step comprising:

15 controlling said transporter to transport said individual objects to said object classification unit,

controlling said classification unit to classify said individual objects into a category selected among the group comprising at least accepted and not accepted, and

20 controlling said classification arrangement to initiate a transport of said individual objects classified as not accepted to said buffer area of said conveyor arrangement.

Item 25: The method according to item 24, further comprising

25 a step of determining a time elapsed since an individual objects was classified, by said object classification unit, as accepted, and

upon said time elapsed exceeding a predetermined threshold, controlling said conveyor arrangement to transport said used containers to a rejection area, which rejection area is optionally partly or fully the same as said infeed area.

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- Item 101: A container return system configured to receive a bulk of deposit return containers, such as used food or beverage containers through an infeed opening, the container return system comprising a first transporting arrangement comprising infeed transporting means, redirection means, and singulator transporting means, wherein:
- said infeed transporting means is configured to transport said used containers along an infeed path from said infeed opening to a redirection area,
  - said redirection means is configured to redirect said used containers at said redirection area, and
  - said singulator transporting means is configured to transport said used containers from said redirection area to an uptake area, which uptake area is adapted to collect used containers in bulk,
- a singulation arrangement configured to single out individual used containers from said bulk and transport said individual used containers from said uptake area to a receiving area, said receiving area positioned at a higher vertical level than said uptake area, and a second transporting arrangement configured to transport said used containers from said receiving area to a classification unit, which classification unit is configured to classify said individual used containers into a category selected among the group comprising at least accepted and not accepted,
- wherein said classification unit is further configured to initiate a transport of only the used containers classified as accepted for further processing or storage as accepted containers,
- wherein said redirection area is arranged at a first distance from said infeed opening in a first direction, and wherein said infeed transporting means is configured to transport said used containers from said infeed opening to said redirection area past said uptake area, as seen from above.

Item 102: The container return system according to item 101,  
wherein said classification unit is configured to classify said individual  
5 used containers into a category selected among the group comprising  
accepted, rejected and unrecognized,  
wherein said classification unit is further configured to:

- initiate a transport of used containers classified as rejected  
to a rejection area via a buffer area, which rejection area is  
10 optionally partly or fully the same as said infeed area, and
- initiate a transport of used containers classified as  
unrecognized to said uptake area, optionally via said buffer  
area.

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Item 103: The container return system according to item 101 or  
102, wherein said uptake area is arranged at a second distance from  
said redirection area in a second direction, which second direction is  
substantially opposite the first direction and/or wherein said second  
20 direction forms an acute angle with said first direction.

Item 104: The container return system according to any one of  
Items 101 to 104, wherein  
said infeed transporting means comprises an active conveyor  
25 arrangement having at least one active conveyor,  
said singulator transporting means comprises at least one active or  
passive conveyor, and  
the path of said at least one active conveyor of the active conveyor  
arrangement and the path of said at least one active or passive  
30 conveyor of the singulator transporting means are spatially separated  
from each other, such that said first transporting arrangement is  
adapted to simultaneously transport used containers from said infeed

area to said redirection area and from said redirection area to said uptake area.

5 Item 105: The container return system according to any one of Items 101 to 103, wherein said first transporting arrangement comprises an active conveyor arrangement, which active conveyor arrangement comprises at least one bi-directional conveyor operable in a forward and a backward direction,  
10 wherein said active conveyor arrangement is arranged to receive used containers transported along said infeed path and said active conveyor arrangement is further configured to:  
transport said used containers to said redirection area by operating said bi-directional conveyor in said forward direction and  
15 transport said used containers from said redirection area to said uptake area by operating said bi-directional conveyor in said backward direction.

20 Item 106: The container return system according to Item 105, wherein said active conveyor arrangement comprises at least one preceding conveyor, which preceding conveyor is configured to receive used containers transported along said infeed path and to transport said used containers to said bi-directional conveyor.

25 Item 107: The container return system according to any one of Items 102 to 106, wherein said first transporting arrangement comprises a return conveyor arrangement configured to receive used containers at said buffer area and to transport said received used containers to said rejection area,  
30 wherein said return conveyor arrangement optionally comprises a bi-directional conveyor, and said active conveyor arrangement and said return conveyor arrangement are optionally fully or partly the same.

Item 108: The container return system according to any one of Items 101 to 107, wherein said first transporting arrangement comprises a set of bi-directional conveyors arranged in sequence.

5 Item 109: The container return system according to any one of Items 101 to 108, wherein said first transporting arrangement further comprises a singulator gate movable between at least a first position and a second position,  
in which first position of said singulator gate the transport of said used  
10 containers is unrestricted between said infeed area and said redirection area, and said gate blocks said used containers from reaching said uptake area, and  
in which second position of said singulator gate the transport of said used containers is unrestricted between said redirection area and said  
15 uptake area, and wherein said gate blocks said used containers from reaching said infeed area from said redirection area.

Item 110: The container return system according to any one of Items 101 to 109, wherein said first transporting arrangement further  
20 comprises a buffer gate having at least a first and a second position, in which first position of the buffer gate used containers arranged in said buffer area are blocked from leaving said buffer area, and in which second position of the buffer gate a movement of said used containers is unrestricted from said buffer area to said uptake area  
25 and/or said rejection area.

Item 111: The container return system according to any one of Items 101 to 110, wherein said singulation arrangement comprises at least one container elevating member for transporting a used  
30 containers from said uptake area to said receiving area along a curved singulation path, wherein said container elevating member is preferably arranged on the inner side of said curved singulation path.

Item 112: A method for processing deposit return containers, such as used food or beverage containers, by a container return system comprising:

- 5 a first transporting arrangement comprising infeed transporting means, redirection means, and singulator transporting means, a singulation arrangement, a second transporting arrangement, and a classification unit,
- 10 the method comprising the steps of:
- receiving used containers in bulk at an infeed area,
  - transporting, by said infeed transporting means, said used containers along an infeed path from said infeed area to a redirection area,
  - 15 - redirecting, by said redirection means, said used containers at said redirection area,
  - transporting, by said singulator transporting means, said used containers from said redirection area to an uptake area, which uptake area is adapted to collect used containers in bulk,
  - 20 - singling out, by said singulation arrangement, individual used containers from said bulk and transporting, by said singulation arrangement, said individual used containers from said uptake area to a receiving area, said receiving area positioned at a higher vertical level than said uptake area,
  - 25 - transporting, by said second transporting arrangement, said used containers, to said classification unit,
  - classifying, by said classification unit, said individual used containers into a category selected among the group comprising at least accepted and not accepted,
  - 30

- initiating, by said said classification unit, a transport of only used containers classified as accepted for further processing or storage.

wherein

- 5        said redirection area is arranged at a first distance of said infeed area in a first direction, and
- said step of transporting, by said infeed transporting means, said used containers along an infeed path from said infeed area to said redirection area, comprises transporting said used containers past said
- 10       uptake area, as seen from above.

Item 113:    The method according to Item 112, further comprising the steps of

- classifying, by said classification unit, said individual used
- 15       containers into a category selected among the group comprising accepted, rejected and unrecognized,
- initiating, by said classification unit, a transport of used containers classified as rejected to a rejection area via a buffer area, which rejection area is optionally partly or fully
- 20       the same as said infeed area, and
- initiating, by said classification unit, a transport of used containers classified as unrecognized to said uptake area, optionally via said buffer area,

- 25       Item 114:    The method according to Item 112 or 113, wherein said infeed transporting means comprises an active conveyor arrangement having at least one active conveyor,
- said singulator transporting means comprises at least one active or passive conveyor, and
- 30       the path of said at least one active conveyor of the active conveyor arrangement and the path of said at least one active or passive

conveyor of the singulator transporting means are spatially separated from each other,

the method further comprising the step of simultaneously transporting used containers from said infeed area to said redirection area and

5 transporting used containers from said redirection area to said uptake area.

Item 115: The method according to Item 112 or 113, wherein said first transporting arrangement comprises an active conveyor

10 arrangement, which active conveyor arrangement comprises at least one bi-directional conveyor operable in a forward and a backward direction, the method further comprising the steps of:

receiving, by said active conveyor arrangement, used containers transported along said infeed path,

15 operating said bi-directional conveyor in said forward direction to transport said used containers to said redirection area, and operating said bi-directional conveyor in said backward direction to transport said used containers from said redirection area to said uptake area.

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## CLAIMS

1. A container return system configured to receive a bulk of deposit return containers, such as used food or beverage containers through an infeed opening, the container return system comprising  
a first transporting arrangement comprising infeed transporting means, redirection means, and singulator transporting means, wherein:
  - said infeed transporting means is configured to transport said used containers along an infeed path from said infeed opening to a redirection area,
  - said redirection means is configured to redirect said used containers at said redirection area, and
  - said singulator transporting means is configured to transport said used containers from said redirection area to an uptake area, which uptake area is adapted to collect used containers in bulk,a singulation arrangement configured to single out individual used containers from said bulk and transport said individual used containers from said uptake area to a receiving area, said receiving area positioned at a higher vertical level than said uptake area, and  
a second transporting arrangement configured to transport said used containers from said receiving area to a classification unit, which classification unit is configured to classify said individual used containers into a category selected among the group comprising at least accepted and not accepted,  
wherein said classification unit is further configured to initiate a transport of only the used containers classified as accepted for further processing or storage as accepted containers,  
wherein  
said redirection area is arranged at a first distance from said infeed opening in a first direction, and wherein said infeed transporting means is configured to transport said used containers from said infeed opening to said redirection area past said uptake area, as seen from above.
2. The container return system according to claim 1, wherein

said transport of said used containers along an infeed path further comprises transporting said containers from said infeed opening to said redirection area via an active infeed area, and

said infeed transporting means comprises an active conveyor arrangement having at least one active conveyor, which active conveyor arrangement is configured to transport said containers along said infeed path or along at least a portion of said infeed path, and is configured to transport said containers from said active infeed area to said redirection area.

3. The container return system according to claim 2, wherein said classification unit is configured to classify said individual used containers into a category selected among the group comprising accepted, rejected and unrecognized, wherein said classification unit is further configured to:

- initiate a transport of used containers classified as rejected to a rejection area via a buffer area, which rejection area is optionally partly or fully the same as said active infeed area, and
- initiate a transport of used containers classified as unrecognized to said uptake area, optionally via said buffer area.

4. The container return system according to any one of claims 1 to 3, wherein said uptake area is arranged at a second distance from said redirection area in a second direction, which second direction is substantially opposite the first direction and/or wherein said second direction forms an acute angle with said first direction.

5. The container return system according to claim 3 or claim 4 when dependent on claim 3, wherein

said singulator transporting means comprises at least one active or passive conveyor, and

the path of said at least one active conveyor of the active conveyor arrangement and the path of said at least one active or passive conveyor of the singulator transporting means are spatially separated from each other, such that said first transporting arrangement is adapted to simultaneously transport used containers

from said infeed area to said redirection area and from said redirection area to said uptake area.

6. The container return system according to claim 5, wherein said first transporting means comprises a buffer gate forming part of said redirection means having at least a first and a second position, in which first position of the buffer gate used containers arranged in said buffer area are blocked from leaving said buffer area, and in which second position of the buffer gate a movement of said used containers is unrestricted from said buffer area to said rejection area.

7. The container return system according to claim 2 or 3, wherein the container return system comprises a redirecting bi-directional conveyor operable in a forward and a backward direction, which redirecting bi-directional conveyor forms part of said redirection means, said infeed transporting means, and said singulator transporting means,

wherein said active conveyor arrangement of said infeed transporting means is configured to transport said containers from said active infeed area to said redirection area when said redirecting bi-directional conveyor is operated in said forward direction, and

wherein said singulator transporting means comprises an active conveyor arrangement configured to transport said containers from said redirection area to said uptake area or to a passive conveyor configured to transport said containers to said uptake area when said redirecting bi-directional conveyor is operated in said backward direction,

wherein the active conveyor arrangement of said infeed transporting means and the active conveyor arrangement of said singulator transporting means is optionally one and the same.

8. The container return system according to claim 7, wherein said active conveyor arrangement of said infeed transporting means comprises at least one preceding conveyor, which preceding conveyor comprises said active

infeed area and is configured to transport said used containers from said active infeed area to said redirecting bi-directional conveyor.

9. The container return system according to claim 7 or 8, wherein said singulator transporting means further comprises a singulator gate movable between at least a first position and a second position,
- in which first position of said singulator gate the transport of said used containers is unrestricted between said active infeed area and said redirection area, and said gate blocks said used containers from reaching said uptake area, and
- in which second position of said singulator gate the transport of said used containers is unrestricted between said redirection area and said uptake area, and wherein said gate blocks said used containers from reaching said infeed area from said redirection area.

10. The container return system according to claim 3 or any one of claims 4 to 9 when dependent on claim 3, wherein said first transporting arrangement comprises a return conveyor arrangement configured to receive used containers at said buffer area and to transport said received used containers to said rejection area.

11. The container return system according to claim 2 or any one of claim 3 to 10 when dependent on claim 2, wherein said active conveyor arrangement of said infeed transporting means comprises a set of bi-directional conveyors arranged in sequence.

12. The container return system according to any one of the preceding claims, wherein said singulation arrangement comprises at least one container elevating member for transporting a used container from said uptake area to said receiving area along a curved singulation path, wherein said container elevating member is preferably arranged on the inner side of said curved singulation path.

13. A method for processing deposit return containers, such as used food or beverage containers, by a container return system comprising:
- a first transporting arrangement comprising infeed transporting means, redirection means, and singulator transporting means,
  - a singulation arrangement,
  - a second transporting arrangement, and
  - a classification unit,
- the method comprising the steps of:
- receiving used containers in bulk at an infeed area,
  - transporting, by said infeed transporting means, said used containers along an infeed path from said infeed area to a redirection area,
  - redirecting, by said redirection means, said used containers at said redirection area,
  - transporting, by said singulator transporting means, said used containers from said redirection area to an uptake area, which uptake area is adapted to collect used containers in bulk,
  - singling out, by said singulation arrangement, individual used containers from said bulk and transporting, by said singulation arrangement, said individual used containers from said uptake area to a receiving area, said receiving area positioned at a higher vertical level than said uptake area,
  - transporting, by said second transporting arrangement, said used containers, to said classification unit,
  - classifying, by said classification unit, said individual used containers into a category selected among the group comprising at least accepted and not accepted,
  - initiating, by said said classification unit, a transport of only used containers classified as accepted for further processing or storage.
- wherein
- said redirection area is arranged at a first distance of said infeed area in a first direction, and

said step of transporting, by said infeed transporting means, said used containers along an infeed path from said infeed area to said redirection area, comprises transporting said used containers past said uptake area, as seen from above.

14. The method according to claim 13, wherein the method comprises:

- receiving used containers in bulk at said infeed area through an infeed opening,
- transporting, by said infeed transporting means, said used containers along an infeed path from said infeed opening to said redirection area via an active infeed area,

wherein said infeed transporting means comprises an active conveyor arrangement having at least one active conveyor, which active conveyor arrangement is configured to transport said containers along said infeed path or along at least a portion of said infeed path, and is configured to transport said containers from said active infeed area to said redirection area.

15. The method according to claim 14, further comprising the steps of

- classifying, by said classification unit, said individual used containers into a category selected among the group comprising accepted, rejected and unrecognized,
- initiating, by said classification unit, a transport of used containers classified as rejected to a rejection area via a buffer area, which rejection area is optionally partly or fully the same as said active infeed area, and
- initiating, by said classification unit, a transport of used containers classified as unrecognized to said uptake area, optionally via said buffer area,

16. The method according to claim 14 or 15, wherein

said singulator transporting means comprises at least one active or passive conveyor, and

the path of said at least one active conveyor of the active conveyor arrangement and the path of said at least one active or passive conveyor of the singulator transporting means are spatially separated from each other,

the method further comprising the step of simultaneously transporting used containers from said infeed area to said redirection area and transporting used containers from said redirection area to said uptake area.

17. The method according to claim 14 or 15, wherein

the container return system comprises a redirecting bi-directional conveyor operable in a forward and a backward direction, which redirecting bi-directional conveyor forms part of said redirection means, said infeed transporting means, and said singulator transporting means, and

said singulator transporting means comprises an active conveyor arrangement,

wherein the method further comprises

transporting, by said active conveyor arrangement of said infeed transporting means, said containers from said active infeed area to said redirection area when operating said redirecting bi-directional conveyor in said forward direction, and

transporting, by said active conveyor arrangement of said singulator transporting means, said containers from said redirection area to said uptake area or to a passive conveyor configured to transport said containers to said uptake area when operating said redirecting bi-directional conveyor in said backward direction,

wherein the active conveyor arrangement of said infeed transporting means and the active conveyor arrangement of said singulator transporting means is optionally one and the same.

18. A container return system for processing used deposit return containers, such as used food or beverage containers, received in bulk, the container return system comprising:

a singulation arrangement for singulation of said used containers received in bulk into individual objects,

a conveying arrangement comprising at least a first conveyor, and

an object classification arrangement comprising a classification unit and a transporter for transporting objects from said singulation arrangement to said classification unit,

wherein said container return system (1) is operable at least in:

a receiving mode, in which said conveying arrangement is configured to receive said used containers at an infeed area of the conveying arrangement and transport said used containers to a buffer area of the conveying arrangement via at least said first conveyor, and

a singulation mode, in which said conveying arrangement is configured to transport said used containers from said buffer area to said singulation arrangement via at least said first conveyor,

wherein

said first conveyor is a bi-directional conveyor, which bi-directional conveyor is configured to operate in a first direction in said receiving mode and in a second direction in said singulation mode, said second direction being opposite to said first direction.