

LOW-TEMPERATURE STORAGE DEVICE FOR AN INTELLIGENT SCIENTIFIC AND TECHNOLOGICAL BIOLOGICAL PRODUCT

BACKGROUND OF THE INVENTION

1. Field of the Invention

5 The present invention relates to a low-temperature storage device, and more particularly to a low-temperature storage device for an intelligent scientific and technological biological product.

2. Description of Related Art

 A conventional low-temperature storage device for preserving biological
10 products has a freezing space disposed in a body of the conventional low-temperature storage device, and a frame for storing a biological product container is disposed in the freezing space. When a container containing a specific biological product needs to be taken, an upper cover that is disposed above the freezing space is opened, and then the container containing the specific
15 biological product is taken out of the conventional low-temperature storage device manually.

 The conventional low-temperature storage device for storing biological products needs to lift the upper cover above the entire freezing space when a specific container needs to be picked up. During the process of lifting the upper
20 cover, the temperature of the external environment will affect the temperature of the environment inside the entire freezing space. As the temperature rises and changes, the temperature inside the freezing space is not easily kept in constant, affecting the quality of the biological product in the storage container inside the freezing space. Furthermore, user's hand reaching into the freezing space also

makes it easy to bring outside dust or dirt into the freezing space and contaminate the biological products stored in the container.

The low-temperature storage device for an intelligent scientific and technological biological product in accordance with the present invention
5 mitigates or obviates the aforementioned problems.

SUMMARY OF THE INVENTION

The main objective of the present invention is to provide a low-temperature storage device for an intelligent scientific and technological biological product.

10 The low-temperature storage device for an intelligent scientific and technological biological product in accordance with the present invention has a body, a picking machine arm, at least one extracting machine arm, at least one transfer assembly, and a liquid nitrogen supply assembly. The body has a carrying chamber, at least one storage zone, and an object taking port. Each
15 storage zone has a biological product storage room and a connection room. The picking machine arm is disposed in the carrying chamber and has a motion range reaching each storage zone and the object taking port. The at least one extracting machine arm is disposed in the connection room of each storage zone respectively. The at least one transfer assembly is disposed in the biological
20 product storage room. The liquid nitrogen supply assembly communicates with the biological product storage room of each storage zone and injects liquid nitrogen into each biological product storage room.

Other objectives, advantages and novel features of the invention will become more apparent from the following detailed description when taken in

conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of a first embodiment of a low-temperature storage device for an intelligent scientific and technological biological product in accordance with the present invention;

Fig. 2 is an operational front side view of the low-temperature storage device in Fig. 1;

Fig. 3 is a block diagram of a controller of the low-temperature storage device in Fig. 1;

Fig. 4 is an enlarged and operational front side view of low-temperature storage device in Fig. 1;

Fig. 5 is a top view of the low-temperature storage device in Fig. 1;

Fig. 6 is another enlarged and operational front side view of low-temperature storage device in Fig. 1;

Fig. 7 is a perspective view of a container frame of the low-temperature storage device in Fig. 1; and

Fig. 8 is a top view of a second embodiment of a low-temperature storage device for an intelligent scientific and technological biological product in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In order to understand the technical features and effects of the present invention in detail, and in accordance with the contents of the specification, the preferred embodiments shown in the figures are further described in detail as follows.

With reference to Figs. 1 to 3, a first embodiment of a low-temperature storage device for an intelligent scientific and technological biological product in accordance with the present invention has a body 10, a picking machine arm 20 disposed in the body 10, an extracting machine arm 30 disposed in the body 10, a transfer assembly 40 disposed in the body 10, a liquid nitrogen supply assembly 50 connected to the body 10, a controller 60 disposed in the body, and a console 70 that cooperates with the controller 60.

The body 10 has a bottom, four corners, a sidewall, four pulleys A, a carrying chamber 11, a storage zone 12, a relay carrying room 13, and an object taking port 14. The four pulleys A are disposed on the bottom of the body 10 at the four corners of the body 10, respectively. Then, the position of the body 10 can be easy to move and change by the pulleys A. The carrying chamber 11 is disposed in the body 10, and the storage zone 12 is disposed adjacent to the carrying chamber 11. The relay carrying room 13 is disposed in and communicates with the carrying chamber 11. The object taking port 14 is formed through the sidewall of the body 10 and communicates with the relay carrying room 13.

The storage zone 12 has a biological product storage room 121 and a connection room 122. The biological product storage room 121 and the connection room 122 are respectively located in a lower half and an upper half of the storage zone 20. The biological product storage room 121 is an enclosed room, and the connection room 122 communicates with the carrying chamber 11. The storage zone 12 has a top plate 123 partitioned between the biological product storage room 121 and the connection room 122, and having a side close

to the carrying chamber 11 and at least two active doors 124 disposed on the side of the storage zone 12. Each one of the at least two active doors 124 may be selected to use an electric door or a pneumatic cylinder door. The at least two active doors 124 are arranged in a row along a straight line at spaced intervals. In
5 the first embodiment, there are five active doors 124 disposed on the top plate 123.

A glass window 111 is formed around the carrying chamber 11 so that the outside world can confirm the conditions inside the carrying chamber 11 and the connection chamber 122 from the glass window 111. A relay door 131 is
10 disposed between the relay carrying room 13 and the carrying chamber 11. The relay carrying room 13 has a side corresponding to the object taking port 14 and a pick-up door 132 formed through the side of the relay carrying room 13. The relay door 131 and the pick-up door 132 are optional open design.

The biological product storage room 121 has a product environment
15 sensor 1213 disposed in the biological product storage room 121 and being a sensor for temperature, humidity, and air cleanliness. An acquisition environment sensor 112 is disposed in the carrying chamber 11. The acquisition environment sensor 112 is a sensor for temperature, humidity, and air clarity. A tag reader 113 disposed in the carrying chamber 11 at one side of the carrying
20 chamber 11.

In the first embodiment of the present invention, an air cleaner 15 is disposed around a top of the carrying chamber 11 and adopts a High-Efficiency Particulate Air (HEPA) filter. The air cleaner 15 filters the air in the environment into the carrying chamber 11 so that the environment of the carrying chamber 11

and the connection chamber 122 becomes a clean room environment. A blower 16 is provided in the carrying chamber 11. An end of the blower 16 is connected by pipeline to the relay carrying room 13. When the pick-up door 132 is opened, the blower 16 extracts a clean space in the carrying chamber 11 and inputs the
5 relay carrying room 13 to make the relay. The air pressure in the relay carrying room 13 is in a positive pressure state, so that the outside dirty air does not enter the carrying chamber 11 through the relay carrying room 13, and the air in the carrying chamber 11 can be kept clean.

The picking machine arm 20 is disposed in the carrying chamber 11. The
10 movable range of the picking robot 20 includes the connection room 122 and the object taking port 14, so that the picking machine arm 20 can extend into the connection room 122. When the relay door 131 is opened, the picking machine arm 20 can extend into the relay carrying room 13 through the relay door 131.

The extracting machine arm 30 is disposed in the connection room 122.
15 The extracting machine arm 30 is coupled with a linear rail 31 at a top of the connection room 122. The linear rail 31 is located directly above the five active doors 124. The linear rail 31 is provided with a railcar 32. The railcar 32 can be selectively moved along the linear rail 31 directly above the active doors 124, respectively.

20 With reference to Figs. 4 to 7, the transfer assembly 40 is disposed in the biological product storage room 121. The transfer assembly 40 forms a liquid nitrogen drum 41 in the biological product storage room 121. The transfer assembly 40 is provided with a rotating shaft 42 arranged vertically and rotatable in a center of the biological product storage room 121. A rotating seat 43 is

arranged around a top of the rotating shaft 42. In the first embodiment of the present invention, the rotating seat 43 is a circle disk-shaped bracket. The rotating seat 43 is located on a top of the liquid nitrogen drum 41, the five active doors 124 are located directly above the rotating seat 43 on the side of the carrying chamber 11, and the five active doors 124 are linearly extended as the radial direction of the rotating shaft 42. A bottom end of the shaft 42 is connected to a servomotor 44 through a transmission structure 421. The servomotor 44 is fixed on the body 10, so that the rotating seat 43 is received by the servomotor 44, and the rotating shaft 42 is rotated with a vertical axis being driven.

According to the number of the five active doors 124, five supporting structure groups 431 are provided from inside to outside in the rotating seat 43 in a concentric arrangement to form five rings. Each supporting structure group 431 has multiple annular spaced supporting structures 432. In the first embodiment of the present invention, each supporting structure 432 is a rectangular socket. When the servomotor 44 drives the rotating shaft 42 to rotate the rotating seat 43, the supporting structures 432 of each supporting structure group 431 will pass sequentially through the corresponding active doors 124, and this enables the transfer assembly 40 to drive the rotating base 43 to selectively move one of the support structures 432 of the support structure group 431 to right below the selected active door 124.

A container frame 45 is respectively and vertically positioned at each support structure 432, and each container frame 45 is a rack extending in an up-down direction. Each container frame 45 is provided with multiple slots 451 symmetrically disposed at right and left sides thereof. The slots 451 are arranged

at top and bottom intervals, and each slot 451 is a slot inclined at an angle of 45 degrees or 60 degrees. A top of each container frame 45 is inserted in a corresponding support structure 432, and a width of each supporting structure 432 is larger than a width of each container frame 45. Two clips 452 are
5 respectively formed on an inner side and an outer side at a top of each container frame 45. The two clips 452 are snapped and positioned at the top edge of the corresponding support structure 432, so that multiple container frames 45 are suspended and positioned at each supporting structure 432 of the rotating base 43 and are located in the liquid nitrogen tank 41.

10 Each support structure 432 can position each one of the container frames 45 and provide a guiding effect to the container frame 45 to move in a vertical direction when each container frame 45 is pulled upwardly. Each container frame 45 can be pulled upwardly relative to the corresponding support structure 432. At the top of each container frame 45, a traction structure 453 is provided. In the first
15 embodiment of the present invention, each traction structure 453 is a pull ring that can be gripped by the lifting clamper 33 of the extracting machine arm 30. At least one container 46 is inserted into one of the multiple slots 451 of each one of the container frames 45. Each container 46 has a surface and an identification tag 461 disposed on the surface of the container 46. Each identification tag 461
20 corresponds to a biological product stored in the corresponding container 46.

With the above configuration, the transfer assembly 40 drives the rotating seat 43 to selectively move one of the support structures 432 and the container frame 45 positioned on the support structure 432 at the selected active door 124. When the active door 124 is open, the extracting machine arm 30 can

pull the selected container frame 45 upwards out of the active door 124. At this time, the picking machine arm 20 can extend into the connection room 122 to pick the container 46 that is disposed on the selected container frame 45 up.

The liquid nitrogen supply assembly 50 is disposed beside the body 10.

5 An end of the liquid nitrogen supply assembly 50 penetrates into the biological product storage room 121 of the body 10 and is connected to the liquid nitrogen drum 41. The method of injecting liquid nitrogen into the liquid nitrogen drum 41 adjusts and controls the environment temperature of the containers 46 and biological products stored in the biological product storage room 121.

10 With reference to Figs. 1 to 3, the controller 60 has a gate control module 61 and a controller connection module 62, and is electrically connected to the acquisition environment sensor 112, the tag reader 113, the product environment sensor 1213, the air cleaner 15, the blower 16, the picking machine arm 20, the extracting machine arm 30, the servomotor 44 of the transfer assembly 40, and
15 the liquid nitrogen supply device 50. The gate control module 61 is electrically connected and controls each of the active doors 124, the relay door 131, and the pick-up door 132.

The controller 60 receives data of the environmental temperature, humidity, and air cleanliness of the biological product storage room 121 and the
20 carrying chamber 11 sensed by the acquisition environment sensor 112 and the product environment sensor 1213. Determining whether it is necessary to control the liquid nitrogen supply assembly 50 to supplement the liquid nitrogen in the storage zone 12, maintain the temperature in the biological product storage room 121 within the user set ambient temperature and error range, and determine

whether to start the air cleaner 15 to inputs clean air into the carrying chamber 11.

The gate control module 61 controls the opening or closing of the active doors 124, the relay door 131, and the pick-up door 132, respectively.

When the transfer assembly 40 moves the container frame 45 that is the
5 selected container 46 located to directly below the active door 124, the controller
60 may control the railcar 32 of the picking machine arm 20 to move directly
above the corresponding active door 124, and then open the corresponding active
door 124 and make the lifting clasper 33 moving downwardly through the
corresponding active door 124 and enters the biological product storage room
10 121 to grasp the traction structure 453 of the container frame 45 and pulls the
container frame 45 upwards out of the corresponding active door 124.

Then, the controller 60 controls the picking machine arm 20 to pick up
the selected container 46 from the corresponding container frame 45. With
reference to Figs. 1 to 3 and 7, the picking machine arm 20 can then move each
15 one of the container frames 45 to the tag reader 113 to read the identification tag
461 of the container 46, and check and identify the container 46 in this way to
prevent taking or storing the wrong container 46 from the container frame 45, and
avoiding accidents or mistakes that may occur due to human operations. At this
time, the extracting machine arm 30 moves the container frame 45 return its
20 original position and the corresponding active door 124 is closed. After the
container 46 is recognized and the recognition result is the correct container 46,
the controller 60 controls the picking machine arm 20 to put the container into the
relay carrying room 13 via the relay door 131. When the gate control module 61
controls the relay door 131 to close and enables the pick-up door 132 to open, the

blower 16 is started. An air flow is input into the relay carrying room 13, and the user can take the desired container 46 containing the biological product from the object taking port 14.

With reference to Figs. 1 to 3, the console 70 is a computer or a single
5 chip controller. The console 70 has an input/output interface 71 and a console connection module 72. The operation can be managed through setting of authority. The console 70 is wired connected to the controller connection module 62 of the controller 60 by the console connection module 72, so that the temperature and humidity data obtained by the controller 60 is obtained. The
10 operation record and time for controlling the picking machine arm 20, the extracting machine arm 30 for storing and taking each container 46, and the liquid nitrogen use data and inventory of the liquid nitrogen supply assembly 50 can be uploaded by the wired connection to the remote console 70 to monitor, and the user can use the input/output interface 71 to control the extracting machine
15 arm 30 and the picking machine arm 20 to pick up a selected container 46 from the biological product storage room 121 by the wired connection, or controls the picking machine arm 20 and the extracting machine arm 30 to move the container 46 placed in the relay carrying room 13 to a designated slot 451 of the container frame 45 in the biological product storage room 121.

20 In the first embodiment of the present invention, the input/output interface 71 controls the controller 60 and is disposed on the console 70. The console 70 also can be integrated the functions of the console 70 to the controller 60, and the input/output interface 71 is modified on the body 10. The input/output interface 71 is directly electrically connected to and controls the controller 60.

The above-mentioned configuration can also complete all the functions of the console 70. In addition to the traction structure 453 of each container frame 45, except that the lifting clamper 33 associated with the extracting machine arm 30 is a pull ring, when the extracting machine arm 30 changes the lifting clamper 33 to a lifting electromagnet. The traction structure 453 of each container frame 45 may be adapted to a cooperating magnetic block configuration so that the extracting machine arm 30 can thereby draw the selected container frame 45 upwards through the opened active door 124. The liquid nitrogen supply assembly 50 may be provided on the body 10 as well as disposed in the body 10. For example, the liquid nitrogen supply assembly 50 may be provided in the carrying chamber 11.

In the present invention, in addition to the foregoing first preferred embodiment, only one storage zone 12 is provided in the body 10, and the biological product storage room 121 and the connection room 122 in the storage zone 12 are respectively provided with the storage zone 12. The transfer assembly 40 and the extracting machine arm 30 described above are connected to each of the connection rooms 122 other than the upper half of the carrying chamber 11. With reference to Fig. 8, a second embodiment of the present invention, it is also possible to divide multiple of storage zones 12 in the body 10, and only one of the carrying chamber 11 is provided in the body 10. A said relay carrying room 13, a said liquid nitrogen supply assembly 50, a said controller 60 and a said console 70, and tag reader 113 is arranged beside the carrying chamber 11.

In the second embodiment of the present invention, each connection

room 122 in the upper half of each storage zone 12 communicates with the carrying chamber 11, respectively, and the liquid nitrogen supply assembly 50 is connected to the biological product storage room 121 in each storage zone 12. Liquid nitrogen may be injected into each liquid nitrogen drum 41. In order to expand the range of motion of the picking machine arm 20, the picking machine arm 20 may be a self-propelled robot. In the second embodiment of the present invention, the structure provided in each storage zone 12, the carrying chamber 11, and the relay carrying room 13 is described in the first embodiment and is provided in the storage zone 12, the carrying chamber 11 and the structure of the relay carrying chamber 13 are the same, and the interaction between the structure provided in each storage zone 12 and the structure provided in the carrying chamber 11 is also a structure provided in the storage zone 12 in the first embodiment of the present invention. The interaction with the structure of the carrying chamber 11 is the same.

The difference between the second embodiment of the present invention and the first embodiment is mainly that the first embodiment is a configuration in which a picking machine arm 20 corresponds to a storage zone 12 and the storage zone 12 is provided. The second embodiment is a structure in which a picking machine arm 20 corresponds to a plurality of storage zones 12 and is respectively disposed in each storage zone 12, because of the structure and operation mode and the first embodiment provided in each storage zone 12. The descriptions in the above are the same, and the configurations and functions of the controller 60 and the console 70 are also the same as those described in the first embodiment, so the present invention will not be further described herein.

Compared with the first embodiment of the present invention, only one storage zone 12 is provided. Since the second embodiment of the present invention has several or more storage zones 12, it is stored in each storage zone. Each container 46 in the biological product storage room 121 of the storage zone
5 12 can perform scheduling of storage locations in accordance with the occurrence of abnormal conditions or the user's needs.

For example, when the controller 60 receives a condition in which the environment temperature, humidity, or air deterrence is abnormal in the biological product storage room 121 where the controller 60 receives the
10 environment sensor 112, the controller 60 automatically judging that the biological product storage room 121 due to the occurrence of an environmental abnormality is no longer suitable for storing the containers 46 of the biological products, the controller 60 instructs the picking machine arm 20 to pick up the biological product storage room 121. After all the containers 46 are operated, all
15 the containers 46 in the biological product storage room 121 having abnormal environments are taken out and then transferred to other environment-friendly biological product storage rooms 121 for storage.

The aforementioned second embodiment of the present invention integrates the controller 60 and the sensors 112 into a smart sensing control
20 system to automatically eliminate the obstacles of the storage environment of the containers 46 and avoid the environmental abnormalities from causing the containers 46. The deterioration of the biological products within containers 46 meets the Industry 4.0's need to automate the elimination of production obstructions.

Even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and features of the invention, the disclosure is illustrative only. Changes may be made in the details, especially in matters of shape, size, and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

WHAT IS CLAIMED IS:

1. A low-temperature storage device for an intelligent scientific and technological biological product comprising:

5 a body having

 a carrying chamber disposed in the body;

 at least one storage zone disposed in the body and communicating with the carrying chamber, and each storage zone having

 a biological product storage room;

10 a connection room disposed above the biological product storage room and communicating with the carrying chamber; and

 a top plate disposed between the biological product storage room and the connection room and having at least two active doors disposed on the top plate; and

15 an object taking port formed through a sidewall of the body and communicating with the carrying chamber;

 a picking machine arm disposed in the carrying chamber of the body and having a motion range reaching each storage zone and the object taking port;

20 at least one extracting machine arm disposed in the connection room of each storage zone respectively, and having a motion range reaching the at least two active doors of each top plate and the biological product storage room of each storage zone;

 at least one transfer assembly disposed in the biological product storage room of each storage zone, and each having

a rotating seat rotatably vertically and having multiple supporting structure groups according to a number of the active doors of each top plate and disposed in a concentric arrangement to form at least two rings, and each supporting structure group having multiple supporting structures passed
5 sequentially through each active door; and

a container frame vertically positioned at each support structure and having at least one container;

wherein each transfer assembly drives the rotating base to selectively move one of the support structures of the support structure group to right below a
10 selected active door;

a liquid nitrogen supply assembly communicating with the biological product storage room of each storage zone and injecting liquid nitrogen into each biological product storage room.

15 2. The low-temperature storage device as claimed in claim 1, wherein each transfer assembly has a rotating shaft vertically and rotatably disposed in a center of the biological product storage room and connected to a servomotor;

the servomotor is disposed on the body;

20 the rotating seat is arranged around a top of the rotating shaft;

each supporting structure of each supporting structure group is a socket;

and

each container has a top engaging with each supporting structure.

3. The low-temperature storage device as claimed in claim 2, wherein
each container frame is a rack extending in an up-down direction and has
multiple slots symmetrically disposed at right and left sides thereof;

5 the slots are arranged at top and bottom intervals, and each slot is an
inclined slot;

 a width of each supporting structure is larger than a width of each
container frame;

 two clips are respectively formed on an inner side and an outer side at a
10 top of each container frame, are snapped and positioned at a top edge of the
corresponding support structure, so that multiple container frames are suspended
and positioned at each supporting structure of the rotating base.

4. The low-temperature storage device as claimed in claim 3, wherein
15 each transfer assembly has a liquid nitrogen drum disposed in the
biological product storage room;

 the container frames of each transfer assembly are disposed in the liquid
nitrogen drum; and

 an end of the liquid nitrogen supply assembly penetrates into the
20 biological product storage room of the body and is connected to the liquid
nitrogen drum.

5. The low-temperature storage device as claimed in any one of claims 1 to 4, wherein

the at least two active doors of each top plate are arranged in a row along
5 a straight line at spaced intervals;

each container frame has a traction structure disposed on a top of the container frame;

each extracting machine arm has a linear rail disposed at a top of the connection room and located directly above the at least two active doors;

10 a railcar is disposed on the linear rail and selectively moved along the linear rail directly above the active doors, respectively; and

a lifting clamper is disposed on the railcar to configure with the traction structure of each container frame.

15 6. The low-temperature storage device as claimed in claim 5, wherein each container has a surface and an identification tag disposed on the surface of the container; and

a tag reader is disposed in the carrying chamber of the body to read and identify the identification tag of each container.

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7. The low-temperature storage device as claimed in claim 6, wherein the body has a relay carrying room disposed in and communicating with the carrying chamber abs the object taking port;

a relay door is disposed between the relay carrying room and the carrying

chamber;

the relay carrying room has a side corresponding to the object taking port
and a pick-up door formed through the side of the relay carrying room;

an air cleaner is disposed around a top of the carrying chamber; and

5 a blower is disposed in the carrying chamber and has an end connected to
the relay carrying room by pipeline.

8. The low-temperature storage device as claimed in claim 7, wherein

the biological product storage room has a product environment sensor
10 disposed in the biological product storage room;

the body has a controller electrically connected to the product
environment sensor, the picking machine arm, the extracting machine arm, and
the liquid he nitrogen supply device; and

the controller has a gate control module electrically connected and
15 controlling each of the active doors, the relay door, and the pick-up door.

9. The low-temperature storage device as claimed in claim 8, wherein

the controller has a controller connection module;

the low-temperature storage device has a console, and the console has
20 a console connection module wired connected to the controller
connection module of the controller; and

an input/output interface controlled the motions of the picking
machine arm and the extracting machine arm by wired connected.