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ABSTRACT

The invention relates to a device for storing elements, each element comprising a first wireless communication unit, the device comprising at least two drawer blocks each comprising:

- a drawer comprising a bottom defining at least one slot for receiving an element,
- for each slot, at least one second wireless communication unit comprising an antenna having a radiation field, each antenna comprising a first state in which said antenna is activated and a second state in which said antenna is deactivated,
- a data processing unit able to command the activation and deactivation of the antenna of each second communication unit according to a control law.

Figure 1

20172360049 02 Oct 2017

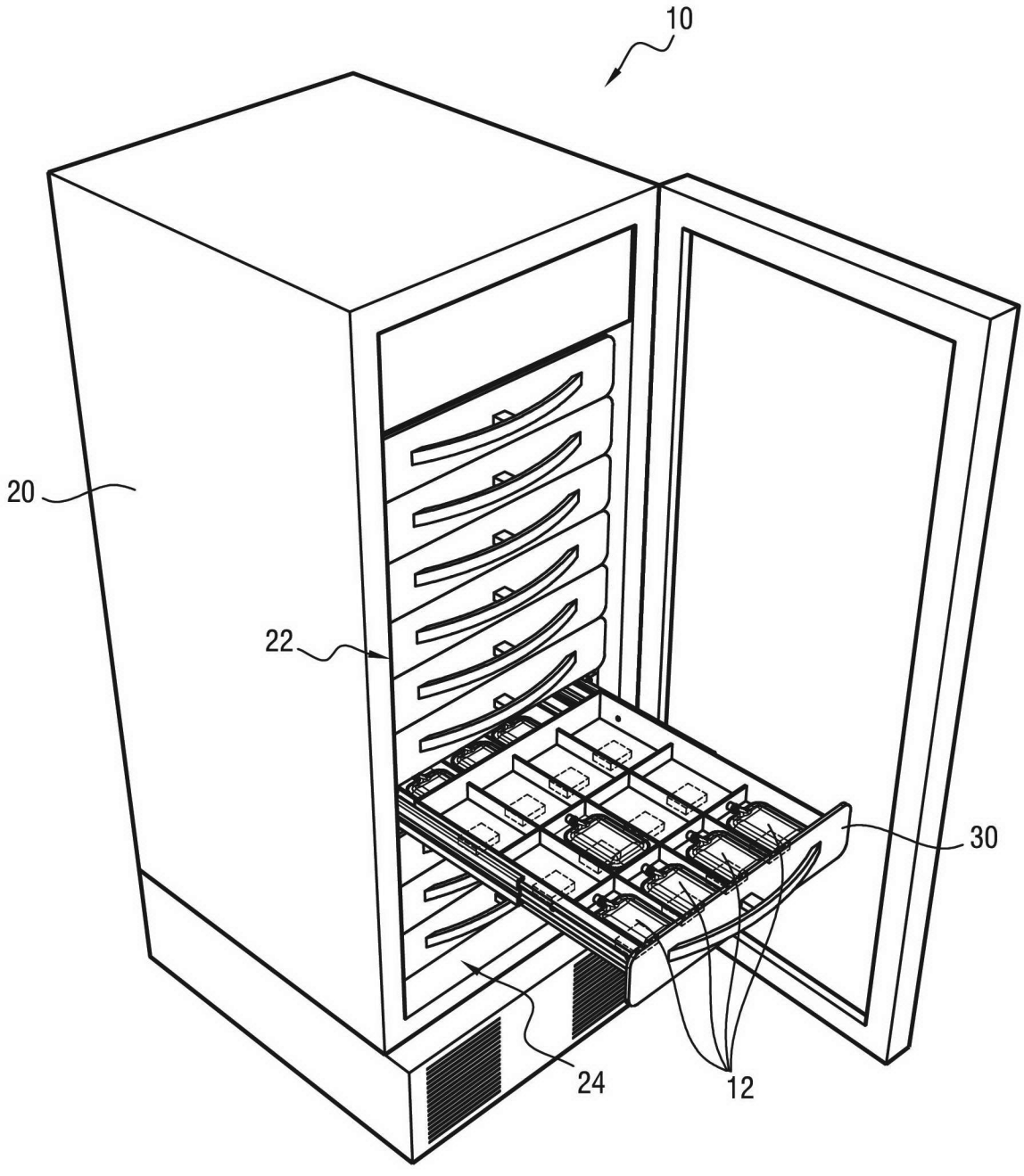

FIG.1

20 Apr 2022
2017236049

A device for storing elements

FIELD OF THE INVENTION

The present invention relates to a device for storing elements.

The present invention also relates to an installation comprising such a device for storing.

BACKGROUND OF THE INVENTION

There already exists devices for storing elements in various fields. The elements are for example bags containing biological products such as blood products (bags of primary blood, of plasma, of platelets, of red blood cells, etc.) or cellular engineering products (cells, stem cells, etc.), or further drug bags such as chemotherapy bags.

It is known to store such bags in refrigerating structures made up of drawers in which the bags are inserted. The bags inserted into such structures generally comprise an identification tag, such as an RFID (radio frequency identification) tag, in which in which are stored in memory pieces of information relative to the corresponding bag. Furthermore, a reader, such as an RFID reader comprising at least one antenna, is arranged across from the provided location of the bags of each drawer in order to read and update the information contained in the tags of said bags.

However, interference may occur between the waves emitted by the antenna of each RFID reader, which makes it difficult to read information stored on the identification tags, and therefore to check the state of the corresponding elements.

SUMMARY OF THE INVENTION

There is a need for a device for storing elements making it possible to check the state of said elements reliably.

Alternatively or additionally, there is a need to at least provide the public with a useful choice.

A first aspect of the present invention relates to a device for storing elements, each element comprising a first wireless communication unit in which information relative to said element is stored, the device comprising at least two drawer blocks assembled on one another to form a vertical stack, each drawer block comprising:

- a support comprising a housing,
- a drawer positioned in the housing of the support and able to slide relatively to the support, the drawer comprising a bottom defining at least one slot for receiving an element,

20 Apr 2022 2017236049

- for each slot, at least one second wireless communication unit able to emit radio waves, each second communication unit being arranged across from the corresponding slot, each second communication unit being suitable for communicating with the set of first communication units, each second communication unit comprising at least one antenna having a radiation field, the radiation field of each antenna covering at least:
    - the slot across from the second communication unit of said antenna, and
    - at least one slot adjacent to said slot across from the second communication unit of said antenna,

  each antenna further comprising a first state in which said antenna is activated and a second state in which said antenna is deactivated,

- a data processing unit connected to each second communication unit, the processing unit being able to command the activation and deactivation of the antenna of each second communication unit according to a control law to determine whether the slot across from the second communication unit of said antenna is occupied by an element and, if applicable, the information relative to said element.

According to specific embodiments, the device comprises one or several of the following features, taken individually or according to all the technically possible combinations:

- each second communication unit corresponding to a slot, the control law is chosen so as to command, in parallel, the activation of the antenna of said second communication unit and the deactivation of the antenna(s) adjacent to said antenna, such that the antenna of each second communication unit is activated at time intervals different from the time intervals of the antennas adjacent to said antenna;

- the processing unit is able to determine the slot to which the information collected by each antenna corresponds based on information communicated by the set of antennas;

- the bottom of each drawer is made from a material able to be traversed by radio waves emitted by the second communication units;

- each second communication unit is arranged above the corresponding slot;

- each second communication unit is arranged below the bottom of the drawer of the corresponding slot;

- each drawer block comprises a plate positioned below the bottom of the drawer of each drawer block and below the second communications units corresponding to the slots at the bottom of the drawer of said drawer block, each plate being able to prevent the passage of radio waves emitted by all of the second communication units;

20 Apr 2022 2017236049

- each first communication unit is a radio identification tag and each second communication unit is a radio identification reader.

A further aspect of the present invention relates to an installation, comprising:

- an enclosure comprising an inner compartment, and
- a device according to the first aspect of the present invention, the device being positioned in the inner compartment of the enclosure.

According to specific embodiments, the installation comprises one or more of the following features, considered alone or according to any technically possible combinations:

- the elements being platelet containers, the enclosure being a platelet agitator.

In the description in this specification, reference may be made to subject matter which is not within the scope of the appended claims. That subject matter should be readily identifiable by a person skilled in the art and may assist in putting into practice the invention as defined in the presently appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Other features and advantages of the invention will become apparent upon reading the description which follows of embodiments of the invention, given only as a non-limiting example and with reference to the drawings which are:

- figure 1, a schematic perspective illustration of an installation comprising a device for storing,
- figure 2, a schematic perspective illustration of the device for storing of figure 1,
- figure 3, a schematic illustration of several drawer blocks of the device for storing of figure 1, and
- figure 4, a schematic illustration of an element intended to be stored in the device of figure 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An installation 10 for storing elements 12 is illustrated in figure 1.

The elements 12 are for example containers (visible in figure 2). Generally, a container refers to any type of bag intended to contain products whose use is conditioned by strict storage constraints.

More particularly, the elements 12 are for example bags containing biological products such as blood products (primary blood cells bags, plasma bags, platelet bags, red blood cells bags…) or cell engineering products (human or animal cells, notably human or animal stem cells, products deriving from human or animal cells).

Alternatively, the elements 12 are drug bags or therapeutic preparation bags containing one or several active ingredients or drugs, such as chemotherapy bags generally containing a solute and one or several active ingredients for chemotherapy.

More generally, the elements 12 are able to contain any product intended to be infused into a human or into an animal.

As visible in figure 4, each element 12 comprises a first wireless communication unit 14. Each first communication unit 14 is for example a tag, such as an adhesive tag affixed on an outer face of the element 12.

In general, each first communication unit 14 comprises at least one antenna, a memory and, optionally, a microprocessor.

The antenna of each first communication unit 14 is for example a radiofrequency antenna.

The memory of each first communication unit 14 comprises pieces of information relative to the corresponding element 12.

Such pieces of information are for example: a unique identifier of the element 12, the storage date of the element 12, the expiry date of the element 12, the date at which the first communication unit 14 of the element 12 has communicated pieces of information for the last time, the donation number relative to the contents of the element 12, the product code of the content of the element 12, the Rhesus group of the content of the element 12, the blood phenotype of the content of the element 12, the identity of the patient from which stems the content of the element 12, the name of the patient from which stems the content of the element 12, the volume of the content of the element 12, the donation center (including the address) where the content of the element 12 has been obtained, the current process on the element 12 and the anticoagulant type of the content of the element 12. In the case of chemotherapy, such pieces of information further comprise the manufacturing date, the product type, the carrier type, the identity of the prescribing physician, the identity of the pharmacist, the identity of the manufacturer, the release date and the status (released, delivered, etc.).

The installation 10 comprises an enclosure 20 and a device for storing 22.

The enclosure 20 comprises an inner compartment 24 for receiving the device for storing 22.

The enclosure 20 is for example a refrigerating enclosure or a freezer. When the refrigerating enclosure is a refrigerator, the temperature of the enclosure is comprised between 0 degrees Celsius (°C) and 5°, preferably equal to 4°. When the refrigerating enclosure is a freezer, the temperature of the enclosure is comprised between -35°C and -196°C, preferably equal to -40°C.

Alternatively, the enclosure 20 is a platelet agitator. The enclosure 20 is then preferably integrated into an incubator having a temperature preferably equal to 24°C.

Hereinafter, relative positions are defined with respect to a common usage direction of the enclosure 20 for which a bottom is defined, generally resting on the ground, and a top opposite the bottom. These relative positions are in particular shown by terms such as "below" or "above".

The device 22 comprises a plurality of drawer blocks 30 and a base 32. As visible in figure 2, the device 22 further comprises a processing unit 33.

As this will be described later on, the drawer blocks 30 are stacked on each other in order to form a vertical stack 38 of drawer blocks 30. Figures 1 to 3 illustrate an example of a stack of ten drawer blocks 30.

Each drawer block 30 comprises a support 40, a drawer 42 and at least one second communication unit 44, visible in figure 2.

The support 40 comprises a housing 45, an upper end 46, a lower end 48 (visible in figure 3) and connections 49 (visible in figure 2).

Each housing 45 is able to receive the corresponding drawer 42.

The upper end 46 of each drawer block 30, visible in figure 3, comprises at least one first assembling member 51. The first assembling members 51 are for example female assembling members.

The lower end 48 of each drawer block 30, visible in figure 3, comprises at least one second assembling member 52, complementary to the first assembling members 51. The second assembling members 52 are for example male assembling members.

In the example illustrated in figure 3, the first assembling members 51 are grooves and the second assembling members 52 are ribs complementary to the grooves.

Thus, each drawer block 30 is assembled to at least one other drawer block 30 of the stack 38 by the first assembling member(s) 51 of said drawer block 30 and/or by the second assembling member(s) 52 of said drawer block 30.

The connections 49 are for example electrical connections.

In the embodiment illustrated in figures 1 to 3, the connections 49 of each drawer block 30 are connected on the one hand to the second communication units 44 of said drawer block 30, and on the other hand to the second communication units 44 of the other drawer blocks 30. Furthermore, the connections 49 are connected to the processing unit 33.

Each drawer 42 is positioned in the housing 45 of the support 40. Each drawer 42 is able to slide relatively to the corresponding support 40.

20 Apr 2022 2017236049

Each drawer 42 comprises a bottom 56 defining at least one slot 58 for receiving an element 12.

The bottom 56 of each drawer 42 is made from a material able to be traversed by radioelectrical waves transmitted by the second communication unit 44 of the drawer block 30 of said drawer 42.

The material of the bottom 56 of each drawer 42 is for example plastic.

In the embodiment illustrated in figures 1 to 3, the bottom 56 of each drawer 42 defines twelve slots 58 for receiving elements 12.

Each slot 58 is for example delimited by edges 59 forming a locker 60..

In the embodiment illustrated in figures 1 to 3, each drawer block 30 comprises as many second communication units 44 as there are slots 58.

In the embodiment illustrated in figures 1 to 3, each second communication unit 44 is arranged below the bottom 56 of the drawer 42 facing the corresponding slot 58, so as to allow communication between said second communication unit 44 and the first communication unit 14 of an element 12 received in said slot 58.

By the expression “facing”, it is meant the fact that each second communication unit 44 is positioned facing the space delimited by the slot 58. Formulated otherwise, the projection of the slot 58 in the plane of the second communication unit 44 coincides with the second communication unit 44.

Alternatively, at least one second communication unit 44 is arranged above the corresponding slot 58.

Each second communication unit 44 is able to communicate, if applicable, with the first communication unit 14 of the element 12 received in said slot 58 to obtain pieces of information relative to the element 12.

Each second communication unit 44 is able to transmit radiofrequency waves. Each second communication unit 44 is adapted for communicating with the set of first communication units 14.

In an exemplary embodiment, the first communication units 14 are RFID tags and the second communication units 44 are RFID readers.

More generally, each second communication unit 44 comprises at least one antenna, a memory, and optionally, a microprocessor.

The radiation field of each antenna covers at least:

- the slot 58 across from the second communication unit 44 of said antenna, and
- at least one slot 58 adjacent to said slot 58 across from the second communication unit said antenna.

2017236049 20 Apr 2022

More specifically, the radiation field of each antenna covers the slots 58 near the antenna based on the intensity and form of the magnetic field of the antenna.

Each antenna further comprises two states: a first state in which said antenna is activated, and a second state in which the antenna is deactivated. An activated antenna is an antenna able to resonate with a predetermined impedance and a predetermined frequency. The predetermined impedance is for example equal to 50 ohms (Ω) and the predetermined frequency is for example equal to 13.56 Megahertz (MHz). Thus, the resonance frequency of an activated antenna is close to the working frequency of said antenna. A deactivated antenna is an antenna that is not capable of resonating at the predetermined frequency. The deactivation of an antenna is for example done by opening the loop of said antenna or detuning the antenna such that the impedance of said antenna at the resonance frequency has a real (or resistive) component much lower than the imaginary (or reactive) component of said antenna.

In the embodiment illustrated in figures 1 to 3, each second communication unit 44 is secured to the drawer 42 of the corresponding drawer block 30. More specifically, each second communication unit 44 is fastened below the bottom 56 of the drawer 42 of the corresponding slot 58.

In an alternative, each second communication unit 44 is secured to the support 40 of the corresponding drawer block 30. Each drawer block 30 further comprises a satellite. The satellite is a casing which contains the second communication unit 44. The satellite is fastened to the support 40 of said drawer block 30 directly under the drawer 42 of said drawer block 30. When the drawer 42 is closed, said second communication unit 44 is across from the corresponding slot 58 and is therefore, if applicable, capable of communicating with a first communication unit 14 positioned in the corresponding slot 58. When the drawer 42 is open, said second communication unit 44 is not moved with the drawer 42, and therefore is not capable of communicating with a first communication unit 14 positioned in the corresponding slot 58.

Optionally, each drawer block 30 also comprises a plate.

Each plate is able to prevent the passing of radioelectric waves transmitted by all the second communication units 44. Each plate is for example made from metal.

Each plate is positioned below the bottom 56 of the drawer 42 of each drawer block 30 and below the second communications units 44 corresponding to the slots 58 at the bottom 56 of the drawer 42 of said drawer block 30. Thus, each second communication unit 44 is able to communicate only with the first communication units 14 positioned above said second communication unit 44.

The base 32 is assembled with the lowest drawer block 30 of the stack 38 of drawer blocks 30. To that end, the base 32 comprises an upper end 62 comprising at least one third assembling member. Each third assembling member is identical to the first assembling members 51. The second assembling member(s) 52 of the last drawer block 30 of the stack 38 are assembled with the third assembling member(s) of the base 32, which makes it possible to close the stack 38.

The processing unit 33 is connected to each second communication unit 44.

The processing unit 33 is able to process the information from the second communication units 44. In particular, the data processing unit 33 is able to command the activation and deactivation of the antenna of each second communication unit 44 according to a control law to determine whether the slot across from the second communication unit 44 of said antenna is occupied by an element 12 and, if applicable, the information relative to said element 12.

More specifically, for each second communication unit 44 corresponding to a slot 58, the control law is chosen so as to command, in parallel, the activation of the antenna of said second communication unit 44 and the deactivation of the antenna(s) adjacent to or facing said antenna, or more generally near said antenna, such that the antenna of each second communication unit 44 is activated at time intervals different from the time intervals of the antennas adjacent to said antenna.

The control law is suitable for allowing each second communication unit 44 to communicate with any first communication unit 14 positioned in the corresponding slot 58, without interference with the waves emitted by the antennas of the second communication units 44 adjacent to said second communication unit 44. Thus, the antenna of each second communication unit 44 is activated and deactivated at time intervals established based on the second communication units 44 adjacent to said second communication unit 44.

The control law depends on the position of the antennas of each second communication unit 44 and the radiation field of said antennas.

For example, it is assumed that the radiation field of each antenna covers the slot 58 across from the antenna and the slots 58 adjacent (sideways, above, below and diagonally) to said slot 58. To ensure the interference of a given second communication unit 44 without interference, the controller commands the deactivation, for a defined duration, of the antennas of the second communication units 44 across from the slots adjacent to said second communication unit 44 and the activation of the antenna of said second communication unit 44. The same command is repeated at different time intervals for the other second communication units 44.

2017236049 20 Apr 2022

In another example, the controller commands the deactivation of the set of antennas and the activation, one by one, of each antenna at different time intervals.

In still another example, the controller commands the activation of only one antenna per drawer block 30 by choosing antennas that are not across from one another and the deactivation of all of the other antennas.

The processing unit 33 is further able to determine the slot to which the information collected by each antenna corresponds based on information communicated by the set of antennas.

Indeed, inasmuch as the radiation field of each antenna covers, aside from the slot 58 corresponding to said antenna, at least one other adjacent slot 58, the processing unit is configured to determine the origin of the information collected by each antenna.

For example, it is assumed that the antennas are arranged below the drawers 42 and that the radiation field of each antenna covers the slot 58 across from the antenna (therefore above the antenna) and the slot 58 adjacent to the antenna and situated in the drawer 42 at the bottom of the antenna (therefore below the antenna). The processing unit 33 is able to compare the information collected by the adjacent antennas and to thereby determine the information corresponding to the slot across from each antenna. In this example, let us assume that a first antenna across from a first slot 58 detects a first signal A and a second signal B and that a second adjacent antenna directly below the first antenna detects the second signal B and a third signal C. The processing unit 33 determines that the second signal B detected by each of the first and second antennas comes from a first communication unit 44 of an element 12 positioned in the first slot. The processing unit 33 further determines that the first signal A is coming from a first communication unit 44 of an element 12 positioned in the slot 58 adjacent to and directly above the first slot 58. The processing unit 33 also determines that the third signal C is coming from a first communication unit 44 of an element 12 positioned in the slot 58 adjacent to and directly below the first slot 58.

In general, the control law is chosen so that the processing unit 33 reliably determines the slot(s) 58 to which the information collected by each antenna corresponds.

As an optional addition, the processing unit 33 is able to account for the strength of the signal, called RSSI (return signal strength intensity), emanating from each antenna. In practice, the closer an antenna is to a first communication unit, the better the RSSI is, i.e., the RSSI is high. For example, for a RSSI from 0 to 7: "7" means that the antenna is as close as possible to the first communication unit and "0" means that the antenna is not detecting any signal.

20 Apr 2022 2017236049

For example, for a device 22 comprising six drawer blocks 30, five antennas and one first communication unit 14 positioned in the third drawer block 30, the RSSI could be {3, 6, 7, 2, 0}.

For example, to find the first communication unit 14, the processing unit 33 is able to consider that said first communication unit 14 is between the two antennas having the strongest RSSI. Alternatively, the processing unit 33 is able to determine said first communication unit 14 by performing weighted mean or k-mean calculations on the obtained RSSIs.

Lastly, the processing unit 33 is able to determine the occupation of each slot 58, and if applicable, from said information, a state of the element 12 positioned in said slot 58.

The determined states are for example two in number: a “valid” state and an “invalid” state. An element 12 is considered as "valid" when the pieces of information relative to the element 12 is compliant with specifications and is considered as "invalid" in the opposite case.

Thus, the processing unit 33 has an instantaneous image of the device for storing 22, namely which element 12 is in which slot 58 and the pieces of information relative to each of said elements 12. The processing unit 33 also comprises a history of the entry and exit dates of each element 12 relative to the device 22.

Optionally, the processing unit 33 is able to sequence, if applicable, the update, by the second communication units 44, of the pieces of information contained in the first communication units 14.

Optionally, the processing unit 33 is able to generate an alarm depending on the occupation of each slot 58 and, if applicable, the state of the element 12 corresponding to said slot 58. For example, if the processing unit 33 determines that a same slot 58 comprises more than one element 12, the processing unit 33 generates an alarm.

The operation of the device 22 integrated into the installation 10 will now be described.

The processing unit 33 commands the activation and deactivation of the antenna of each second communication unit 44 according to a control law. This allows the antenna of each second communication unit 44 to collect, if applicable, information relative to the elements 12 of the corresponding slots 58. The processing unit 33 determines, from said pieces of information, the slots 58 occupied by the elements 12, and if applicable, a state of the elements 12. Depending on the case, the processing unit 33 activates, or does not activate, an alarm.

Thus, the device 22 gives the possibility of reliably controlling the state of the elements 12 stored in the device 22, as well as the occupation level of the slots 58 of the drawer blocks 30.

In particular, the activation and deactivation of the antennas based on the control law makes it possible to reduce the interference between signals, which improves reading of the information stored on the first communication units 14.

Furthermore, the specific positioning of the readers below the corresponding drawer makes it possible to obtain a smaller bulk.

The device 22 is therefore a device for storing elements making it possible to check the status of elements 12 reliably without congesting the storage area.

Furthermore, it is easy to assemble and disassemble the drawer blocks 30 of the device 22. Such a modularity of the device 22 gives the possibility of adapting the device 22 to a large number of facilities 10, by modifying the number of drawer blocks 30 of the stack 38.

Furthermore, a stack of drawer blocks is much lighter and more compact than a plurality of drawers, and therefore easier to manipulate and install.

Additionally, from a production standpoint, thousands of identical drawer blocks 30 are manufactured, rather than tens of cabinets with different formats. This makes it possible to achieve economies of scale, simplify inventory management, and simplify maintenance.

Furthermore, the device 22 is adaptable to an installation 10 not already having RFID technology.

Additionally, the reduced bulk makes it possible to contemplate configurations in which the installation 10 contains a larger number of elements 12.

Moreover, the installation 10 and/or the device 22 are easy to manufacture.

Lastly, in the alternative according to which each drawer block 30 comprises a satellite, the satellite is in a single block and is therefore easy to replace in case of failure.

While various embodiments of the present invention have been described above, it should be understood that they have been presented by way of example only, and not by way of limitation. It will be apparent to a person skilled in the relevant art that various changes in form and detail can be made therein without departing from the spirit and scope of the invention. Thus, the present invention should not be limited by any of the above described exemplary embodiments.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group

of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken as an acknowledgment or admission or any form of suggestion that that prior publication (or information derived from it) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates.

CLAIMS

1.- A device for storing elements, each element comprising a first wireless communication unit in which information relative to said element is stored, the device comprising at least two drawer blocks assembled on one another to form a vertical stack, each drawer block comprising:

- a support comprising a housing,
- a drawer positioned in the housing of the support and able to slide relatively to the support, the drawer comprising a bottom defining at least one slot for receiving an element,
- for each slot, at least one second wireless communication unit able to emit radio waves, each second communication unit being arranged across from the corresponding slot, each second communication unit being suitable for communicating with the set of first communication units, each second communication unit comprising at least one antenna having a radiation field, the radiation field of each antenna covering at least:
    - the slot across from the second communication unit of said antenna, and
    - at least one slot adjacent to said slot across from the second communication unit of said antenna,

each antenna further comprising a first state in which said antenna is activated and a second state in which said antenna is deactivated,

- a data processing unit connected to each second communication unit, the processing unit being able to command the activation and deactivation of the antenna of each second communication unit according to a control law to determine whether the slot across from the second communication unit of said antenna is occupied by an element and, if applicable, the information relative to said element.

2.- The device according to claim 1, wherein, each second communication unit corresponding to a slot, the control law is chosen so as to command, in parallel, the activation of the antenna of said second communication unit and the deactivation of the antenna(s) adjacent to said antenna, such that the antenna of each second communication unit is activated at time intervals different from the time intervals of the antennas adjacent to said antenna.

3.- The device according to claim 2, wherein the processing unit is able to determine the slot to which the information collected by each antenna corresponds based on information communicated by the set of antennas.

4.- The device according to any one of claims 1 to 3, wherein the bottom of each drawer is made from a material able to be traversed by radio waves emitted by the second communication units.

5.- The device according to any one of claims 1 to 4, wherein each second communication unit is arranged above the corresponding slot.

6.- The device according to any one of claims 1 to 4, wherein each second communication unit is arranged below the bottom of the drawer of the corresponding slot.

7.- The device according to claim 6, wherein each drawer block comprises a plate positioned below the bottom of the drawer of each drawer block and below the second communication units corresponding to the slots at the bottom of the drawer of said drawer block, each plate being able to prevent the passage of radio waves emitted by all of the second communication units.

8.- The device according to any one of claims 1 to 7, wherein each first communication unit is a radio identification tag and each second communication unit is a radio identification reader.

9.- An installation, comprising:

- an enclosure comprising an inner compartment, and
- a device according to any one of claims 1 to 8, the device being positioned in the inner compartment of the enclosure.

10.- The installation according to claim 9, wherein the elements are platelet containers, the enclosure being a platelet agitator.

20172360049 02 Oct 2017

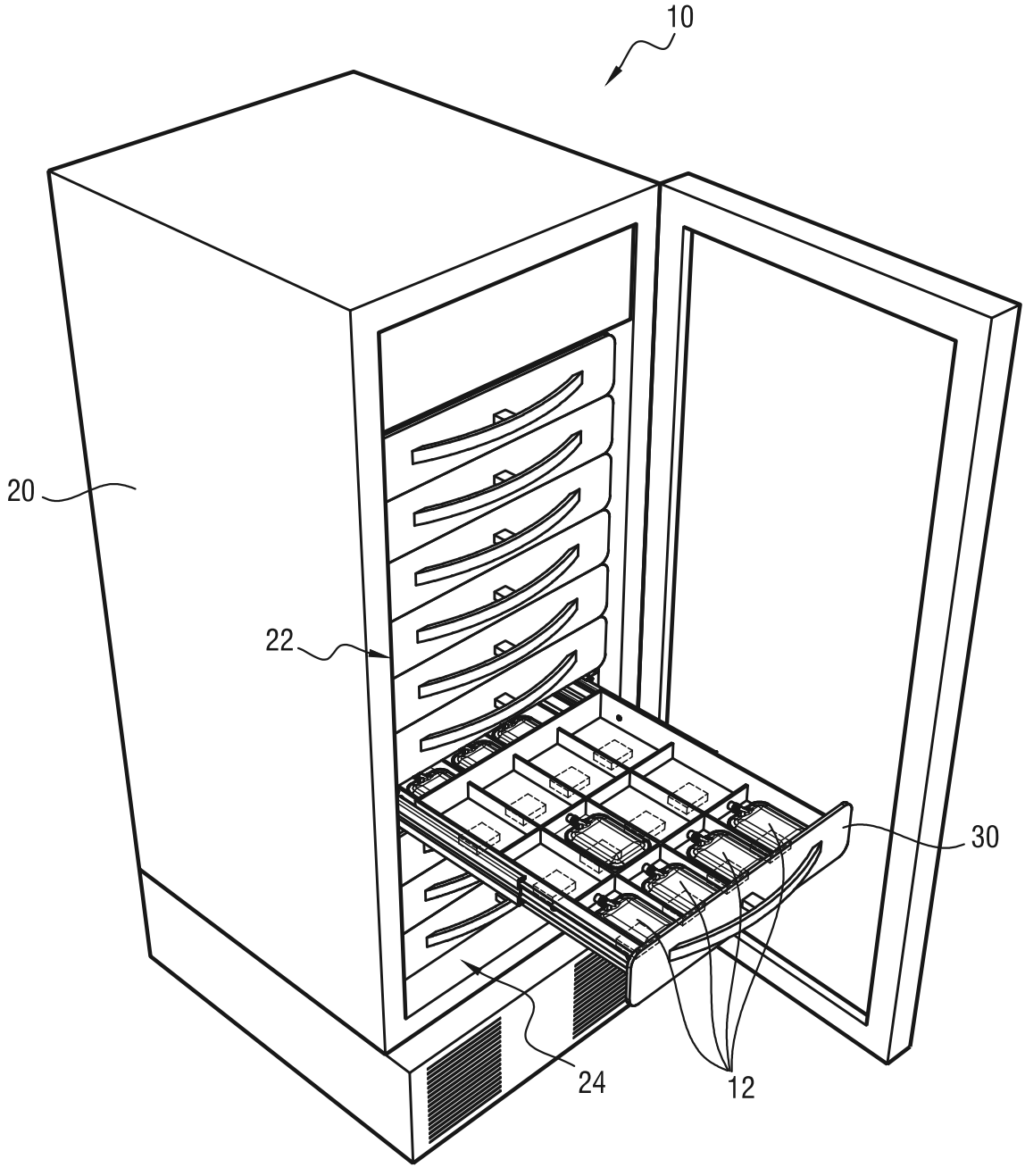

FIG.1

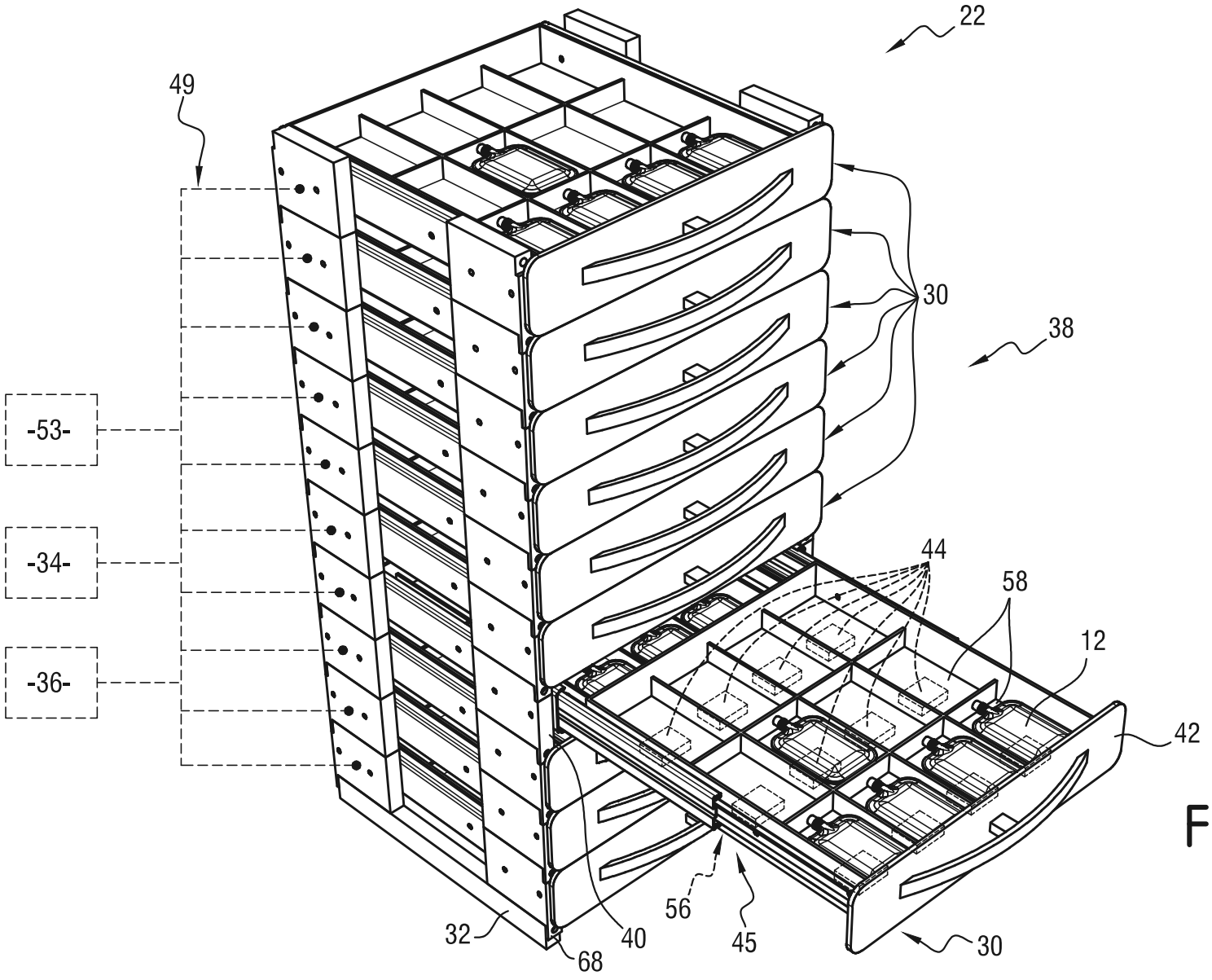

FIG.2

2017236049 02 Oct 2017

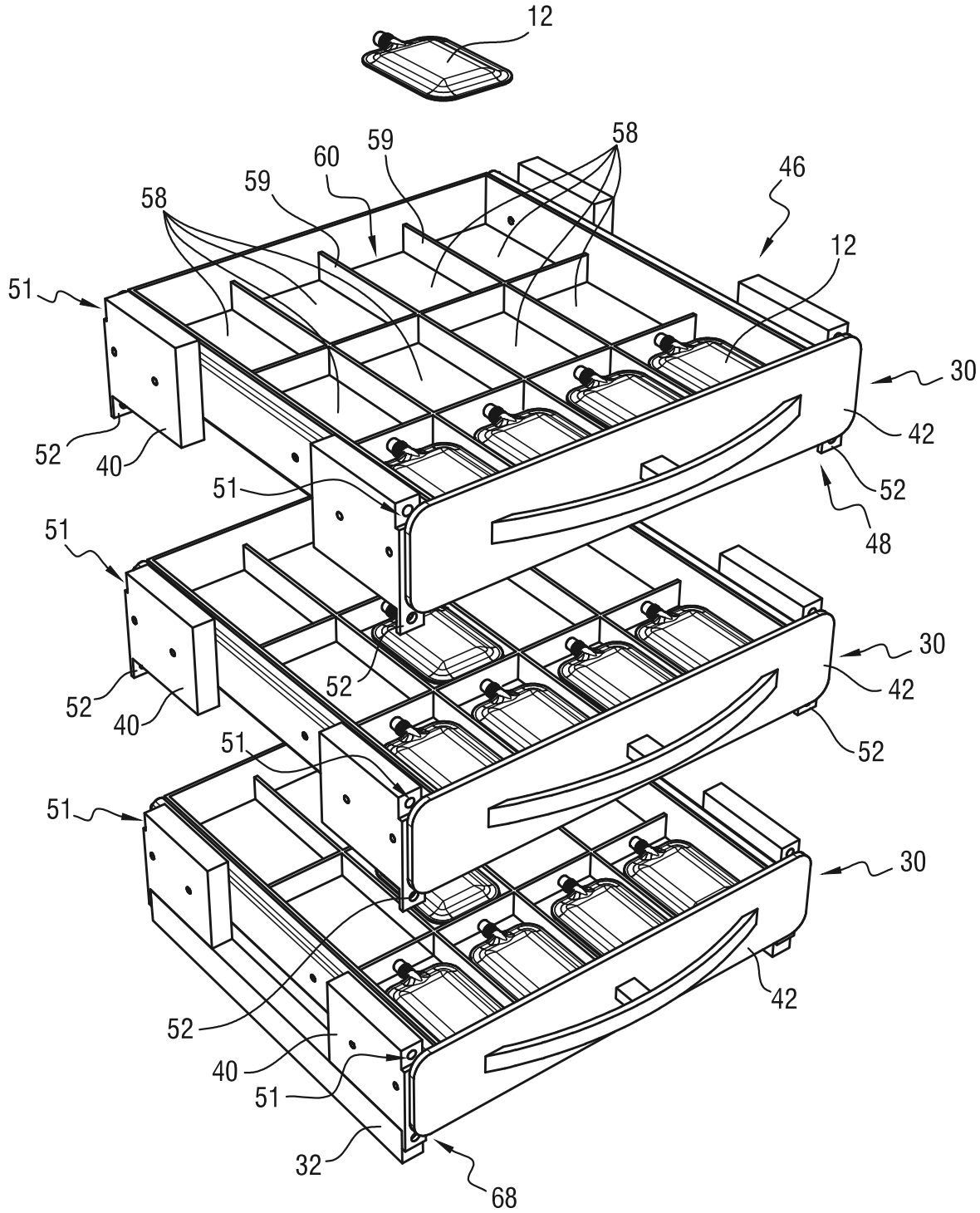

FIG.3

2017236049 02 Oct 2017

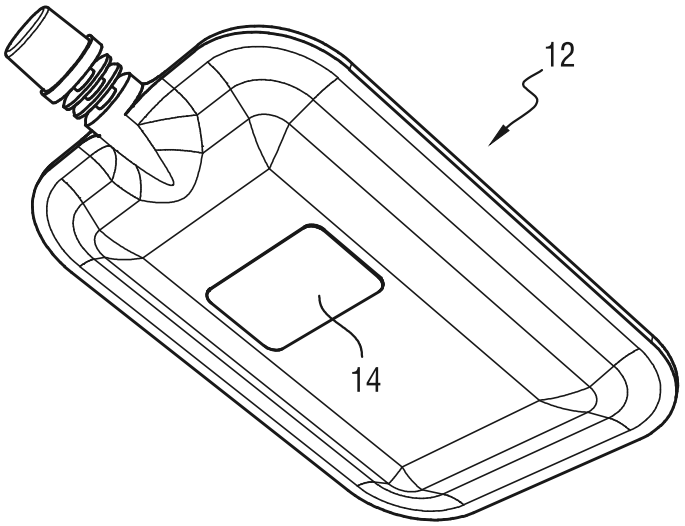

FIG.4