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**INTELLIGENT STORAGE CABINET FOR STANDARD SAMPLES, AND METHOD OF ACCESSING SAMPLES**

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## Abstract

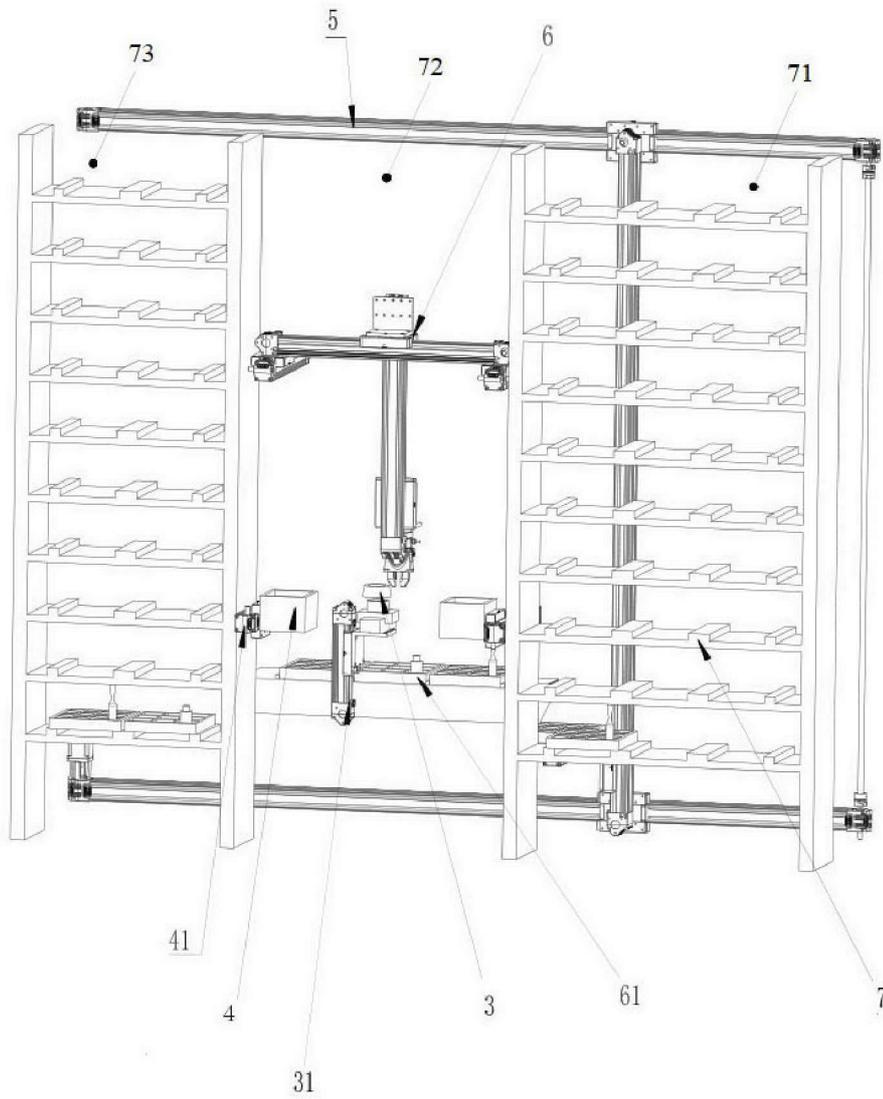
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The present invention provides an intelligent storage cabinet for standard samples, comprising: a temporary storage area, a storage area, a movable mechanical arm, a sample taking-out opening and a sample storage opening, wherein the temporary storage area includes an accessing mechanical arm and a temporary storage box: during storage of a standard sample, the accessing mechanical arm grabs a standard sample bottle, which is put in through the sample storage opening, to the temporary storage box, and then the movable mechanical arm puts the temporary storage box onto a storage rack in the storage area as a sample box; during taking-out of a standard sample, the movable mechanical arm moves the sample box from the storage rack in the storage area to a position under the accessing mechanical arm, and the accessing mechanical arm grabs the corresponding standard sample bottle in the sample box and takes it to the sample taking-out opening so as to move the corresponding standard sample bottle out of the intelligent storage cabinet for standard samples. The intelligent storage cabinet for standard samples has a small size, a compact and simple structure, a nice looking, separate access and large storage capacity, and thus can realize intelligent storage of standard samples, traceable management of information and effective improvement of work efficiency.

# Abstract

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# INTELLIGENT STORAGE CABINET FOR STANDARD SAMPLES, AND METHOD OF ACCESSING SAMPLES

## Technical Field

The present invention relates to the technical field of intelligent logistics manufacturing, in particular relates to an intelligent storage cabinet for standard samples, as well as a method of accessing samples by using the afore-mentioned intelligent storage cabinet for standard samples.

## Background

At present, many problems exist in the management of laboratory standard samples, such as multiple standard sample types, various standard sample packaging specifications including plastic, glass, glass ampoules, etc., and small packaging sizes and so on, as a result, the management is difficult. As for storage, a room-temperature standard sample will be stored in an ordinary sample cabinet with a key, while a refrigerated sample will be stored in an ordinary refrigerator. Apparently, the storage space is small and fixed. Moreover, the standard samples are handed over by means of manual registration, so there are risks of human errors.

With an application number of CN201711444241.5, the application for patent discloses a full-automatic refrigerating storeroom based on erythrocyte refrigerating, comprising: a storeroom body, wherein a transportation mechanism is arranged at a storeroom door outside the storeroom body, the transportation mechanism comprising two double-layer and stepped movable belt lines arranged in a movable butt joint manner and two inner double-layer belt lines, the double-layer stepped movable belt lines being provided with recycle cases internally provided with multiple sets of sample boxes; the storeroom body is internally provided with a temporary storage area, a clamping area and a storage area, wherein the clamping area is provided with a stacking mechanical arm, the temporary storage area is provided with a temporary storage frame and a three-coordinate mechanical arm, and the storage area comprises multiple sets of intensive storage cabinets. Single blood boxes are densely stored, and any blood bag can be taken at will; the temporary storage area is arranged, a temporary storage goods shelf is arranged, and the waiting time within a batch is shortened by transferring of the recycle cases; the stacking mechanical arm is adopted for stacking the recycle cases in the temporary storage area; and the three-coordinate mechanical arm is adopted so as to realize precise transferring from the temporary storage area to the storage area.

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With an application number of CN202010948163.8, the application for patent discloses a biological sample refrigerating storage system, comprising: a controller, a refrigerating storeroom, multiple storage racks, a carrying assembly, a sorting device and at least one refrigeration system; the afore-mentioned invention solves the following problems such as that the sample storage effect is poor in the prior art because the whole boxes are taken out when a storage system is used for storing and taking out samples, and that the sample storeroom and samples are prone to frost due to frequent opening of a door when the samples are put in or taken out, as well as the high energy consumption of the storage apparatus; meanwhile, when the sample boxes are stored, sample test tubes in the boxes are stacked in order in advance, thereby facilitating unified management and next-time use.

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With an application number of CN201711424702.2, the application for patent discloses a multifunctional vending machine for sites such as malls, supermarkets, stations, airports, office buildings and drugstores, which can sell articles of daily use, box food, drugs or the like, provide convenient and rapid selling services for assembly occupancies, and replace artificial selling in large-scale supermarkets and small stores, thereby achieving full-automatic self-service. The multifunctional vending machine includes a storage area, a replenishment area, a delivery area, an ordering area, a heating area and so on. The storage area includes a freezing area, a refrigeration area and a room temperature area. The vending machine includes at least one replenishment opening, at least one delivery opening, at least one ordering area and at least one heating area; a merchant places goods in the vending machine through the replenishment area, a mechanical arm automatically places the goods in a specified area, customers select the goods through the ordering areas, and then the mechanical arm automatically takes out the goods and places the goods in the delivery area.

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All of the above-mentioned prior arts are greatly different from the present invention, and cannot solve the technical problem we intend to solve. Therefore, we are now providing a novel intelligent storage cabinet for standard samples.

### **Summary of the Invention**

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The object of the present invention is to provide an intelligent storage cabinet for standard samples, wherein the storage cabinet has separate access and large storage capacity, and thus can realize intelligent storage of standard samples, traceable management of information and effective improvement of work efficiency.

The object of the present invention can be realized by means of the technical measure below: an intelligent storage cabinet for standard samples, comprising: a temporary storage area, a storage area, a movable mechanical arm, a sample taking-out opening and a sample storage opening, wherein the temporary storage area includes an accessing mechanical arm and a temporary storage box: during storage of a standard sample, the accessing mechanical arm grabs a standard sample bottle, which is put in through the sample storage opening, to the temporary storage box, and then the movable mechanical arm puts the temporary storage box onto a storage rack in the storage area as a sample box; during taking-out of a standard sample, the movable mechanical arm moves the sample box from the storage rack in the storage area to a position under the accessing mechanical arm, and the accessing mechanical arm grabs the corresponding standard sample bottle in the sample box and takes it to the sample taking-out opening so as to move the corresponding standard sample bottle out of the intelligent storage cabinet for standard samples.

The object of the present invention can also be realized by means of the technical measures below.

The storage area comprises a refrigerating storage area and a room-temperature storage area, wherein the refrigerating storage area and the room-temperature storage area are respectively located on both sides of the temporary storage area, and the movable mechanical arm puts the sample box into a corresponding storage area according to the storage requirement of the sample during storage of a standard sample.

The intelligent storage cabinet for standard samples further comprises a sample storage movable module, wherein the sample storage movable module is connected to the sample storage opening, and moves the standard sample bottle in the sample storage opening to a position under the accessing mechanical arm during storage of a standard sample.

The intelligent storage cabinet for standard samples further comprises a sample taking-out movable module, wherein the sample taking-out movable module is connected to the sample taking-out opening, and moves the sample taking-out opening out of the intelligent storage cabinet for standard samples during taking-out of a standard sample.

The movable mechanical arm is a triaxial movable module, comprising two sets of translating modules, a set of lifting module and a set of stretchable module provided on a frame of a cabinet body of the intelligent storage cabinet for standard samples, wherein both ends of

the stretchable module are respectively fixed to sliders of the two sets of translating modules, a stretchable pallet for lifting the sample box is connected to the stretchable module, and the two sets of translating modules are connected by a connecting shaft and a shaft coupling, thereby realizing simultaneous translation as one piece.

5 The accessing mechanical arm is a triaxial movable module provided with a flexible gripping jaw for compatibly grabbing standard sample bottles of different sizes.

The intelligent storage cabinet for standard samples further comprises multiple motors, which are respectively connected to a movable module so as to respectively power each of movable modules.

0 The intelligent storage cabinet for standard samples further comprises a touch screen, which is connected to a control center, so that a user can access the standard sample, as well as verify and obtain standard sample information.

The intelligent storage cabinet for standard samples further comprises a scanner, with which a user can scan a two-dimensional code of a standard sample bottle during storage  
5 thereof so as to obtain information of the standard sample and upload the information to the control center, and can scan the two-dimensional code of the standard sample bottle that is taken out during taking-out of the standard sample so as to obtain information of the standard sample and upload the information to the control center for confirmation of the standard sample bottle.

20 The accessing mechanical arms comprises two parallel accessing movable modules, on which a horizontal movable module is provided, wherein the horizontal movable module translates back and forth along the accessing movable modules, and is provided with a vertical movable module which moves leftward and rightward along the horizontal movable module, the vertical movable module being provided with a flexible gripping jaw configured to grab the  
25 standard sample bottle.

The intelligent storage cabinet for standard samples further comprises a controller, wherein the controller controls connection of a computer to the touch screen, and controls wireless or wired connection of the computer to the control center, the touch screen being provided on the cabinet body of the intelligent storage cabinet for standard samples.

30 The intelligent storage cabinet for standard samples further comprises a scanner for

scanning standard sample bottles, the scanner being connected to the controller.

The accessing mechanical arms comprises two parallel accessing movable modules, on which a horizontal movable module is provided, wherein the horizontal movable module translates back and forth along the accessing movable modules, and is provided with a vertical movable module which moves leftward and rightward along the horizontal movable module, the vertical movable module being provided with a flexible gripping jaw configured to grab the standard sample bottle.

The intelligent storage cabinet for standard samples further comprises a controller, wherein the controller controls connection of a computer to the touch screen, and controls wireless or wired connection of the computer to the control center, the touch screen being provided on the cabinet body of the intelligent storage cabinet for standard samples.

The controller adopted in the present invention is a common controller which is commercially available.

A method of accessing a sample by using the intelligent storage cabinet for standard samples, including:

during storage of a standard sample, a user scans a two-dimensional code on a standard sample bottle by using a scanner, so as to obtain information of the standard sample and upload the information to a control center, and puts the standard sample bottle into a sample storage opening, a sample storage movable module moves the standard sample bottle to a position under an accessing mechanical arm, which moves a flexible gripping jaw to grab the standard sample bottle and puts it into a temporary storage box; and then the sample storage movable module moves back to the sample storage opening so that the user can store next standard sample bottle, thereby realizing rapid storage and shortening waiting time; in an idle state or when the temporary storage box is full, the movable mechanical arm lifts the temporary box so as to store it on a sample storage rack in a corresponding storage area, and takes an empty standard sample box to the temporary storage area for later use; and

during taking-out of a standard sample, a user applies for one or more needed standard samples via an LIMS system, wherein the LIMS system delivers a task to a standard sample intelligent management system with approval so that the management system mobilizes the movable mechanical arm to the corresponding storage area, thereby lifting the corresponding

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5 standard sample box to a position under the accessing mechanical arm, which moves the flexible gripping jaw to grab the corresponding standard sample bottle and put it into the sample taking-out opening; when one or more needed standard samples are put into the sample taking-out opening, the sample taking-out movable module moves the sample taking-out opening out, so that the user can take the standard sample bottle out and make confirmation by using the scanner.

0 As described in the present invention, the intelligent storage cabinet for standard samples comprises a cabinet body, wherein a touch screen is provided on an upper part of the cabinet, a sample storage opening and two sample taking-out openings are provided outside the cabinet body, and a temporary storage area, a room-temperature storage area and a refrigerating storage area are provided inside the cabinet body, so the intelligent storage cabinet for standard samples is capable of compatibly storing standard sample bottles of various specifications. The intelligent storage cabinet for standard samples has a small size, a compact and simple structure, a nice looking, separate access and large storage capacity, and thus can realize intelligent storage of standard samples, traceable management of information and effective improvement of work efficiency.

### 5 Description of Drawings

Fig. 1 is a structure diagram of the interior of the intelligent storage cabinet for standard samples of the present invention;

20 Fig. 2 is a structure diagram of the exterior of the present invention;

Fig. 3 is a structure diagram of the movable mechanical arm of the present invention;

Fig. 4 is a distribution diagram of the internal areas of the present invention.

### Embodiments

25 Figs. 1 and 2 show structure diagrams of the intelligent storage cabinet for standard samples of the present invention. The intelligent storage cabinet for standard samples comprises a cabinet body 1, inside which a temporary storage area 72, a room-temperature storage area 71, a refrigerating storage area 73 and a movable mechanical arm 5 are provided. Inside the cabinet body, standard sample boxes of various specifications can be stored, and standard sample bottles of various specifications can also be compatibly stored. The standard sample boxes are  
30 of the same overall size, but have different number of storage cells inside, such as 4×5 cells,

3×3 cells and so on.

The movable mechanical arm 5 is used for movement and accessing of standard sample boxes in different storage areas. The temporary storage area 72 is provided with an accessing mechanical arm 6 and a temporary storage box 61.

The accessing mechanical arms comprises two parallel accessing movable modules 63, on which a horizontal movable module 64 is provided, wherein the horizontal movable module 64 translates back and forth along the accessing movable modules, and is provided with a vertical movable module 65 which moves leftward and rightward along the horizontal movable module 64, the vertical movable module 65 being provided with a flexible gripping jaw 62 configured to grab the standard sample bottle.

The intelligent storage cabinet for standard samples further comprises a controller, wherein the controller controls connection of a computer to the touch screen 2, and controls wireless or wired connection of the computer to the control center, the touch screen being provided on the cabinet body of the intelligent storage cabinet for standard samples.

The intelligent storage cabinet for standard samples further comprises a scanner for scanning standard sample bottles, the scanner being connected to the controller.

A sample storage opening 3 and two sample taking-out openings 4 are provided outside the cabinet body, wherein the sample storage opening 3 is connected to the sample storage movable module 31, and the sample taking-out openings 4 are connected to the sample taking-out movable module 41. The accessing mechanical arm 6 is in cooperation with the sample storage movable module 31 and the sample taking-out movable module 41, so as to rapidly store or take out a standard sample. The sample taking-out openings are not designated for standard sample bottles from the refrigerating or room-temperature area, and are chosen according to the sample taking-out tasks by the user. The sample taking-out openings are located at both sides of the sample storage opening, and are located, together with the sample storage opening, at a lower position right in front of the user for the convenience of the user's sample accessing.

The refrigerating storage area is provided with an auto-door, wherein the movable mechanical arm 5 automatically opens and closes the door during accessing of the standard sample box.

The refrigerating storage area 73 and the room-temperature storage area 71 are respectively

provided with multiple layers of sample storage racks 7, and thus are capable of compatibly storing standard sample boxes of various specifications.

As shown in Fig. 3, the movable mechanical arm 5 is a triaxial movable module, comprising two sets of translating modules 51, a set of lifting module 52 and a set of stretchable module 53 provided on a frame, wherein both ends of the stretchable module 53 are respectively fixed to sliders of the two sets of translating modules 51, a stretchable pallet 54 for lifting the sample box is connected to the stretchable module 53, and the two sets of translating modules 51 are connected by a connecting shaft 55 and a shaft coupling 56, thereby realizing simultaneous translation as one piece.

A first motor 57 is connected to a horizontal module of the movable mechanical arm 5, so as to power horizontal movement of the movable mechanical arm 5.

Each of the movable modules is provided with a corresponding motor for powering.

As shown in Fig. 4, the accessing mechanical arm 6 is a triaxial movable module, which has the same structure as the triaxial movable module of the movable mechanical arm 5, and the accessing mechanical arm 6 is provided with a flexible gripping jaw 62 for compatibly grabbing standard sample bottles of different sizes to multiple positions in the temporary storage box 61.

A sample storage movable module 31 is provided under the sample storage opening 3 so as to move the standard sample bottle to a position under the accessing mechanical arm 6, and a sample taking-out movable module 41 is provided under the sample taking-out opening 4.

A touch screen is provided at an upper part of a cabinet body 1, and is connected to a management system, so that a user can access the standard samples, as well as verify and obtain standard sample information.

During storage of a standard sample, a user scans a two-dimensional code on a standard sample bottle by using a scanner, so as to obtain information of the standard sample and upload the information to a control center, and puts the standard sample bottle into a sample storage opening 3, a sample storage movable module 31 moves the standard sample bottle to a position under an accessing mechanical arm 6, which moves a flexible gripping jaw 62 to grab the standard sample bottle and puts it into a temporary storage box 61; and then the sample storage movable module 31 moves back to the sample storage opening 3 so that the user can store next standard sample bottle, thereby realizing rapid storage and shortening waiting time; in an idle

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5 state or when the temporary storage box 61 is full, the movable mechanical arm 5 lifts the temporary box 61 so as to store it on a sample storage rack 7 in a corresponding storage area, and takes an empty standard sample box to the temporary storage area for later use. The standard sample box is put at the temporary storage area as a temporary storage box, and is moved onto a storage rack in the room-temperature area or in the refrigeration area as a formal standard sample box for sample storage after it is full. 2-3 temporary boxes can be provided in the temporary storage area, and only one can be provided when the space is limited.

0 During taking-out of a standard sample, a user applies for one or more needed standard samples via an LIMS system, wherein the LIMS system delivers a task to a standard sample intelligent management system with approval so that the management system mobilizes the movable mechanical arm 5 to the corresponding storage area, thereby lifting the corresponding standard sample box to a position under the accessing mechanical arm 6, which moves the flexible gripping jaw 62 to grab the corresponding standard sample bottle and put it into the sample taking-out opening 4; when one or more needed standard samples are put into the  
5 sample taking-out opening 4, the sample taking-out movable module 41 moves the sample taking-out opening out, so that the user can take the standard sample bottle out and make confirmation by using the scanner.

0 A standard sample will be stored in the standard sample box on the storage rack in the room-temperature area or in the refrigeration area in the cabinet according to its storage requirements. The sample is taken away by the user standing outside the cabinet and waiting for the intelligent storage cabinet to automatically send the sample according to demands. The user needs to apply first, and the control center will send instructions to the intelligent cabinet after the application is approved. The movable mechanical arm 5 in the cabinet is controlled by the intelligent cabinet to take out the standard sample box, in which the sample is stored, on the  
25 storage rack in the corresponding area (the room-temperature or refrigeration area), and then the accessing mechanical arm 6 takes the sample to the sample taking-out opening and sends it out so that it can be taken away manually.

## Claims

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1. An intelligent storage cabinet for standard samples, comprising: a temporary storage area, a storage area, a movable mechanical arm, a sample taking-out opening and a sample storage opening, wherein the temporary storage area includes an accessing mechanical arm and a temporary storage box: during storage of a standard sample, the accessing mechanical arm grabs a standard sample bottle, which is put in through the sample storage opening, to the temporary storage box, and then the movable mechanical arm puts the temporary storage box onto a storage rack in the storage area as a sample box; during taking-out of a standard sample, the movable mechanical arm moves the sample box from the storage rack in the storage area to a position under the accessing mechanical arm, and the accessing mechanical arm grabs the corresponding standard sample bottle in the sample box and takes it to the sample taking-out opening so as to move the corresponding standard sample bottle out of the intelligent storage cabinet for standard samples.

2. The intelligent storage cabinet for standard samples according to claim 1, wherein the storage area comprises a refrigerating storage area and a room-temperature storage area, wherein the refrigerating storage area and the room-temperature storage area are respectively located on both sides of the temporary storage area, and the movable mechanical arm puts the sample box into a corresponding storage area according to the storage requirement of the sample during storage of a standard sample.

3. The intelligent storage cabinet for standard samples according to claim 1, further comprising a sample storage movable module, wherein the sample storage movable module is connected to the sample storage opening, and moves the standard sample bottle in the sample storage opening to a position under the accessing mechanical arm during storage of a standard sample.

4. The intelligent storage cabinet for standard samples according to claim 1, further comprising a sample taking-out movable module, wherein the sample taking-out movable module is connected to the sample taking-out opening, and moves the sample taking-out opening out of the intelligent storage cabinet for standard samples during taking-out of a standard sample.

5. The intelligent storage cabinet for standard samples according to claim 1, wherein the

movable mechanical arm is a triaxial movable module, comprising two sets of translating modules, a set of lifting module and a set of stretchable module provided on a frame of a cabinet body of the intelligent storage cabinet for standard samples, wherein both ends of the stretchable module are respectively fixed to sliders of the two sets of translating modules, a stretchable pallet for lifting the sample box is connected to the stretchable module, and the two sets of translating modules are connected by a connecting shaft and a shaft coupling, thereby realizing simultaneous translation as one piece.

6. The intelligent storage cabinet for standard samples according to claim 5, wherein the accessing mechanical arm is a triaxial movable module provided with a flexible gripping jaw for compatibly grabbing standard sample bottles of different sizes.

7. The intelligent storage cabinet for standard samples according to claim 6, further comprising multiple motors, which are respectively connected to a movable module so as to respectively power each of movable modules.

8. The intelligent storage cabinet for standard samples according to claim 1, further comprising a touch screen, which is connected to a control center, so that a user can access the standard sample, as well as verify and obtain standard sample information.

9. The intelligent storage cabinet for standard samples according to claim 1, further comprising a scanner, with which a user can scan a two-dimensional code of a standard sample bottle during storage thereof so as to obtain information of the standard sample and upload the information to the control center, and can scan the two-dimensional code of the standard sample bottle that is taken out during taking-out of the standard sample so as to obtain information of the standard sample and upload the information to the control center for confirmation of the standard sample bottle.

10. A method of accessing a sample by using the intelligent storage cabinet for standard samples according to any one of claims 1 to 9, including:

during storage of a standard sample, a user scans a two-dimensional code on a standard sample bottle by using a scanner, so as to obtain information of the standard sample and upload the information to a control center, and puts the standard sample bottle into a sample storage opening, a sample storage movable module moves the standard sample bottle to a position under an accessing mechanical arm, which moves a flexible gripping jaw to grab the standard

sample bottle and puts it into a temporary storage box; and then the sample storage movable module moves back to the sample storage opening so that the user can store next standard sample bottle, thereby realizing rapid storage and shortening waiting time; in an idle state or when the temporary storage box is full, the movable mechanical arm lifts the temporary box 61 so as to store it on a sample storage rack in a corresponding storage area, and takes an empty standard sample box to the temporary storage area for later use; and

during taking-out of a standard sample, a user applies for one or more needed standard samples via an LIMS system, wherein the LIMS system delivers a task to a standard sample intelligent management system with approval so that the management system mobilizes the movable mechanical arm to the corresponding storage area, thereby lifting the corresponding standard sample box to a position under the accessing mechanical arm, which moves the flexible gripping jaw to grab the corresponding standard sample bottle and put it into the sample taking-out opening; when one or more needed standard samples are put into the sample taking-out opening, the sample taking-out movable module moves the sample taking-out opening out, so that the user can take the standard sample bottle out and make confirmation by using the scanner.

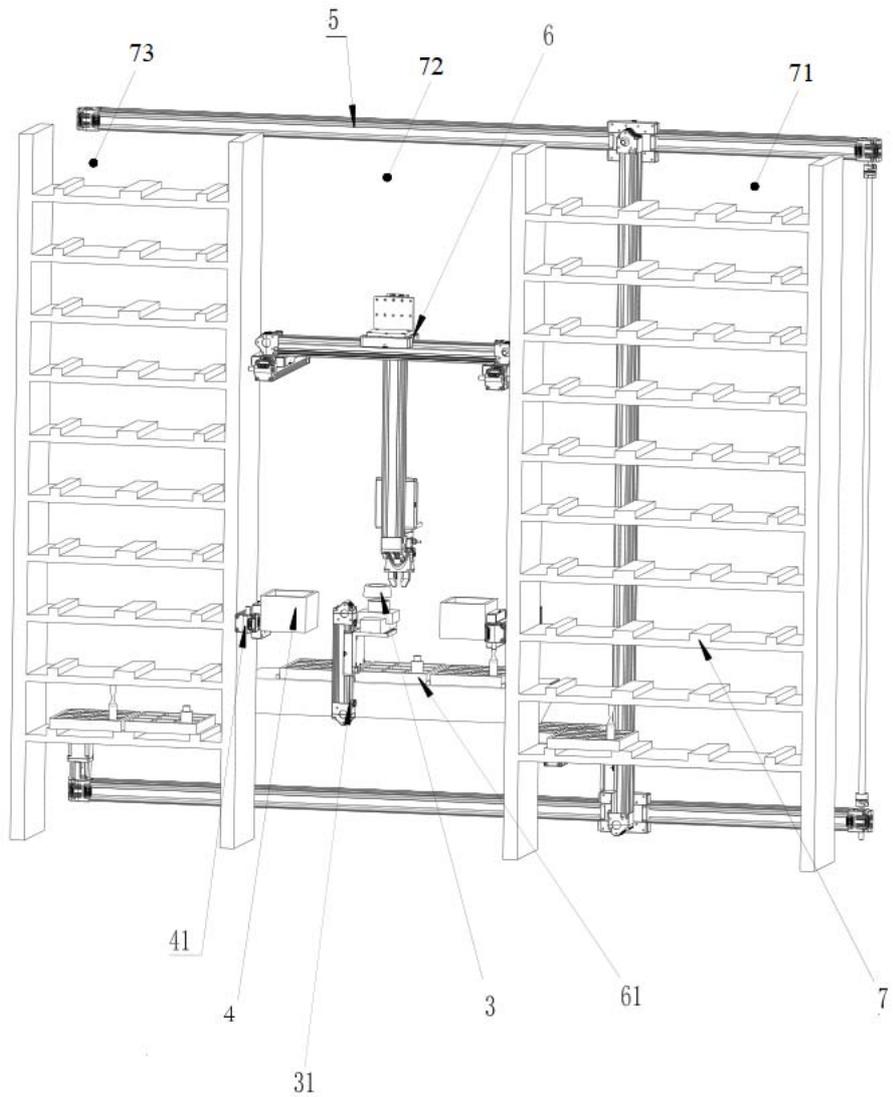


Fig. 1

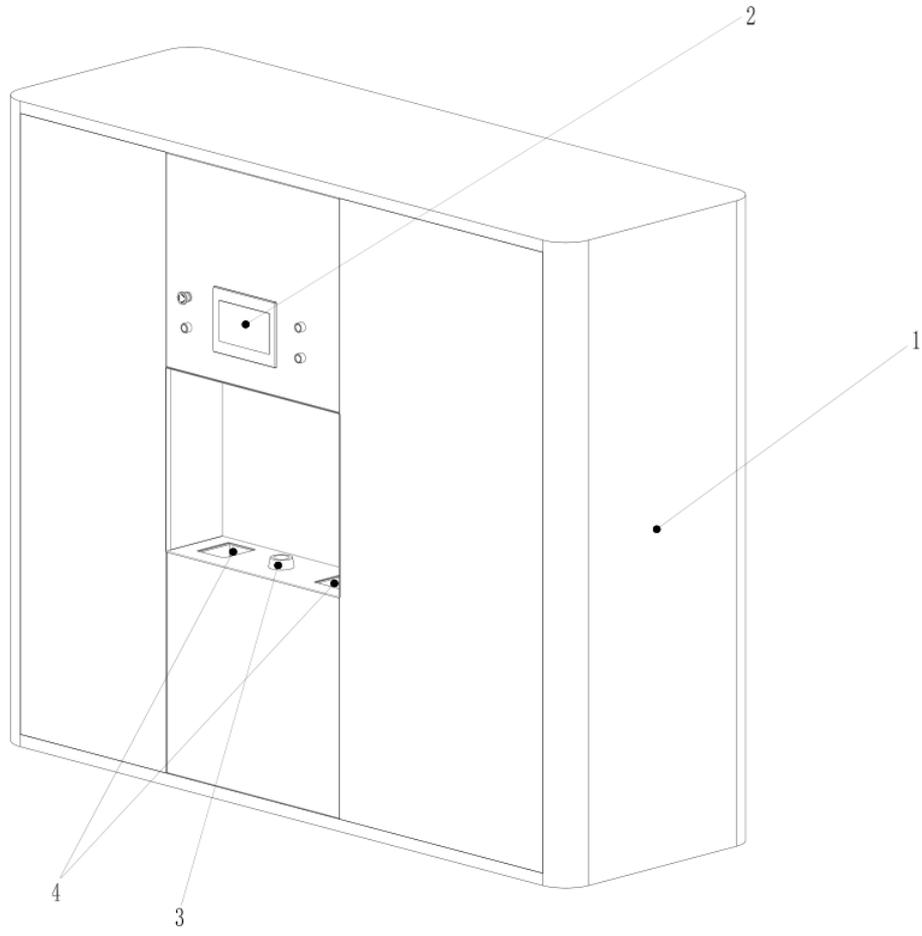


Fig. 2

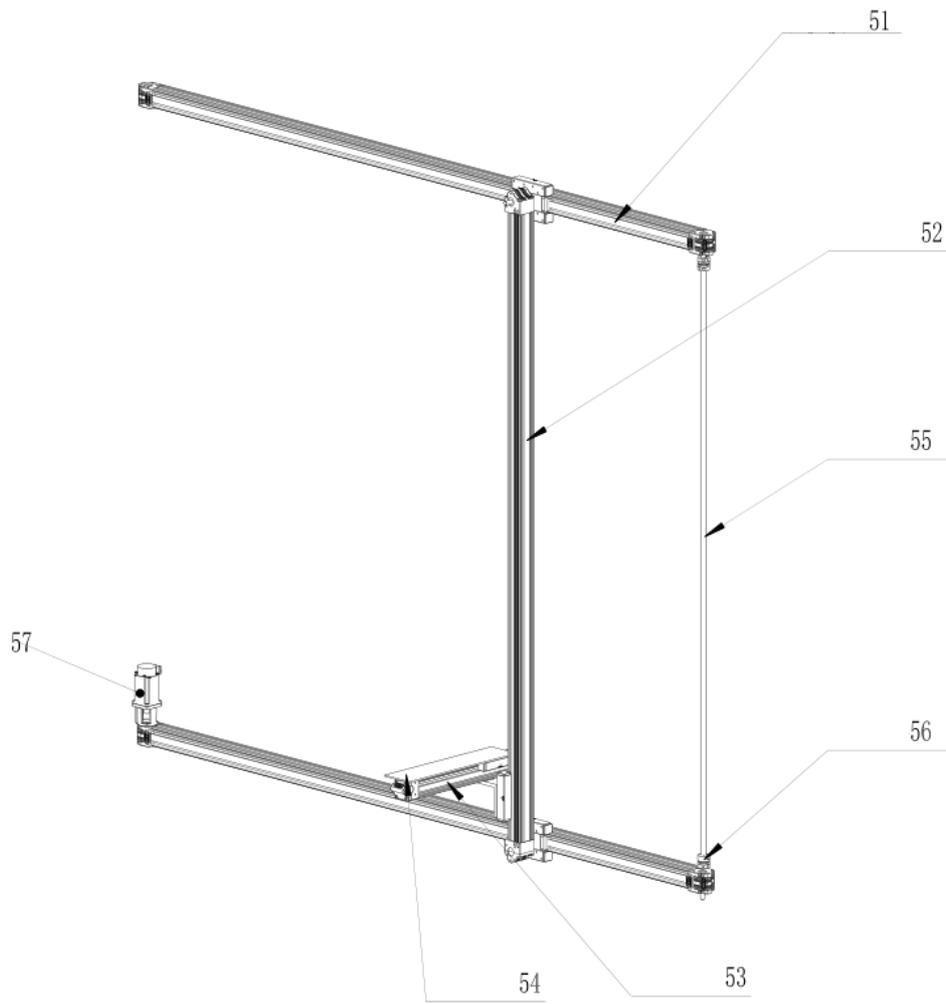


Fig. 3

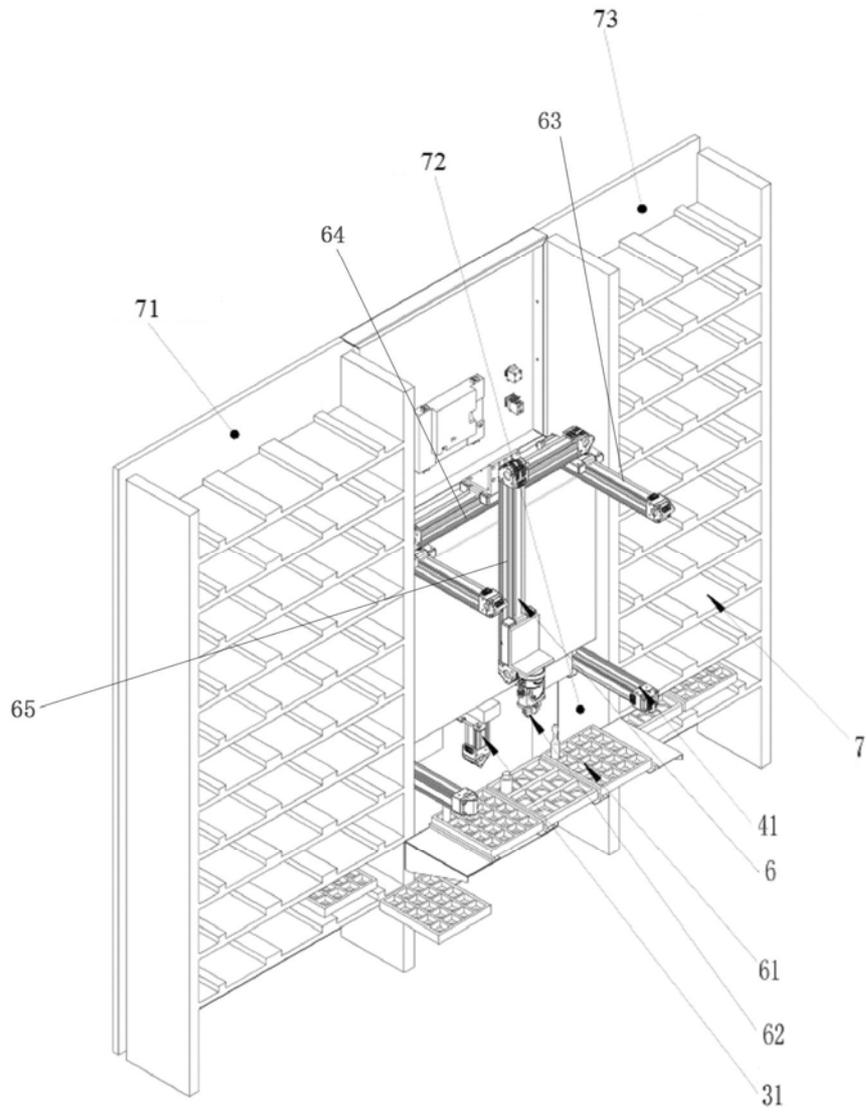


Fig. 4