NEGATIVE PRESSURE DELIVERY SYSTEM

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority from Taiwan Patent application No. TW 111123609 filed on June 24, 2022, entitled “NEGATIVE PRESSURE DELIVERY SYTEM”, the content of which is hereby incorporated by reference in their entirety for all purposes.

TECHNICAL FIELD

[0002] The present invention relates to a negative pressure delivery system, and more particularly to a negative pressure delivery system which is capable of determining the categories and orientations of one or more containers.

BACKGROUND

[0003] There has been various negative pressure deliver systems for delivering containers such as test tubes. For conventional negative pressure delivery systems, if various containers are to be sent to different receiving destinations, it is necessary to manually classify the containers, and then place the containers into corresponding sending modules, so that the containers can be sent into negative pressure pipelines for being delivered to respective receiving destinations via the negative pressure pipelines. Such an approach is not only time-consuming, but also difficult to eliminate the possibility of erroneous identification and classification.

[0004] In addition, since the sending modules for conventional negative pressure delivery systems are large, when multiple sending modules are required in a negative pressure delivery system for respectively delivering containers of various categories to corresponding receiving destinations, such a negative pressure delivery system will therefore be bulky. For negative pressure delivery systems which are often installed in buildings such as medical institutions, bulky systems will

adversely occupy more space in the buildings.

[0005] Further, with the configuration for sending modules in the aforementioned negative pressure delivery systems, it is difficult for each container entering the sending module to be set to the same orientation before being sent into the negative pressure pipeline. Accordingly, various containers may enter the negative pressure pipelines in different orientations, which may affect the delivering speed of the containers in the negative pressure pipelines, and may cause congestion and/or collision of the containers in the negative pressure pipelines.

SUMMARY OF THE INVENTION

[0006] In one embodiment, a negative pressure delivery system comprises: a container temporary storage configured to store a container to be delivered, wherein the container includes a first end portion a second end portion, the shape of the first end portion is different from the shape of the second end portion, and a label is disposed on an outer surface of the container; a transfer and identification module including a transfer section, an identification section, and a pushing device, wherein the transfer section is configured to transfer the container from the container temporary storage to the identification section and allow the container to move across the identification section, wherein the identification section is configured to determine information related to the container according to the label on the container; a sending module including a body having a container sending port, a driving source mounted on the body, a rotary disc accommodated within the body, and a transmission mechanism connecting the driving source and the rotary disc, wherein the rotary disc is driven by the driving source via the transmission mechanism so as to be rotatable about a horizontal center axis; a receiving module including a negative pressure generator and a negative pressure compartment; a transfer pipeline connecting the container sending port of the sending module and the receiving module; and a controller coupled to and in communication with the sending

module, the receiving module, and the transfer and identification module. The controller includes instructions for: causing the identification section to identify the label on the container during the movement of the container across the identification section, determine the information related to the container according to the label, and transmit the determined information to the controller; causing, based on the determined information, the pushing device to push the container into the rotary disc of the sending module; next, based on the determined information, causing the rotary disc to rotate about the horizontal center axis for aligning the first end portion of the container with the container sending port; and thereafter, causing the sending module to send the container through the container sending port and into the transfer pipeline, and activating the negative pressure generator for creating a negative pressure environment within the transfer pipeline, so as to enable the container to move along the transfer pipeline to the negative pressure compartment of the receiving module.

[0007] In another embodiment, a negative pressure delivery system comprises: a container temporary storage configured to store a container to be delivered, wherein the container includes a first end portion a second end portion, the shape of the first end portion is different from the shape of the second end portion, and a label is disposed on an outer surface of the container; a transfer and identification module including a transfer section, an identification section, and a pushing device, wherein the transfer section is configured to transfer the container from the container temporary storage to the identification section and allow the container to move across the identification section, wherein the identification section is configured to determine a category and an orientation of the container according to the label on the container; a plurality of sending modules, each of which includes a body having a container sending port, a driving source mounted on the body, a rotary disc accommodated within the body, and a transmission mechanism connecting the driving source and the rotary disc, wherein the rotary disc is driven by the driving

source via the transmission mechanism so as to be rotatable about a horizontal center axis; a plurality of receiving modules, each of which includes a negative pressure generator and a negative pressure compartment; a plurality of transfer pipelines, each of which connects the container sending port of one of the plurality of sending modules and a corresponding one of the plurality of receiving modules; and a controller coupled to and in communication with the plurality of sending modules, the plurality of receiving modules, and the transfer and identification module. The controller includes instructions for: causing the identification section to identify the label on the container during the movement of the container across the identification section, determine the category and the orientation of the container according to the label, and transmit the determined category and orientation to the controller; causing, based on the determined category and orientation, the pushing device to push the container into the rotary disc of a target sending module of the plurality of sending modules, wherein the target sending module corresponds to the category of the container; next, based on the determined category and orientation, causing the rotary disc to rotate about the horizontal center axis for aligning the first end portion of the container with the container sending port of the target sending module; and thereafter, causing the target sending module to send the container through the container sending port of the target sending module, and into a target transfer pipeline of the plurality of transfer pipelines connected to the container sending port of the target sending module, and activating the negative pressure generator of a target receiving module of the plurality of receiving modules for creating a negative pressure environment within the target transfer pipeline, so as to enable the container to move along the target transfer pipeline to the negative pressure compartment of the target receiving module.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 schematically illustrates a structure of a negative pressure delivery

system according to an embodiment of the present invention.

[0009] FIG. 2 schematically illustrates a perspective view showing an automatic sender of the negative pressure delivery system according to an embodiment of the present invention.

[0010] FIG. 3 illustrates an example of a container delivered by the negative pressure delivery system.

[0011] FIG. 4 schematically illustrates a sending module of the automatic sender according to an embodiment of the present invention.

[0012] In the drawings of the present invention, reference numerals may be used more than once to indicate same and/or similar components.

DETAILED DESCRIPTION

[0013] The following embodiments are described in order to provide further understanding of the technical features and advantages of the present invention. It is to be notes that various embodiments shown in the drawings are for illustrative purposes only and therefore not drawn to scale. In the drawings, many details are omitted in order to avoid unnecessary confusion.

[0014] FIG. 1 illustrates a structure of a negative pressure delivery system 1 according to an embodiment of the present invention. As shown in FIG. 1, the negative pressure delivery system 1 may include an automatic sender 11, one or more receiving modules 12, one or more transfer pipelines 13 connecting the automatic sender 11 and the one or more receiving modules 12, and a controller 14 coupled to the automatic sender 11 and the one or more receiving modules 12. FIG. 2 schematically illustrates a perspective view showing the automatic sender 11 of the negative pressure delivery system 1 according to an embodiment of the present invention. As shown in FIGs. 1 and 2, the automatic sender 11 may include a container temporary storage 111, a transfer and identification module 112, and multiple (e.g., four) sending modules 113-1~113-4. For the purpose of illustrating,

in the following description, the sending modules 113-1~113-4 are sometimes referred to as sending modules 113. It is also to be noted that the number of the sending modules 113 are not limited to the number disclosed herein, and can be increased/decreased as required. In addition, the number of the transfer pipelines 13 and the receiving modules 12 may be increased/decreased with the increase/decrease in the number of the sending modules 113. For example, in the embodiment in which four sending modules 113-1, 113-2, 113-3, and 113-4 are provided, four receiving modules 12-1, 12-2, 12-3, and 12-4 (referred to as receiving modules 12, collectively) may be provided, and four transfer pipelines 13-1, 13-2, 13-3, and 13-4 may be employed to connect the sending modules 113 and the receiving modules 12, respectively.

[0015] The container temporary storage 111 may be configured to hold one or more containers 2 to be delivered. FIG. 3 illustrates an example of the container 2 having a substantially cylindrical shape, but containers 2 having other shapes and/or configurations may also be used as long as they can be delivered with the negative pressure delivery system 1. In the embodiment shown in FIG. 3, the container 2 includes a first end portion 21 and a second end portion 22. The shape of the first end portion 21 is different from that of the second end portion 22, but it is not limited thereto. Further, a label 23 is disposed on an outer surface of the container 2. The label 23 may provide various types information associated with the container 2 for an identification operation described below. In one embodiment, the label 23 may include information indicative of the orientation of at least one of the first end portion 21 and the second end portion 22. In another embodiment, the label 23 may be disposed close the first end portion 21 or the second end portion 22, and may be used as an indicator for indicating the first end portion 21 or the second end portion 22. In one embodiment, in addition to the information indicative of the orientation of at least one of the first end portion 21 and the second end portion 22, the label 23 may also include information related to the content of the container 2.

Moreover, for example, the label may be in the form of a barcode, but it is not limited thereto.

[0016] Referring back to FIG. 2, the transfer and identification module 112 may include a transfer section 112A, an identification section 112B, and a pushing device 112C. The transfer section 112A may be configured to transfer the container 2 from the container temporary storage 111 to the identification section 112B. In the embodiment shown in FIG. 2, the transfer section 112A is configured to have a stepped form, and push the container 2 upward, such that the container 2 may be moved upward along each step and reach the identification section 112B. However, this is exemplary only, and other approaches and/or mechanisms, such as conveyor belts, transfer arms, etc., may be used for transferring the container 2 to the identification section 112B. Once the container 2 reaches the identification section 112B, the transfer section 112A may, for example, continue pushing the container 2 for enabling the container 2 to start moving across the identification section 112B.

[0017] Continue referring to FIG. 2, the identification section 112B may be configured to include a slope, which allows the container 2 to move across an effective identification area of the identification section 112B in a rolling or sliding manner. Note that the sloped identification section 112B as shown in FIG. 2 is exemplary only, and any other configuration such as a conveyor belt, a transfer arm, etc., may be used for enabling the movement of the container 2 across the identification section 112B. For example, during the movement of the container 2 across the identification section 112B, the identification section 112B may capture one or more images of the label 23 on the container 2 and analyze the information carried by the label 23, using optical identification techniques (e.g., scanning lens). For example, such information may include the destination to which the container 2 is delivered, and/or the orientation of the container 2 at the identification section 112B, and may also include the content of the container 2, the sampling date/time of the content, etc. The container 2 may reach the pushing device 112C after having

passed the identification section 112B. In the embodiment shown in FIG. 2, the pushing device 112C is configured to be laterally movable since the sending modules 113-1~113-4 are disposed on a side of the transfer and identification module 112, such that the container 2 identified by the identification section 112B may be pushed to one of the sending modules 113-1~113-4 connected to a destination receiving module 12. Nevertheless, the positioning of the sending modules 113 as shown in FIG. 2 is only exemplary, and other position and/or arrangement for disposing the sending modules 113 may be chosen. Accordingly, the direction of movement of the pushing device 112C may also be adjusted based on the positioning of the sending modules 113, in order to push the container 2 identified by the identification section 112B into a designated one of the sending modules 113.

[0018] Details of the sending module 113 are described below. FIG. 4 schematically illustrates the sending module 113 of the automatic sender 11 according to an embodiment of the present invention. As shown in FIG. 4, the sending module 113 may include a body 1131, a driving source 1132 mounted on the body 1131, a rotary disc 1133 accommodated within the body 1131, and a transmission mechanism (not shown) connecting the driving source 1132 and the rotary disc 1133. The body 1131 may be provided with a container sending port 1131A, and a first end 13A of the transfer pipeline 13 may be connected to the container sending port 1131A. For example, the rotary disc 1133 may be a circular disc disposed on a plane that is normal to a horizontal center axis X substantially parallel to the horizontal plane. A space S may be provided within the rotary disc 1133 for accommodating one container 2. The space S may have an opening on the peripheral side of the rotary disc 1133. The identified container 2 may be pushed through the opening of the space S on the peripheral side of the rotary disc 1133 by the pushing device 112C in a direction parallel to a plane normal to the horizontal center axis X, thereby entering the space S. When the rotary disc 1133

is driven by the driving source via the transmission mechanism, the rotary disc 1133 may rotate a predetermined angle clockwise or counterclockwise about the horizontal center axis X, such that the first end portion 21 or second end portion 22 of the container 2 within the rotary disc 1133 is aligned with the container sending port 1131A. For example, the driving source may be a motor, a driving pneumatic cylinder, or the like. Further, in the case that the driving source 1132 is a driving pneumatic cylinder, it can controlled solely with solenoid valves without requiring additional electronic controlling devices such as motor controllers. By way of example only, with the aforementioned configuration in which the sending module 113 is disposed on a side of the transfer and identification module 112, the container 2 may be in a horizontal orientation before being sent into the space S by the pushing device 112C, with the first end portion 21 and second end portion 22 of the container 2 facing both sides of the transfer and identification module 112, respectively. In such an embodiment, the predetermined angle of the rotation of the rotary disc 1133 may be 90 degrees clockwise or 90 degrees counterclockwise, but it is not limited thereto.

[0019] Referring back to FIG. 1, as shown, each of the receiving modules 12 may include a negative pressure generator 121 and a negative pressure compartment 122. Specifically, a second end 13B of the transfer pipeline 13 is connected to an inlet side 122A of the negative pressure compartment 122. In addition, an outlet side 122B of the negative pressure compartment 122 may be connected to the negative pressure generator 121 via a pipe 123. When the negative pressure generator 121 is activated, gas within the negative pressure compartment 122 is drawn out via the pipe 123, and gas within the transfer pipeline 13 connected to the negative pressure compartment 122 is in turn drawn out, thereby creating a negative pressure within the transfer pipeline 13. Under such a circumstance, once a container 2 is pushed into the transfer pipeline 13 by the sending module 113, the negative pressure within the transfer pipeline 13 enables

the container 2 to be transferred into the negative pressure compartment 122, and received by a receiver at the receiving module 12.

[0020] For example, the transfer pipelines 13 may be, but not limited thereto, pipelines of flexible materials, such as silicone tubes, PTFE (Teflon) tubes, or the like. In one embodiment, the outer diameter of the transfer pipeline 13 may be between 22mm and 25mm, and the inner diameter of the transfer pipeline 13 may be between 19mm and 22mm. In one particular embodiment, the outer diameter of the transfer pipeline 13 is approximately 22mm, and the inner diameter of the transfer pipeline 13 is approximately 19mm. In one embodiment, a vacuum generator 13C may be provided in each of the transfer pipelines 13, and close to the container sending port 1131A (i.e., close to the first end 13A of the transfer pipeline 13). Such a vacuum generator 13C may be configured to be activated when the container 2 is sent into the transfer pipeline 13 by the sending module 113 for generating vacuum between the vacuum generator 13C and the container sending port 1131A, thereby providing an auxiliary attraction within the transfer pipeline 13 to facilitate the movement of the container 2 toward the receiving module 12.

[0021] Specifically, the controller 14 (shown in FIG. 1) may be configured to be coupled to and communicate with the sending modules 113, the receiving modules 12, and the transfer and identification module 112. For example, the controller 14 may include one or more memory devices, one or more mass storage devices, and one or more processors. The controller 14 is configured to at least control operations of the sending modules 113, the receiving modules 12, and the transfer and identification module 112. Various instructions may be stored in the controller 14 for implementing/performing the aforementioned transfer, identification, and sending of the containers 2. In some embodiments, the instructions mentioned above may be loaded from the mass storage devices of the controller 14 into the memory devices, and executed on the processors of the controller 14. The instructions described herein may be configured in any suitable way. For example,

various subroutines or control objectives may be programmed to control operations of the components of the negative pressure delivery system necessary for performing negative pressure delivery of containers. The instructions described herein can be written in any suitable computer-readable programming language. In some embodiments, the instructions are implemented in software. In other embodiments, the instructions may be implemented in hardware or firmware.

[0022] One or more embodiments of the instructions described herein can also be implemented as computer-readable codes on a non-transitory computer-readable medium. The non-transitory computer-readable medium is any data storage hardware unit that stores data subsequently read by a computer system, such as a memory device. Examples of non-transitory computer-readable media include hard disks, network attached storage (NAS), ROM, RAM, compact discs (CD-ROM), recordable compact discs (CD-R), rewritable compact discs (CD-RW), magnetic tapes, and other optical and non-optical data storage hardware units. In some embodiments, non-transitory computer-readable media include computer-readable tangible media distributed on computer systems coupled via a network, so that the computer-readable codes can be stored and executed in a distributed manner.

[0023] In the embodiment where containers 2 are sent to the same destination, the instructions described herein may include instructions for performing the following operations: causing the identification section 112B to identify the label 23 on each of the containers 2 during the movement of the containers 2 across the identification section 112B, determine the information related to the containers 2 (e.g., the orientation of the containers 2 presented at the identification section 112B) according to the labels 23, and transmit the result of determination to the controller 14; causing, based on the result of determination, the pushing device 112C to push one of the containers 2 into the rotary disc 1133 of the sending module 113; next, based on the result of determination, with the container 2 being located within the rotary disc 1133, causing the driving source 1132 to rotate the rotary disc 1133 about

the horizontal center axis X via the transmission mechanism, for aligning a predetermined one of the first end portion 21 and the second end portion 22 of the container 2 with the container sending port 1131A, such that for each container 2 passing through the container sending port 1131A, the same one of the first and second end portions 21 and 22 thereof can enter the container sending port 1131A first; thereafter, causing the sending module 113 to send the container 2 through the container sending port 1131A and into the transfer pipeline 13, and activating the negative pressure generator 121 of the receiving module 12 for creating a negative pressure environment within the transfer pipeline 13, thus enabling the container 2 to move along the transfer pipeline 13 to the negative pressure compartment 122 of the receiving module 12.

[0024] Furthermore, in the embodiment where containers 2 belong to multiple categories and will be sent to different destinations according to its category, the instructions described herein may include instructions for performing the following operations: causing the identification section 112B to identify the label 23 on each of the containers 2 during the movement of the containers 2 across the identification section 112B, determine the information related to the containers 2 (e.g., the category of the respective containers 2 and the orientation of the containers 2 presented at the identification section 112B) according to the labels 23, and transmit the result of determination to the controller 14; causing, based on the result of determination, the pushing device 112C to push one of the containers 2 into the rotary disc 1133 of a target sending module (e.g., the aforementioned sending module 113-1) of sending modules 113; next, based on the result of determination, with the container 2 being located within the rotary disc 1133, causing the driving source 1132 to rotate the rotary disc 1133 about the horizontal center axis X via the transmission mechanism, for aligning a predetermined one of the first end portion 21 and the second end portion 22 of the container 2 with the container sending port 1131A, such that for each container 2 passing through the container sending port

1131A, the same one of the first and second end portions 21 and 22 thereof can enter the container sending port 1131A first; thereafter, causing the sending module 113-1 to send the container 2 through the container sending port 1131A and into a target transfer pipeline (e.g., the aforementioned transfer pipeline 13-1) of transfer pipelines 13 that is connected to the transfer module 113-1, and activating the negative pressure generator 121 of a target receiving module (e.g., the aforementioned receiving module 12-1) of receiving modules 12 that is connected to the transfer pipeline 13-1 for creating a negative pressure environment within the transfer pipeline 13-1, thus enabling the container 2 to move along the transfer pipeline 13-1 to the negative pressure compartment 122 of the receiving module 12-1.

[0025] For example, the relationship between the category of containers and target sending modules corresponding thereto can be set in advance and stored in the controller 14.

[0026] With the configuration of the negative pressure delivery system of the present invention, it is possible to effectively solve the problems of time delay and damage to containers and/or contents thereof, which result from the requirement of long-distance and long-time manual delivery when the sites for sending and receiving containers are located on different floors of a building, or even in different buildings. Moreover, since in the negative pressure delivery system of the present invention, pipes of flexible materials having a smaller size than that of conventional negative pressure delivery techniques are employed as transfer pipelines, it is more flexible in arranging the transfer pipelines. In addition, no matter the locations of the sites for sending and receiving containers are newly-built or existing, the arrangement for transfer pipelines can be performed, and therefore reducing the difficulty of construction and optimizing container delivery. As a result, the time required from the delivery of containers to the completion of analyzing the contents of the containers can be reduced. In addition, with the negative pressure delivery

system of the present invention, it is not necessary to provide any form of additional packaging to containers before the delivery of the containers, that is, users can directly place the containers into the negative pressure delivery system of the present invention. Thereafter, the negative pressure delivery system of the present invention can automatically perform identification, classification, alignment, and sending to the input containers. In this manner, it is possible to reduce the demand on container packaging, improve efficiency of delivery, and even reduce the risk of container contamination. Furthermore, the sending module(s) in the negative pressure delivery system of the present invention can perform automatic orientation to each container entering the sending module(s), and send each container into a corresponding transfer pipeline in the same orientation. Accordingly, each container can travel to the receiving end at substantially the same delivering speed in the transfer pipeline, so that congestion and/or collision of containers in the transfer pipelines can be effectively avoided, even if there are multiple containers presented in one transfer pipeline simultaneously.

[0027] Although the present invention has been described in detail with reference to the preferred embodiments and drawings for the purpose of illustration, it is to be understood that those with ordinary skill in the art may implement various modifications, changes, and equivalents without departing from the spirit and scope of the present invention. However, these modifications, changes, and equivalents should also be included in the scope of the present invention.

CLAIMS

What is claimed is:

1. A negative pressure delivery system, comprising:

a container temporary storage configured to store a container to be delivered, wherein the container includes a first end portion a second end portion, the shape of the first end portion is different from the shape of the second end portion, and a label is disposed on an outer surface of the container;

a transfer and identification module including a transfer section, an identification section, and a pushing device, wherein the transfer section is configured to transfer the container from the container temporary storage to the identification section and allow the container to move across the identification section, wherein the identification section is configured to determine information related to the container according to the label on the container;

a sending module including a body having a container sending port, a driving source mounted on the body, a rotary disc accommodated within the body, and a transmission mechanism connecting the driving source and the rotary disc, wherein the rotary disc is driven by the driving source via the transmission mechanism so as to be rotatable about a horizontal center axis;

a receiving module including a negative pressure generator and a negative pressure compartment;

a transfer pipeline connecting the container sending port of the sending module and the receiving module; and

a controller coupled to and in communication with the sending module, the receiving module, and the transfer and identification module, the controller including instructions for performing the following operations:

causing the identification section to identify the label on the container during the movement of the container across the identification section, determine the

information related to the container according to the label, and transmit the determined information to the controller;

causing, based on the determined information, the pushing device to push the container into the rotary disc of the sending module;

next, based on the determined information, causing the rotary disc to rotate about the horizontal center axis for aligning the first end portion of the container with the container sending port; and

thereafter, causing the sending module to send the container through the container sending port and into the transfer pipeline, and activating the negative pressure generator for creating a negative pressure environment within the transfer pipeline, so as to enable the container to move along the transfer pipeline to the negative pressure compartment of the receiving module.

2. The negative pressure delivery system of claim 1, wherein the container is pushed into the rotary disc in a direction parallel to a plane normal to the horizontal center axis.

3. The negative pressure delivery system of claim 1, wherein a vacuum generator is provided in the transfer pipeline, and wherein the vacuum generator is disposed close to the container sending port.

4. The negative pressure delivery system of claim 1, wherein during the movement of the container across the identification section, the identification section captures and analyze an image of the label on the container for determining an orientation of the container.

5. The negative pressure delivery system of claim 4, wherein the container moves across the identification section in a rolling manner.

6. The negative pressure delivery system of claim 1, wherein the transfer pipeline is made of a flexible material pipeline having an outer diameter between 22mm and 25mm and an inner diameter between 19mm and 22mm.

7. A negative pressure delivery system, comprising:

a container temporary storage configured to store a container to be delivered, wherein the container includes a first end portion a second end portion, the shape of the first end portion is different from the shape of the second end portion, and a label is disposed on an outer surface of the container;

a transfer and identification module including a transfer section, an identification section, and a pushing device, wherein the transfer section is configured to transfer the container from the container temporary storage to the identification section and allow the container to move across the identification section, wherein the identification section is configured to determine a category and an orientation of the container according to the label on the container;

a plurality of sending modules, each of which includes a body having a container sending port, a driving source mounted on the body, a rotary disc accommodated within the body, and a transmission mechanism connecting the driving source and the rotary disc, wherein the rotary disc is driven by the driving source via the transmission mechanism so as to be rotatable about a horizontal center axis;

a plurality of receiving modules, each of which includes a negative pressure generator and a negative pressure compartment;

a plurality of transfer pipelines, each of which connects the container sending port of one of the plurality of sending modules and a corresponding one of the plurality of receiving modules; and

a controller coupled to and in communication with the plurality of sending modules, the plurality of receiving modules, and the transfer and identification module, the controller including instructions for performing the following operations:

causing the identification section to identify the label on the container during the movement of the container across the identification section, determine the category and the orientation of the container according to the label, and transmit the determined category and orientation to the controller;

causing, based on the determined category and orientation, the pushing device to push the container into the rotary disc of a target sending module of the plurality of sending modules, wherein the target sending module corresponds to the category of the container;

next, based on the determined category and orientation, causing the rotary disc to rotate about the horizontal center axis for aligning the first end portion of the container with the container sending port of the target sending module; and

thereafter, causing the target sending module to send the container through the container sending port of the target sending module, and into a target transfer pipeline of the plurality of transfer pipelines connected to the container sending port of the target sending module, and activating the negative pressure generator of a target receiving module of the plurality of receiving modules for creating a negative pressure environment within the target transfer pipeline, so as to enable the container to move along the target transfer pipeline to the negative pressure compartment of the target receiving module.

8. The negative pressure delivery system of claim 7, wherein the container is pushed into the rotary disc in a direction parallel to a plane normal to the horizontal center axis.

9. The negative pressure delivery system of claim 7, wherein a vacuum generator is provided in each of the plurality of transfer pipelines, and wherein the vacuum generators are respectively disposed close to the container sending ports to which the plurality of transfer pipelines are connected.

10. The negative pressure delivery system of claim 7, wherein during the movement of the container across the identification section, the identification section captures and analyze an image of the label on the container for determining the category and the orientation of the container.

11. The negative pressure delivery system of claim 10, wherein the container moves across the identification section in a rolling manner.

12. The negative pressure delivery system of claim 7, wherein each of the plurality of transfer pipelines is made of a flexible material pipeline having an outer diameter between 22mm and 25mm and an inner diameter between 19mm and 22mm.