

A SINGULATION ARRANGEMENT FOR SINGULATION OF CONTAINERSTechnical field

The invention is related to a singulation arrangement for singulation of containers and to a reverse vending machine configured to receive a bulk of containers.

5

Background art

In the context of this application, a singulation arrangement may be any arrangement adapted to handle used food or beverage containers for recycling or reuse in a container return system, including deposit return containers, such as
10 empty beverage bottles and cans, or and/or glasses and/or cups such as coffee cups, of any size and material, such as PET, aluminium, tin, or glass. Such a system may be used by professional operators, for example in recycling centers collecting used beverage containers from the restaurant industry.

A singulation arrangement may also be a part of a reverse vending machine
15 (RVM) located, for example, in a supermarket, where an end-consumer feeds used beverage containers into the reverse vending machine. Typically, only the front of the reverse vending machine, including the infeed area, is visible and accessible to the end-consumer, with a backroom facility only accessible to store employees or other authorized personnel.

20 Reverse vending machines are generally arranged so that a person can return empty containers, and in some cases receive some money in return. The reverse vending machine may collect a large number of containers in a short period of time. This means that the reverse vending machine needs to be very efficiently storing the containers so that the storage bin for the containers need not be replaced too
25 frequently. Therefore, the containers are compressed by the reverse vending machine so that they each take up less space than before being compressed.

EP3481753B1 discloses a device for singulation of used beverage or food containers received in bulk into individual objects. The device includes a first receiving area arranged for simultaneously receiving and keeping a plurality of
30 containers and a second receiving area positioned at a higher vertical level than the first receiving area. The device further includes a transporting device including a

container 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 upon activation of the transporting device, and the first axis is inclined at an angle of 1 degrees to 45 degrees relative the horizontal plane.

A problem with this type of singulation device is that the size and shape of the first receiving area is limited by the circular design of the transport device. Another disadvantage is that it may be difficult to return objects that could cause downtime.

Summary of the invention

It is an objective of the present invention to mitigate, alleviate or eliminate one or more of the above-identified deficiencies in the art and disadvantages singly or in any combination and solve at least the above-mentioned problems.

According to a first aspect of the invention, these and other objects are achieved, in full or at least in part, by a singulation arrangement for singulation of containers, such as reusable or recyclable used food or beverage containers, received in bulk. The singulation arrangement comprises a reservoir adapted to collect used containers in bulk, and a transport unit adapted to transport containers from an uptake area of said reservoir to a receiving area, said receiving area being arranged at a higher altitude than said uptake area. The transport unit comprises a flexible conveyor element, provided with a plurality of container carriers, and a path control device configured to control said flexible conveyor element to move along a curved path when transporting said containers.

The present disclosure is at least partly based on the realization that a longer path from an infeed area to the uptake area enables a 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 transport unit. Thereby, the bulk of used containers which is received by the singulation arrangement 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, it provides for reduced noise from the singulation arrangement, as fewer used containers in the uptake area results in less scrambling of containers during singulation.

Singulation arrangement according to the first aspect of the invention
5 enables such a long path to the simulator arrangement while allowing for a limited footprint of the arrangement. This is advantageous for allowing personnel easy access to different parts of the arrangement for maintenance or cleaning.

Further, the flexible conveyor element enables a longer uptake distance in the uptake area, which provides for a more robust and stable uptake of containers in
10 the uptake area.

Another advantage with the singulation arrangement is that the flexible conveyor element will make it possible to align the container carriers with the conveyor present in the receiving area.

A further advantage is that the flexible conveyor element makes it possible to
15 transport objects in two different directions. Hence, objects that are not accepted or may get stuck and cause downtime can be returned in an efficient manner by reversing the transport direction of the flexible conveyor element.

The path control device may comprise a curved control structure.

The at least a part of said curved path may be C-shaped.

20 The path control device may comprise at least two deflection members, the flexible conveyor element being looped around each of the least two deflection members.

The at least two deflection members may be located at respective ends of the transport unit.

25 The at least one of said deflection members may comprise a wheel.

The wheel may be a drive wheel.

The singulation arrangement may further comprise a V-shaped guide portion arranged in connection with an upper part of the transport unit and adapted to guide the containers while transported towards the receiving area by the transport
30 unit.

The flexible conveyor element may be a chain.

The flexible conveyor element may be a belt, preferably a modular belt or a timing belt.

The reservoir may be elongated in a transport direction of the flexible conveyor element in the uptake area.

The reservoir may have a tapering cross-section that tapers towards a bottom section of the reservoir in the uptake area.

5 According to a second aspect of the invention, these and other objects are achieved, in full or at least in part, by a container return system configured to receive a bulk of containers, such as reusable or recyclable used food or beverage containers, through an infeed opening. The reverse vending machine comprises a singulation arrangement according to the features described above, an infeed device
10 for forwarding containers from said infeed opening to the reservoir of the singulation arrangement, a classification unit, and a transporter for transporting containers from the receiving area of the singulation arrangement to the classification unit.

15 The container return system may further comprise a devaluation means downstream of the classification unit.

The container return system may further comprise a cabinet downstream of the classification unit, the cabinet being adapted to receive a collection means for receiving containers downstream of the transporter.

20 Effects and features of the second aspect of the present invention are largely analogous to those described above in connection with the first aspect of the inventive concept. Embodiments mentioned in relation to the first aspect of the present invention are largely compatible with the further aspects of the invention.

25 Other objectives, features and advantages of the present invention will appear from the following detailed disclosure, from the attached claims, as well as from the drawings. It is noted that the invention relates to all possible combinations of features.

30 Generally, all terms used in the claims are to be interpreted according to their ordinary meaning in the technical field, unless explicitly defined otherwise herein. All references to “a/an/the [element, device, component, means, step, etc.]” are to be interpreted openly as referring to at least one instance of the element, device, component, means, step, etc., unless explicitly stated otherwise.

The term used container should be interpreted as empty container, e.g. after (most of) the contents of the container has been drunk, eaten, disposed of or

otherwise used. A used container may not be completely empty when fed into the singulation arrangement.

A singulation arrangement as described herein may also be used to receive other types of recyclable or reusable containers. As non-limiting examples, a singulation arrangement according to the present disclosure may be configured to receive used containers for cosmetics, paint, chemicals, or any other type of consumer or professional product.

The process of separating containers for individual forwarding and processing may be referred to as singulation.

By the term "bulk" or variations of that term it is meant that more than one used container can be received by the singulation arrangement simultaneously, and preferably that the used containers can be of various shapes and sizes, such as cans, cylindrical, square or odd-shaped bottles, 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 singulation arrangement may be adapted to receive and process all or some of the different standard sizes of containers in different countries. 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.

According to one example, the diameter, or length, of the used containers received and transported by the singulation arrangement 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 the containers received and transported by the singulation arrangement 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 the used containers that are received and transported by the singulation arrangement is at least 10 g, and/or at most 3 kg, or at most 5 kg. Additionally or alternatively, the volume of the used containers that are received and transported by the singulation arrangement is at least 10 ml, or at least 50 ml, and/or at most 3 L, or at most 5 L, or at most 8 L.

According to one example, the height (i.e. the longest side) of the smallest used container handled by the return arrangement is smaller than the diameter of the largest used container handled by the singulation arrangement.

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

5 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

10 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

15 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 singulation arrangement at a certain height, which is typically chosen to be easily reachable for

20 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

25 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.

In the context of this invention, a container return system may be any system

30 adapted to collect, sort, crush, compact and/or convey used deposit return containers for recycling or reuse, including used food or beverage containers, such as empty beverage bottles and cans, or and/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 “pfand” from the Deutsche Pfandsystem GmbH (DPG) or any other national/international deposit system for used containers such as used food and beverage containers. Such a system may be used by professional operators, for example in recycling centers collecting used beverage containers from the restaurant industry. 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-consumer, with a backroom facility only accessible to store employees or other authorized personnel.

The term used container should be interpreted as empty container, e.g. 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 nearly all the container content has been e.g. 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, the container return system 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.

As used herein, the term “comprising”, and variations of that term are not intended to exclude other additives, components, integers, or steps.

As used herein, the term “horizontal”, and variations of that term includes any substantially horizontal direction.

As used herein, the term “vertical”, and variations of that term includes any substantially vertical direction.

Brief description of the drawings

The above, as well as additional objects, features and advantages of the present invention, will be better understood through the following illustrative and

non-limiting detailed description of embodiments of the present invention, with reference to the appended drawings, where the same reference numerals may be used for similar elements, and wherein:

Fig. 1 is a perspective view of one exemplary embodiment of a singulation
5 arrangement according to a first aspect of the invention when provided in a container return system according to a second aspect of the invention.

Fig. 2 is another perspective view of the exemplary embodiment of the singulation arrangement in Fig. 1.

Fig. 3A to 3C are perspective views of further exemplary embodiments of the
10 singulation arrangement according to the first aspect of the invention when provided in the container return system according to the second aspect of the invention.

Fig. 4 is an enlargement of a portion of the singulation arrangement in Fig. 1.

Fig. 5 is another enlargement of the portion of the singulation arrangement
15 in Fig. 1.

Fig. 6 is yet another enlargement of the portion of the singulation arrangement in Fig. 1.

Fig. 7 is another perspective view of one exemplary embodiment of the singulation arrangement according to the first aspect of the invention when
20 provided in the container return system according to the second aspect of the invention.

Fig. 8 is another perspective view of one exemplary embodiment of the singulation arrangement according to the first aspect of the invention when
25 provided in the container return system according to the second aspect of the invention.

Detailed description of preferred embodiments of the invention

Fig. 1 and 2 illustrate an exemplary embodiment of a container return system
24 comprising a singulation arrangement 1 for singulation of containers 2, such as
30 reusable or recyclable used food or beverage containers, received in bulk. In this document, used beverage or food containers may also be referred to as containers 2. The used beverage or food containers 2 typically have an elongated shape, they can for example be substantially cylindrical. Furthermore, the food or beverage

containers 2 may be made of different materials, such as plastic, paper, metal or glass, or a combination thereof.

The singulation arrangement 1 comprises a reservoir 3 adapted to collect used containers 2 in bulk, and a transport unit 4 adapted to transport containers 2
5 from an uptake area 5 of the reservoir 3 to a receiving area 6. The receiving area 6 is arranged at a higher altitude than the uptake area 5. That is, the receiving area 6 is positioned above the uptake area 5 in a vertical direction.

The containers 2 received in bulk are collected in the reservoir 3 after entering the singulation arrangement 1. The containers 2 are then kept in the
10 reservoir 3 until they are randomly brought from uptake area 5 of the reservoir 3 to the receiving area 6 by means of the transport unit 4. The size and shape of the reservoir 3 will be discussed later on in the application text.

The transport unit 4 comprises an endless flexible conveyor element 7 which is provided with a plurality of container carriers 8, and a path control device 9 which
15 is used to control the flexible conveyor element 7 to move along a curved path when transporting the containers 2. The curved path, or at least a part thereof, is C-shaped. The path control device 9 comprises a curved control structure 10 which is the component that actually shapes the curved path of the flexible conveyor element 7. Naturally, other shapes of the curved path is also possible, such as a S-
20 shape, which will be discussed in greater detail later on in the application text. Basically, the size, shape and extension of the flexible conveyor element 7 can be varied in any suitable manner also long as its main objective is achieved.

The number of the container carriers 8 may depend on the size of the transport unit 4. The container carriers 8 may be equally spaced or non-equally
25 spaced along the flexible conveyor element 7 of the transport unit 4. The container carriers 8 may have a size and design adapted for bringing containers of different shapes and sizes collected in the uptake area 5 to the receiving area 6. The container carriers 8 and/or the container supporting surface of the container carriers 8 may for example be rectangular, elliptical, flat, cup-shaped, formed as a paddle or shovel
30 etc., or be a combination of these such as flat and rectangular. It may be solid or have small openings. If the transport unit 4 comprises more than one container carrier 8, the shape of the elevating members may, but need not, be the same.

Further, each container carrier 8 may, but need not, be provided with a rim arranged at the outer periphery of the elevating member, and extending in the transport direction, for providing additional support to the container upon transport of the container from the uptake area 5 to the receiving area 6.

5 The path control device 9 comprises a number of deflection members 11 around which the flexible conveyor element is looped. In this specific embodiment, the flexible conveyor element 7 is constituted by an endless chain and the deflection wheels are constituted by gear wheels adapted to guide and drive the endless chain.

 The singulation arrangement 1 further comprises a V-shaped guide portion
10 12 which is arranged in an upper part of the transport unit 4 and which is adapted to guide the containers 2 while being transported towards the receiving area 6 by the transport unit 4.

 The guide portion 12 extends in a more or less vertical direction within the singulation arrangement 1 while being slightly curved in order to be able to align
15 with the curved path of the flexible conveyor element 7. The guide portion 12 is arranged in close connection with the flexible conveyor element 7 and its carriers 8 along a part of the extension of the flexible conveyor element 7.

 An upper portion of the guide portion 12 is arranged in connection with a transporter 13 for transporting containers 2 from the receiving area 6 of the
20 singulation arrangement 1 to a classification unit 14 arranged downstream of the singulation arrangement 1. The guide portion 12 mainly guides and prevents the containers 2 from falling back into the uptake area 5 of the reservoir 3 during transport. A further transporter 32 – also constituted by a conveyor – is provided downstream of the classification unit 14.

25 As stated above, one advantage given by the flexible conveyor element 7, is that it can run in a forward direction as well as in a backward direction. This makes it possible to transport the containers 2 in two different directions. Thus, by placing a receptacle 15 upstream of and in connection with the reservoir 3, it is possible to change the direction of the flexible conveyor element 7 from the forward direction
30 to the backward direction and guide containers back out of the singulation arrangement 1 if, for example, incorrectly inputted therein.

 In Fig. 3A, another exemplary embodiment of the container return system 24 comprising the singulation arrangement 1 for singulation of containers 2 is

illustrated. Here, the flexible conveyor element 7 is constituted by an endless modular belt. It would also be possible to use a different belt, such as a timing belt.

The flexible conveyor element 7 is looped around two deflection members 11 constituted by wheels, at least one of which being a drive wheel. The two
5 deflections members 11 are located at respective ends of the transport unit 4 and arranged on a tilted shaft 16, respectively.

In this embodiment, the curved control structure 10 of the path control device 9 extends along the entire length of the flexible conveyor element 7 with the exception of the loop around the deflection members 11. Since the modular belt and
10 its surrounding control structure 10 may be curved in any direction, the flexible conveyor element 7 can be given any suitable shape thinkable.

In Fig. 3B, another exemplary embodiment of the container return system 24 comprising the singulation arrangement 1 for singulation of containers 2 is illustrated. In this embodiment, the carriers 8 are provided with at least one side
15 wall 34. The side wall 34 extends along the entire length or a portion of a side surface 35 of the carrier 8 and is used to ensure that the container 2 is kept in place on the carrier 8 during transport by the transport unit 4 – at least along a predetermined distance. The size and shape of the carriers 8 their side walls 34 may naturally be varied in any suitable size and shape as long as they fulfil the purpose
20 described above.

In Fig. 3C, another exemplary embodiment of the container return system 24 comprising the singulation arrangement 1 for singulation of containers 2 is illustrated. In this embodiment, a sensor 33 is arranged at the transport unit 4, for example, in connection with the V-shaped guide portion 12. The sensor is used to
25 detect if one or several metal containers are transported by the transport unit 4. If a metal container is detected, the transport unit 4 could, for example, be instructed to reduce its speed in order to ensure that the metal containers in question do not fall off the carriers 8 during transport by the transport unit 4.

In one example, the transport unit 4 could be instructed to reduce its speed if
30 it is detected that two (or more) metal containers are transported by the transport unit 4 at the same time.

The sensor 33 could for example be an inductive sensor.

Fig. 4 to 6 illustrate an exemplary embodiment of the reservoir 3 of the singulation arrangement 1. The reservoir 3 is elongated in a transport direction of the flexible conveyor element 7 in the uptake area 5 and has a tapering cross-section that tapers towards a bottom section 17 of the reservoir 3 in the uptake area 5.

5 More specifically, the width of the reservoir 3 increases from its bottom section 17 towards its top section 18. The bottom section 17 of the reservoir is curved such that it has a first portion 19 which is inclined downwards to a mid-portion 20 – constituting the lowest part of the reservoir 3 – and a second portion 21 inclined upwards from the mid-portion 20.

10 The first portion 19 is used to transport the containers forward and is inclined in order to avoid that the containers 2 fall into receptacle 15. The mid-portions 20 includes the actual uptake area 5 where the containers 2 are retrieved by means of the container carrier 8 and transported through the second portion 21 and up towards the guide portion 12.

15 The reservoir 3 has an area 22 before reaching the guide portion 12 with a larger width than the width of the uptake area 5. This area 22 allows containers 2 to topple over and fall back down into the reservoir 3 when they are not aligned properly.

The reservoir also has a pocket 23 downstream of the guide portion 12 in
20 connection with the transporter 13 for transporting containers 2 from the receiving area 6 of the singulation arrangement 1 to a classification unit 14. The pocket 23 is used to catch any containers 2 falling off the transporter 13 and to guide them back down to the uptake area 5 of the reservoir 3.

Suitable measurements for the reservoir could, for example, be in the range
25 of 300-400 mm, preferably 350 mm as the width (a) of the area 22, in the range of 350-400 mm, preferably 375 mm as the width (b) of the first portion 19 of the bottom section 17, in the range of 600-700 mm, preferably 650 mm as the length (c) of first portion 19 of the bottom section 17, and in the range of 400-460 mm, preferably 430 mm as the depth (d) of the uptake area 5.

30 The reservoir 3 has a first sidewall 30 and a second sidewall 31 – on each side of the mid-portion 20 of the bottom section 17 (at the uptake area 5). The curvature of the first side wall 30 differs from the curvature of the second side wall 31. Preferably, the curvature of the first side wall 30 is greater than the curvature of the

second side wall 31. The second side wall 31 may also be completely straight, i.e. no curvature.

This design of the reservoir 3 – where the bottom section 17 is tighter than the top section 18 – will make it easier to align the containers 2 in the uptake area 5 of the reservoir 3. Thus, this design is preferred even though a wider bottom section of the reservoir 3 would allow for a bigger volume.

In Fig. 7, another exemplary embodiment of the singulation arrangement 1 for singulation of containers 2 is illustrated. Here, the curved path of the flexible conveyor element 7 is S-shaped which means that the containers 2 are transported in one single direction through the entire singulation arrangement 1.

Fig. 8 illustrates yet another exemplary embodiment of the singulation arrangement 1 for singulation of containers 2. In this embodiment, the curved path of the flexible conveyor element 7 is still C-shaped but the connecting transporter 13 is angled 90 degrees in relation to the embodiments illustrated in Fig. 1 to 3. This way, the guide portion 12 could be eliminated from the singulation arrangement 1.

We will now describe the entire container return system 24 in greater detail. The container return system 24 is configured to receive a bulk of containers, such as reusable or recyclable used food or beverage containers 2, through an infeed opening 25. The container return system 24 has an infeed device 26, redirections means 27 and singulation transporting means 28. The infeed device 26 is configured to transport the containers 2 from the infeed opening 25 to a redirection area 29.

The redirection means 27 is configured to redirect the containers 2 at the redirection area 29, and the singulation transporting means 28 is configured to transport the containers 2 from the redirection area 29 to an uptake area 5 of the singulation arrangement 1, which uptake area 5 is adapted to collect the containers 2 in bulk.

As stated above, the container return system 24 comprises a singulation arrangement 1 configured to single out individual used containers from the bulk and configured to transport the individual containers 2 from the uptake area 5 to the receiving area 6. The receiving area 6 is positioned at a higher vertical level than the uptake area 5.

The container return system 24 further comprises a transporter 13 for transporting containers 2 from the receiving area 6 of the singulation arrangement 1

to the classification unit 14. A further transporter 32 – also constituted by a conveyor – is provided downstream of the classification unit 14.

The container return system 24 may further comprise a devaluation means (not shown) arranged downstream of the classification unit 14 and a cabinet (not shown) downstream of the devaluation means, which cabinet is adapted to receive a collection means for receiving containers 2 downstream of the transporter 14.

When the singulation arrangement 1 is used in a container return system 24, containers 2 are provided through an infeed opening 25 therein to an infeed device 26, either one by one or in bulk. The infeed device 26 forwards the containers 2 from the infeed opening to the redirection area 29. From there, the redirection means 27 redirects the containers 2 towards the singulation transporting means 28 which transports the containers 2 from the redirection area 29 to an uptake area 5 of the singulation arrangement 1. The containers 2 are aligned in the first portion 19 of the bottom section 17 in the reservoir 3 and slides down towards the mid-portion 20 of the bottom section 17, constituting the uptake area 5. From there, the containers 2 are retrieved by means of the container carrier 8 of the flexible conveyor element 7 and transported through the second portion 21 and up to the transporter 13 while being guided by the guide portion 12. The transporter 13 transports the containers 2 from the receiving area 6 of the singulation arrangement 1 to the classification unit 14.

The classification unit 14 is configured to classify the individual containers 2 into a category selected among the group comprising at least accepted and not accepted and is further configured to initiate a transport of only the containers 2 classified as accepted for further processing or storage as accepted containers 2.

Rejected containers 2 are sorted down to the infeed device 26 behind the redirection means 27 and may be sent back to the infeed opening 25 when the session is over.

The container return system also normally has a devaluation means (not shown) arranged downstream of the classification unit 14.

It is understood that other variations in the present invention are contemplated and, in some instances, some features of the invention can be employed without a corresponding use of other features. Accordingly, it is

appropriate that the appended claims be construed broadly in a manner consistent with the scope of the invention.

CLAIMS

1. Singulation arrangement (1) for singulation of containers (2), such as reusable or recyclable used food or beverage containers (2), received in bulk, said
5 singulation arrangement (1) comprising:
a reservoir (3) adapted to collect used containers (2) in bulk, and
a transport unit (4) adapted to transport containers (2) from an uptake area (5) of said reservoir (3) to a receiving area (6), said receiving area (6) being arranged at a higher altitude than said uptake area (5),
10 wherein the transport unit (4) comprises a flexible conveyor element (7), provided with a plurality of container carriers (8), and a path control device (9) configured to control said flexible conveyor element (7) to move along a curved path when transporting said containers (2).
- 15 2. Singulation arrangement (1) according to claim 1, wherein the path control device (9) comprises a curved control structure (10).
3. Singulation arrangement (1) according to any one of the preceding claims, wherein at least a part of said curved path is C-shaped.
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4. Singulation arrangement (1) according to any one of the preceding claims, wherein the path control device (9) comprises at least two deflection members (11), the flexible conveyor element (7) being looped around each of the least two deflection members (11).
25
5. Singulation arrangement (1) according to claim 4, wherein said at least two deflection members (11) are located at respective ends of the transport unit (4).
6. Singulation arrangement (1) according to any one of the preceding claims
30 4-5, wherein at least one of said deflection members (11) comprises a wheel.
7. Singulation arrangement (1) according to claim 6, wherein said wheel is a drive wheel.

8. Singulation arrangement (1) according to any one of the preceding claims, further comprising a V-shaped guide portion (12) arranged in connection with an upper part of the transport unit (4) and adapted to guide the containers (2) while transported towards the receiving area (6) by the transport unit (4).

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9. Singulation arrangement (1) according to any one of the preceding claims, wherein the flexible conveyor element (7) is a chain.

10. Singulation arrangement (1) according to any one of the preceding claims 1-8, wherein the flexible conveyor element (7) is a belt, preferably a modular belt or a timing belt.

11. Singulation arrangement (1) according to any one of the preceding claims 1-10, wherein the reservoir (3) is elongated in a transport direction of the flexible conveyor element (7) in the uptake area (5).

12. Singulation arrangement (1) according to claim 11, wherein the reservoir (3) has a tapering cross-section that tapers towards a bottom section (17) of the reservoir (3) in the uptake area (5).

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13. A container return system (24) configured to receive a bulk of containers (2), such as reusable or recyclable used food or beverage containers, through an infeed opening (25), the reverse vending machine (24) comprising:

25 a singulation arrangement (1) according to any one of the preceding claims, an infeed device (26) for forwarding containers (2) from said infeed opening (25) to the reservoir (3) of the singulation arrangement (1), a classification unit (14), and a transporter (13) for transporting containers (2) from the receiving area (6) of the singulation arrangement (1) to the classification unit (14).

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14. The container return system (24) according to claim 13, further comprising a devaluation means downstream of the classification unit (14).

15. The container return system (24) according to claim 14, further comprising a cabinet downstream of the classification unit (14), the cabinet being adapted to receive a collection means for receiving containers (2) downstream of the transporter (13).