(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 254 371 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
04.10.2023 Bulletin 2023/40

(21) Application number: **23165740.4**

(22) Date of filing: **30.03.2023**

(51) International Patent Classification (IPC):
G07F 7/06 *(2006.01)* ***G07F 11/04*** *(2006.01)*
G07F 11/40 *(2006.01)* ***G07F 17/00*** *(2006.01)*
G07F 17/12 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
G07F 7/06; G07F 11/04; G07F 11/40; G07F 17/0014; G07F 17/12

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(30) Priority: **30.03.2022 IT 202200006275**

(71) Applicant: **Levico Acque S.B. S.r.l.**
38056 Levico Terme (TN) (IT)

(72) Inventors:
- **CHINI, Alberto**
  38122 Trento (TN) (IT)
- **FRANZONI, Mauro**
  25050 Provaglio d'Iseo (BS) (IT)
- **SCARAMUZZA, Andrea**
  36030 Costabissara (VI) (IT)
- **MAGLIONE, Alfredo**
  38123 Trento (TN) (IT)

(74) Representative: **Caldon, Giuliano et al**
Gallo & Partners S.r.l.
Via Rezzonico, 6
35131 Padova (IT)

(54) **AUTOMATED CABINET**

(57) Automated cabinet (1) for bottles (100), which comprises multiple compartments (2) adjacent to each other, each of which is provided with a box-like body (3), a door (6) and a detection system (7).

The box-like body (3) of each compartment (2) is frontally provided with an access opening (4) and therein defines a space (5) intended to house least one transportation case (101) designed to contain a series of bottles (100).

The door (6) of each compartment (2) is mounted on box-like body (3) and it is movable between an opening position, in which the door (6) frees the access opening (4) to allow a user to insert or remove the transportation case (101) of bottles (100), and a closing position, in which the door (6) occludes the access opening (4).

The detection system (7) of each compartment (2) is designed to detect the presence the bottles (100) in said transportation case (101) inserted into the space (5).

Furthermore, each detection system (7) comprises a series of optical sensors (8) arranged at the box-like body (3) of the respective compartment (2), each of the optical sensors (8) being provided with an optical axis (Z) passing through the space (5) in a corresponding positioning zone (A) of the space (5);

Furthermore, each compartment (2) comprises positioning means (9) associated with the box-like body (3) and designed to position a transportation case (101) in the space (5) with the bottles (100) in the transportation case (101) arranged in corresponding positioning zones (A) to intercept each of the optical axis (Z) which passes through the aforementioned corresponding positioning zone (A).

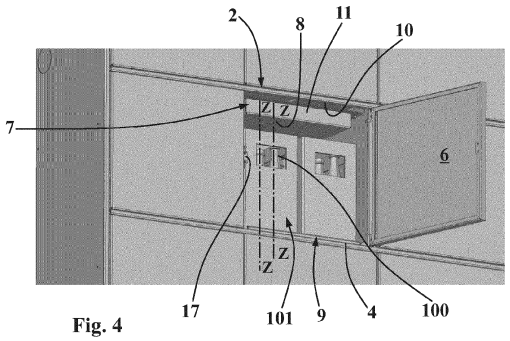

Fig. 4

EP 4 254 371 A1

Description

Field of the invention

[0001] The present invention relates to an automated cabinet, according to the preamble of the independent claim 1.

[0002] The automated cabinet in question is particularly useful in the organized large-scale distribution industry, since it can be used to recover returned empty bottles, in particular glass bottles adapted to contain foodstuffs (water, beverages, jam, tomato puree and the like), and possibly also to allow the collection of filled bottles by a customer after purchase.

[0003] For example, such automated cabinet is intended to be installed at commercial premises, such as supermarkets, so that customers can return the used empty bottles directly to the place where the bottles were previously purchased.

State of the art

[0004] In the organized large-scale distribution industry, it is known to install - at the supermarkets - automated cabinets for the recovery of used empty bottles. These automated cabinets allow to recover empty bottles, particularly glass bottles adapted to contain foodstuffs (water, beverages, jam, tomato puree and the like) so that they can then be returned to the manufacturer who sterilizes them, refills them with a new product and puts them back on the market, therefore preventing empty bottles from being treated simply as waste and significantly reducing the environmental impact thereof.

[0005] Particularly, patent CN 108257297 discloses an automated cabinet comprising multiple compartments adj acent to each other, each of which is provided with a box-like body, provided with an access opening and therein defining a space, and a door connected to the box-like body and which can be opened so as to allow a user to insert empty bottles into the space.

[0006] Each compartment of the automated cabinet further comprises a detection system, which is designed to detect the presence of empty bottles in the corresponding space following the closure of the door by a user.

[0007] In particular, the aforementioned detection system comprises a photo camera which captures an image of the interior of the space, after the user has inserted the empty bottles and closed the door.

[0008] Furthermore, such detection system is operatively connected to an electronic control unit designed to analyze the captured image so as to detect how many bottles have been inserted and to establish the type of bottles they belong to.

[0009] Furthermore, the electronic control unit is configured to calculate, based on the number of bottles returned and the type of bottles, an amount to be reimbursed to the user, in order to reward him/her for returning empty bottles and to encourage him/her to continue the habit of returning the empty bottles.

[0010] However, the automated cabinet of the prior art described briefly up to now, revealed - in application - some drawbacks too.

[0011] The main drawback lies in the fact that the detection system in each compartment is provided with a photo camera and, therefore, the automated cabinet is particularly expensive.

[0012] A further drawback lies in the fact that the photo camera of the detection system of each compartment is designed to capture an overall image of the interior of the corresponding space. The electronic control unit must therefore be provided with a high calculation power so as to able to analyze the captured image by means of complex algorithms so as to discriminate - thereon - the cluster of pixels referable to each of the inserted bottles with respect to the pixels representing the background, that is with respect to the pixels referable to the walls of the box-like body which delimit the space.

[0013] Furthermore, the electronic control unit has to analyze the pixel clusters in the image referable to each empty bottle identified, so as to establish the shape of the bottle and/or detect the presence of any logos, barcodes or reference signs made from fluorescent paints and, therefore, determine the type of empty bottles inserted by the user.

[0014] Furthermore, should the user insert empty bottles into the space in a disorderly manner, that is with bottles each arranged in a different orientation with respect to the photo camera and/or with bottles that are in contact with each other, the electronic control unit may not be able to distinguish pixel clusters referable to different empty bottles, to recognize the shape of the bottles and/or to identify their logos, barcodes and reference signs. The electronic control unit could therefore perform a calculation of the number of empty bottles that is incorrect or fail to determine the correct type of bottles inserted by the user and, as a result, it could calculate an incorrect amount to be returned to the user for the empty bottles returned.

Summary of the invention

[0015] Therefore, in this situation, the problem on which the present invention is based is to eliminate the problems of the prior art mentioned above, by providing an automated cabinet, that is simple and cost-effective to manufacture.

[0016] A further object of the present invention is to provide an automated cabinet, which is operatively entirely reliable.

[0017] A further object of the present invention is to provide an automated cabinet, which does not require a high calculation power so as to be able to identify the number of bottles inserted thereinto.

[0018] A further object of the present invention is to provide an automated cabinet, which does not require a high calculation power so as to be able to determine the

type of bottles inserted thereinto.

[0019] A further object of the present invention is to provide an automated cabinet, which does not require complex algorithms for analyzing the signal generated by the detection system so as to identify the inserted bottles.

[0020] A further object of the present invention is to provide an automated cabinet, which is quick to identify the bottles inserted thereinto.

Brief description of the drawings

[0021] The technical characteristics of the invention, according to the aforementioned objects, are clearly observable from the content of the claims outlined below and the advantages thereof will be more apparent from the detailed description that follows, provided with reference to the attached drawings, which represent an embodiment thereof provided purely by way of nonlimiting example, wherein:

- figure 1 shows a front perspective view of an automated cabinet according to the present invention, according to a preferred embodiment;
- figure 2 shows a front view of the automated cabinet of figure 1;
- figure 3 shows a front perspective view of the automated cabinet of figure 1, with a door of a compartment arranged in the opening position so as to allow to view transportation cases containing bottles inserted into a space of the aforementioned compartment;
- figure 4 shows a bottom front perspective view of the compartment of figure 3;
- figure 5 shows a top front perspective view of the compartment of figure 3;
- figure 6 shows a top front perspective view of the compartment of figure 3, from whose space there have been removed the transportation cases containing the bottles;
- figure 7 shows a top cross-sectional view of the compartments of the cabinet of figure 1 arranged along a side-by-side row;
- figure 8 shows a perspective view of a transportation case and bottles intended to be inserted into the space of the compartments of the automated cabinet of figure 1;
- figure 9 shows a perspective view of a detection system of a compartment of the automated cabinet of figure 1;
- figure 10 shows a bottom view of the detection system of figure 9.

Detailed description of a preferred embodiment

[0022] With reference to the attached figures, an automated cabinet for bottles 100 according to the present invention has been indicated in its entirety with 1.

[0023] In greater detail, the expression "bottles" hereinafter shall be used to indicate any reusable container, in particular made of glass and, for example, adapted to contain foodstuffs, such as glass bottles for water or other beverages, glass jars for jam or preserves, glass bottles for tomato puree or the like.

[0024] Advantageously, the automated cabinet 1 according to the invention can be particularly used in the organized large-scale distribution industry, since it can be used to recover returned empty bottles 100, in particular made of glass and adapted to contain foodstuffs as reported above.

[0025] Advantageously, the automated cabinet 1 in question can be installed in commercial premises, such as for example supermarkets, so that the customers can return the empty bottles 100 directly to the place where the bottles 100 had been purchased previously.

[0026] Furthermore, the automated cabinet 1 in question may also be used for the storage of filled bottles 100, that contain a certain product to be sold, so that the user can remove the filled bottles 100 that he/she has purchased, from the cabinet 1.

[0027] Therefore, the automated cabinet 1 can be advantageously used by customers or only for returning used empty bottles 100, or only for collecting - from the automated cabinet 1 - the filled bottles 100 just purchased, or for returning the used empty bottles 100 and collecting the filled bottles 100.

[0028] The automated cabinet 1 for bottles 100 according to the invention comprises multiple compartments 2 arranged adjacent to each other.

[0029] In greater detail, the compartments 2 are fixed.

[0030] Advantageously, the automated cabinet 1 according to the invention comprises a fixed support frame (for example intended to be placed on the ground) and the compartments 2 are rigidly fixed to the aforementioned support frame.

[0031] Particularly, such compartments 2 are distributed along substantially horizontal side-by-side rows W, the side-by-side rows W being arranged on top of each other.

[0032] For example, as shown in the attached figures 1 to 3, the automated cabinet 1 comprises sixteen compartments 2, which are distributed along four horizontal side-by-side rows W with four compartments 2 each.

[0033] Each compartment 2 comprises a box-like body 3, which is frontally provided with an access opening 4 and therein defines a space 5.

[0034] In greater detail, each space 5 is accessible, for example by a customer or an operator who works for the supermarket where the automated cabinet 1 is advantageously installed, through the access opening 4.

[0035] Furthermore, the space 5 defined by the box-like body 3 of each compartment 2 is designed to house at least one transportation case 101 designed to contain at least one series of bottles 100. In order to allow a user to easily transport the transportation case 101 with bottles 100 therein, the transportation case 101 advanta-

geously comprises at least one handle, in particular two handles, so that a user can grasp the transportation case 101 with both hands.

[0036] In greater detail, as shown in particular in figure 8, the transportation cases 101 which are intended to be housed in spaces 5 are advantageously of the type comprising a substantially rectangular-shaped terminal wall 102, a lateral delimitation wall 103, which extends protruding from the terminal wall 102 substantially orthogonally thereto and delimits, together with the terminal wall 102, a containment volume 104, and multiple partitioning septa 105 arranged in the containment volume 104 to define multiple containment seats 106 inside the aforementioned containment volume 104, each of the containment seats 106 being sized to contain a single corresponding bottle 100. In a per se conventional manner, such transportation cases 101 are advantageously designed to transport six bottles 100 and their containment seats 106, each intended to receive a single bottle 100, are preferably distributed in two rows by three arranged adjacent to each other.

[0037] Any handles are preferably obtained on the lateral delimitation wall 103, in particular by means of corresponding gripping openings, within each of which a user can insert his/her fingers to grasp the transportation case 101. Given that the terminal wall 102 is advantageously substantially rectangular-shaped, the lateral delimitation wall 103 is preferably provided with two minor sides, opposite to each other, and two major sides, in turn opposite to each other. Particularly, the handles may be obtained by means of gripping openings on the minor sides, or on the major sides, or both on the minor sides and on the major sides of the lateral delimitation wall 103.

[0038] Without departing from the scope of protection of the present invention, the space 5 of each compartment 2 may be designed to contain transportation cases 101 with conformation different from the one described above, for example, having a different number of containment seats 106 and/or having containment seats 106 distributed differently.

[0039] The box-like body 3 of each compartment 2 comprises an upper wall 10, preferably placed as upper delimitation of the corresponding space 5. Advantageously, such upper wall 10 is arranged substantially horizontally.

[0040] Furthermore, the box-like body 3 of each compartment 2 comprises a lower wall 15, which is preferably placed as lower delimitation of the corresponding space 5 and it is, particularly, opposite and parallel to the upper wall 10.

[0041] Advantageously, the lower wall 15 is in turn arranged substantially horizontally. Furthermore, the box-like body 3 of each compartment 2 comprises a side wall 18, which extends protruding from the lower wall 15 to the upper wall 10, on which side wall 18 the access opening 4 for the space 5 being obtained.

[0042] Advantageously, the side wall 18 extends preferably substantially vertically.

[0043] In greater detail, the lower wall 15 and the upper wall 10 of box-like body 3 of each compartment 2 are substantially quadrangular-shaped, particularly rectangular or square-shaped, and the side wall 18 delimits, together with the lower wall 15 and the upper wall 10, a substantially parallelepiped-shaped space 5.

[0044] Furthermore, each compartment 2 comprises a door 6 mounted on the corresponding box-like body 3 and movable between an opening position, in which the door 6 frees the access opening 4 to allow a user to insert or remove a transportation case 101 of bottles 100, and a closing position, in which the door 6 occludes the access opening 4.

[0045] In greater detail, the door 6 of each compartment 2 is hinged to the corresponding box-like body 3, particularly hinged to the side wall 18 of the corresponding box-like body 3 at the access opening 4.

[0046] Preferably, the door 6 is hinged on the side wall 18 around a transversal revolution axis to the upper wall 10 and the lower wall 15, whose revolution axis is particularly substantially vertical. Advantageously, the support frame of the automated cabinet 1 extends depthwise between two main faces (one front face and one rear face), which are arranged substantially vertical. Preferably, access openings 4 of box-like bodies 3 (and therefore in particular the doors 6) are arranged on the aforementioned front face of the support frame.

[0047] In particular, the compartments 2 are rigidly fixed to the aforementioned support frame with access openings 4 of their box-like bodies 3 arranged on the front face of the support frame. For example, the automated cabinet 1 may be arranged with the rear face against a masonry wall (or against the rear face of another automated cabinet 1) so that users can access the spaces 5 through access openings 4 which are arranged on the common front face.

[0048] Advantageously, each compartment 2 comprises an automatic lock 17, which is associated with the corresponding door 6 and it can be switched between a constraint configuration, in which the automatic lock 17 retains the corresponding door 6 in the closing position, and a release configuration, in which the automatic lock 17 releases the corresponding door 6 to allow it to move from the closing position to the opening position.

[0049] Furthermore, each compartment 2 comprises a detection system 7 designed to detect the presence the bottles 100 in the transportation case 101 inserted into the space 5.

[0050] According to the idea on which the present invention is based, the detection system 7 comprises a series of optical sensors 8 arranged at the box-like body 3 of the respective compartment 2, each of the optical sensors 8 being provided with an optical axis Z passing through the space 5 in a corresponding positioning zone A of the space 5

[0051] Advantageously, the optical sensors 8 are rigidly fixed to compartments 2 (fixed) and, in particular, they are rigidly constrained to the support frame of the

automated cabinet 1. In this manner, in particular, the optical sensors 8 always have a fixed position during the normal conditions of use of the automated cabinet 1.

[0052] Preferably, the optical sensors 8 are rigidly mounted on box-like body 3 of the corresponding compartments 2.

[0053] Furthermore, each compartment 2 comprises positioning means 9 associated with the boxlike body 3 and designed to position a transportation case 101 in the space 5 with the bottles 100 in the aforementioned transportation case 101 arranged in corresponding positioning zones A to intercept each of the optical axis Z which passes through the aforementioned corresponding positioning zone A.

[0054] In greater detail, the positioning zones A of space 5 are each to be advantageously intended as a volume within the space 5 extending around the optical axis Z of a corresponding optical sensor 8.

[0055] Therefore, the positioning zones A are preferably defined by the optical sensors 8 through their optical axes Z.

[0056] Advantageously, in order to prevent the positioning zones A defined and traversed by the optical axes Z of optical sensors 8 from being partially superimposed with each other, such optical axes Z are substantially parallel to each other.

[0057] Furthermore, advantageously, the expression "series of optical sensors" shall be intended a particular distribution of the optical sensors 8 which has its optical axes Z oriented so as to in turn define a particular distribution of positioning zones A within the space 5, where the particular distribution of positioning zones A within space 5 preferably depends on the particular type of transportation case 101 that is intended to be inserted into the spaces 5 of compartments 2 of the automated cabinet 1 in question and on how the bottles 100 can be distributed inside the aforementioned transportation case 101.

[0058] Advantageously, also the positioning means 9 are shaped as a function of the particular type of transportation case 101 that is intended to be inserted into the spaces 5 of the compartments 2 of the automated cabinet 1 in question.

[0059] Therefore, given that the series of optical sensors 8 advantageously have a distribution which depends on the particular type of transportation case 101 that is intended to be inserted into the spaces 5 and the positioning means 9 advantageously being shaped as a function of the particular type of transportation case 101 that is intended to be inserted into the spaces 5, the positioning means 9 are preferably shaped as a function of the series of optical sensors 8, and therefore, in particular, also as a function of the particular distribution of positioning zones A within space 5, and vice versa, the series of optical sensors 8 preferably has a distribution that depends on the positioning means 9.

[0060] In this manner, in use, when a transportation case 101 with bottles 100 is inserted in the space 5, the positioning means 9 advantageously keep each of the bottles 100 contained in transportation case 101 at a determined positioning zone A and, therefore, they allow the optical axis Z of each optical sensor 8 to intercept a corresponding bottle 100.

[0061] Therefore, advantageously, the series of optical sensors 8 and the positioning means 9 shaped as a function of the particular distribution of the aforementioned optical sensors 8 cooperate with each other so that each bottle 100 of a transportation case 101 inserted into the space 5 is arranged at a single positioning zone A within the space 5 which is defined and traversed by the optical axis Z of a corresponding single optical sensor 8.

[0062] In particular, the positioning means 9 associated with box-like body 3 are designed to position a transportation case 101 in the space 5 with the containment seats 106 of the aforementioned transportation case 101 each arranged at a determined positioning zone A, so that each bottle 100 contained in a corresponding containment seat 106 is arranged at a determined positioning zone A and it is intercepted by the optical axis Z of a corresponding single optical sensor 8.

[0063] In greater detail, the aforementioned detection system 7, which is provided with a series of optical sensors 8 each with optical axis Z passing through a corresponding positioning zone A of space 5, and the positioning means 9, which are designed to position a transportation case 101 with the bottles 100 arranged at each of a positioning zone A, allow the use of optical sensors 8 which are particularly simple and cost-effective, given that each sensor 8 is in use, will generate a signal containing information relating to a single bottle 100 and not containing information relating to multiple bottles 100 taken at the same time.

[0064] Furthermore, given that the positioning means 9 are configured so as to keep each bottle 100 of transportation case 101 in a corresponding positioning zone A, each bottle 100, in use, will always have substantially the same orientation with respect to the optical axis Z of the optical sensor 8 corresponding to the positioning zone A in which the bottle 100 is found. Therefore, the use of complex signal analysis algorithms of the detection system 7 will not be necessary to recognize bottles 100, given that the bottles 100 in transportation case 101 - always having the same orientation with respect to the optical sensors 8 - will always show to the corresponding optical sensor 8 the same surface with the same extent and shape and therefore it will be sufficient to analyze even only one parameter extracted from the signal generated by the detection system 7 to detect whether or not a bottle 100 is present in a predetermined positioning zone A. Furthermore, there will be no need of using complex algorithms for analyzing the signals generated by the detection system 7 not even to distinguish the information relating to different bottles 100, given that the signal generated by each optical sensor 8 of the detection system 7 contains information relating to a single corresponding bottle 100.

[0065] As a result, in particular, the above-mentioned configuration of the detection system 7 and the positioning means 9 on the one hand allows to use simple (and also cost-effective) optical sensors 8 and, on the other hand, there will be no need of using complex algorithms for analyzing the signals generated by the detection system 7, thus making the recognition of the bottles 100 particularly quick and reliable, in particular the recognition of the number of bottles 100 in the transportation case 101.

[0066] In order to make the automated cabinet 1 in question as spacious as possible while avoiding the creation of an excessive number of compartments 2, as illustrated for example in the attached figures, the detection system 7 of each compartment 2 advantageously comprises more than a series of optical sensors 8, the series of optical sensors 8 being arranged at the box-like body 3 of the respective compartment 2, and the positioning means 9 associated with box-like body 3 are designed to position more than one transportation case 101, the transportation cases 101 being intended to be arranged side by side in the corresponding space 5 with the bottles 100 contained therein which are arranged in corresponding positioning zones A.

[0067] In particular, the detection system 7 of each compartment 2 comprises a series of optical sensors 8 which is equal to the number of transportation cases 101 which the positioning means 9 are designed to hold in position within space 5.

[0068] For example, the detection system 7 of each compartment 2 comprises two series of optical sensors 8 and the positioning means 9 are designed to position two corresponding transportation cases 101 in the corresponding space 5.

[0069] Advantageously, the automated cabinet 1 in question comprises an electronic control unit, which is preferably operatively connected to the detection system 7 of each compartment 2.

[0070] Preferably, the electronic control unit is also operatively connected to the automatic lock 17 of each compartment 2 in order to selectively switch the above-mentioned automatic lock 17 between the constraint configuration and the release configuration, respectively so as to selectively retain the door 6 of each compartment 2 in the closing position and to allow such door 6 to pass from the closing position to the opening position.

[0071] Advantageously, the electronic control unit is configured to command the detection system 7 to monitor the space 5 of each compartment 2, in order to verify the presence or absence of objects in the space 5, that is in particular so as to verify the presence of bottles 100 contained in a transportation case 101 inserted inside the space 5.

[0072] Furthermore, the automated cabinet 1 in question, according to an embodiment not shown in the attached figures, advantageously comprises a control panel, which is preferably operatively connected to the electronic control unit.

[0073] In particular, through the above-mentioned control panel, a user may interact with the automated cabinet 1 in question in order to activate a procedure for returning the used empty bottles 100, that is in particular a procedure for returning at least one transportation case 101 containing empty bottles 100.

[0074] Possibly, through the above-mentioned control panel, a user may interact with the automated cabinet 1 in question to activate a procedure for collecting a transportation case 101 containing freshly purchased filled bottles 100, the transportation case 101 containing filled bottles 100 is in particular stored in the space 5 delimited by the box-like body 3 of a compartment 2 having its door 6 in the closing position and its automated lock 17 in the constraint configuration, so that the above-mentioned transportation case 101 cannot be removed from the space 5 by the user before the user has paid for the purchase thereof.

[0075] Possibly, through the above-mentioned control panel, a user may interact with the automated cabinet 1 in question in order to activate, at the same time, a procedure for returning the used empty bottles 100 and collecting a transportation case 101 containing filled bottles 100. Alternatively or additionally to the to the control panel, the automated cabinet 1 in question advantageously comprises a remote data communication module, for example Bluetooth, wi-fi, NFC or the like, which is designed to connect in data communication with a portable device of a user, such as for example a smartphone, and, preferably, to allow the user to interact with the automated cabinet 1 in question, in particular to activate a procedure for returning a transportation case 101 containing empty bottles 100 and/or a procedure for collecting a transportation case 101 containing filled bottles 100.

[0076] In use, for example in the case where the user has activated, through the control panel or the remote data communication module, a procedure for returning a transportation case 101 containing empty bottles 100, the electronic control unit switches - to the release configuration - the automatic lock 17 of a compartment 2 having its empty space 5, so as to allow the user to move the corresponding door 6 from the closing position to the opening position and insert - into the space 5 - a transportation case 101 with used bottles 100 therein, it switches the above-mentioned automatic lock 17 to the restraint configuration following the movement of the door 6 from the opening position to the closing position, and it commands the detection system 7 of the corresponding compartment 2 to monitor space 5 in order to verify the presence of a transportation case 101 and bottles 100 in the above-mentioned transportation case 101. Advantageously, the electronic control unit comprises a calculation module, which is preferably integrated in the electronic control unit by means of an appropriate functional software. Such calculation module is advantageously designed to calculate an amount to be refunded to a user as a function of the number of empty bottles 100 contained in transportation case 101 which was inserted into

the space 5 of one of the compartments 2, particularly during the procedure for returning the used empty bottles 100.

[0077] Furthermore, particularly, the electronic control unit is designed to refund the user with the above-mentioned amount calculated by its calculation module, for example by depositing a corresponding amount of money in an account whose details were previously provided by the user through the control panel or remote data communication module, by adding points to a (virtual or physical) loyalty card of the user or the like.

[0078] Furthermore, in use, for example in the case where the user has activated, through the control panel or the remote data communication module, a procedure for collecting a transportation case 101 containing filled bottles 100 just purchased, the electronic control unit switches - to the release configuration - the automatic lock 17 of a compartment 2 having its space 5 occupied by a transportation case 101 containing filled bottles 100, so as to allow the user to move the corresponding door 6 from the closing position to the opening position and remove - from the space 5 - the aforementioned transportation case 101, it switches - to the constraint configuration - such automatic lock 17 following the movement of the door 6 from the opening position to the closing position and, possibly, it commands the detection system 7 of the corresponding compartment 2 to monitor the space 5 so as to verify whether the transportation case 101 has been actually collected by the user.

[0079] Advantageously, the optical sensors 8 of each detection system 7 are positioned on a substantially horizontal lying plane arranged on one side of said boxlike body 3 and the optical axes Z of the optical sensors 8 are substantially orthogonal to the aforementioned lying plane. Therefore, given that the optical axes Z of optical sensors 8 are advantageously and substantially orthogonal to the substantially horizontal lying plane on which the optical sensors 8 are arranged, such optical axes Z are preferably arranged vertically.

[0080] Furthermore, in greater detail, the lying plane on which the optical sensors 8 of the detection system 7 of each compartment 2 are arranged is advantageously parallel to the upper wall 10 of the box-like body 3 of the corresponding compartment 2 and the optical axes Z are preferably orthogonal to such upper wall 10.

[0081] In addition, the lying plane on which the optical sensors 8 of the detection system 7 of each compartment 2 are arranged is advantageously parallel to the lower wall 15 of the box-like body 3 of the corresponding compartment 2, and - therefore - the optical axes Z are orthogonal to such lower wall 15.

[0082] Advantageously, the series of optical sensor 8 is organized according to a matrix M having at least two columns X and at least two rows Y, preferably two columns X and three rows Y, so that the above-mentioned series of optical sensors 8 has a distribution adapted to detect the bottles 100 contained in a conventional transportation case 101 having six containment seats 106, which are arranged in two rows - with three containment seats 106 each - arranged side by side.

[0083] Furthermore, according to a preferred embodiment shown in the attached figures, optical sensors 8 are advantageously arranged at the upper wall 10, more in detail mounted on such upper wall 10, and - furthermore - preferably facing downwards, namely in particular facing towards the lower wall 15.

[0084] Furthermore, the positioning means 9 are advantageously arranged at the lower wall 15.

[0085] In this manner, the optical axes Z of the optical sensors 8 advantageously intersect the lower wall 15 projecting - thereon - the positioning zones A, at the lower wall 15 there being arranged positioning means 9 designed to position at least one transportation case 101 with the bottles 100 arranged in such positioning zones A defined and traversed by the optical axes Z. Furthermore, in this manner, the optical sensors 8 advantageously arranged at the upper wall 10 and preferably facing downwards are designed to detect the top portion of bottles 100 contained in the transportation case 101, that is - in particular - to detect the neck of bottles 100.

[0086] Preferably, such positioning means 9 comprise at least one positioning seat 16 obtained on the lower wall 15 of the corresponding said box-like body 3 and intended to receive, substantially to size, the bottom of a transportation case 101.

[0087] In greater detail, the fact that each positioning seat 16 is intended to receive - substantially to size - the bottom of a transportation case 101 entails that potential movements of the transportation case 101 in the corresponding space 5 are limited as much as possible and, therefore, significantly reduced the risk of the transportation case 101 being inserted with an orientation not provided for in the space 5, that is for example with its containment seats 106 containing the bottles 100 arranged not precisely at a positioning zone A but partly superimposed with a positioning zone A and with another adjacent positioning zone A. Therefore, the positioning seats 16 advantageously reduce the risk that the transportation cases can be positioned in the spaces 5 with the bottles 100 therein which are not intersected by any optical axes Z or which are, on the contrary, intersected by multiple optical axes Z, for example by the optical axes Z of two optical sensors 8 of the detection system 7 adjacent to each other. Advantageously, the positioning seats 16 of the positioning means 9 of the various compartments 2 are substantially rectangular-shaped, so as to receive - therein - the substantially rectangular terminal wall 102 of a conventional transportation case 101. Furthermore, the positioning seat 16 of positioning means 9 can be advantageously obtained - depressed - on the lower wall 15 of the corresponding box-like body 3, for example obtained by drawing or bending the sheet metal on such lower wall 15 prior to assembly, it may be delimited by corresponding delimitation elements fixed to the aforementioned lower wall 15 and extending protruding from the latter or it may be delimited laterally by the side

wall 18 of the box-like body 3 which extends protruding from the lower wall 15, in the case where side wall 18 delimits a space 5 counter-shaped, along a plane parallel to the lower wall 15, with respect to the transportation case 101 intended to be inserted into the space 5.

[0088] In greater detail, the detection system 7 of each compartment 2 comprises two or more series of optical sensors 8 (each of which for example organized according to its matrix M having at least two columns X and at least two rows Y as described above) and the positioning means 9 of each compartment 2 in turn comprise two or more corresponding positioning seats 16, in particular adjacent to each other.

[0089] In this case, particularly, the aforementioned positioning means 9 preferably comprise at least one delimitation septum 19, which is interposed between two positioning seats 16 adjacent to each other.

[0090] In particular, such delimitation septum 19 may be obtained as a single body with the lower wall 15, in particular for example in cases where the positioning seats 16 are obtained - depressed - on the lower wall 15, or it can be fixed to the above-mentioned lower wall 15, for example by welding, gluing, connection with bolts or the like.

[0091] According to an embodiment not shown in the attached figures, the optical sensors 8 are advantageously arranged at the lower wall 15, in particular mounted on such lower wall 15, and - furthermore - they are preferably faced upwards, that is particularly faced towards the upper wall 10. In this case, the space 5 of each compartment 2 is intended to receive - therein - a transportation case 101 having multiple through openings obtained on the terminal wall 102, each of the through openings being obtained at a containment seat 106, so that the sensors 8 of the detection system 7 which are advantageously arranged at the lower wall 15 and preferably faced upwards can capture the bottom of the bottles 100 each contained in a respective containment seat 106.

[0092] According to the preferred embodiment, as shown in the attached figures 4, 9 and 10, the detection system 7 of each compartment 2 advantageously comprises at least one support structure 11 fixed to the upper wall 10 of the box-like body 3 of the corresponding compartment 2 and arranged inside the space 5, the support structure 11 at least partially delimiting a housing volume 12 and being provided with a bottom wall 13 on which multiple viewing openings 14 are obtained.

[0093] In greater detail, the optical sensors 8 of the aforementioned detection system 7 are arranged inside such housing volume 12 and they are positioned each aligned with a corresponding viewing opening 14, which is traversed by the optical axis Z of the corresponding optical sensor 8.

[0094] Advantageously, the bottom wall 13 of the support structure 11 is parallel to the upper wall 10 and, preferably, also to the lower wall 15.

[0095] Furthermore, in particular the detection system 7 of each compartment 2 comprises a printed circuit board 20, which is inserted into the housing volume 12 and it carries the optical sensors 8 mounted.

[0096] In this manner, the installation of the detection system 7 inside each corresponding compartment 2 is particularly simple and quick, given that it is sufficient to provide a printed circuit board 20 carrying the optical sensors 8 mounted and couple it to the support structure 11, in particular inserting it into the positioning volume 12, and, then, fixing the support structure 11 to the upper wall 10 of the corresponding box-like body 3.

[0097] In order to make the fixing of the support structure 11 to the upper wall 10 as simple as possible, the support structure 11 advantageously comprises a fixing flange 21, which is preferably provided with multiple through holes 22 traversed by screws (not shown) screwed to the upper wall 10.

[0098] Advantageously, the optical sensors 8 of each detection system 7 are of time-of-flight type, in particular for example LiDAR.

[0099] In greater detail, such optical sensors 8 each comprise at least one emitter device, which is designed to emit an electromagnetic radiation beam inside the space 5, and an optical detector, which is designed to detect a reflected electromagnetic radiation beam.

[0100] In particular, the emitter device and the optical detector of each optical sensor 8 are arranged adjacent to each other.

[0101] Furthermore, the emitter device is advantageously designed to emit the electromagnetic radiation beam along an emission axis and the optical detector corresponding to the aforementioned emitter device is advantageously designed to detect the reflected electromagnetic radiation beam along at least one optical sensitivity axis which diverges from the emission axis by a particularly small diverging angle, for example amounting to a few tenths or a few hundredths of degree.

[0102] In this manner, the emission axis of the emitter device and the optical sensitivity axis of the optical detector of the same optical sensor 8 can be considered substantially superimposed and defining both the optical axis Z of the optical sensor 8.

[0103] Advantageously, the electronic control unit connected to the optical sensors 8 of the detection system 7 of each compartment 2 is at least provided with a control module, which is configured to actuate the emitter device of each optical sensor 8 to emit a corresponding electromagnetic radiation beam, and with a detection module, which is configured to receive from the optical detector of each optical sensor 8 a detection signal containing information relating to a reflected electromagnetic radiation beam.

[0104] The electronic control unit advantageously further comprises a timing module, which is configured to calculate, for each optical sensor 8, a time interval extending between the actuation of the corresponding emitter device by said control module and the generation of a detection signal by the corresponding optical detector,

and a first comparison module, which is configured to compare, for each optical sensor 8, the aforementioned time interval with a limit threshold.

[0105] Furthermore, such first comparison module is advantageously configured to detect the presence of a bottle 100 in the positioning zone A corresponding to a pre-established optical sensor 8 with the time interval - calculated by the timing module with reference to the aforementioned pre-established optical sensor 8 - which is lower than the limit threshold and, furthermore, to detect the absence of a bottle 8 in the positioning zone A corresponding to a pre-established optical sensor 8 with the time interval - calculated by the timing module with reference to the aforementioned pre-established optical sensor 8 - which is substantially equal to such limit threshold.

[0106] As a matter of fact, in use, in particular with reference to the preferred embodiment having the optical sensors 8 arranged at the upper wall 10, the electromagnetic radiation beam emitted by the emitter device of a pre-established optical sensor 8 will travel through the emission axis until it abuts against the lower wall 15, if the transportation case 101 is not present, or the terminal wall 102 of the transportation case 101, if a transportation case 101 is present without any bottle 100 being arranged in the positioning zone A corresponding to the pre-established optical sensor 8, and, furthermore, such electromagnetic radiation beam will be reflected by the lower wall 15 or by the terminal wall 102 to travel through the optical sensitivity axis of the optical detector and reach the optical detector after a time interval from the actuation of the emitter device which is substantially equal to the limit threshold.

[0107] Instead, in use, the electromagnetic radiation beam emitted by the emitter device of a pre-established optical sensor 8 will travel through the emission axis until it abuts against a bottle 100 arranged in the positioning zone A corresponding to the aforementioned optical sensor 8 and contained in a transportation case 101 positioned in the space 5 (in particular until it abuts against the neck of the aforementioned bottle 100) and it will be reflected by the bottle 100 to travel through the optical sensitivity axis of the optical detector and reach thereto after a time interval from the actuation of the emitter device which is smaller than the limit threshold. Preferably, the electronic control unit further comprises a second comparison module, which is configured to compare - should there have been detected, by the first comparison module, the presence of a bottle 100 in a pre-established positioning zone A - at least one parameter obtained starting from the time interval, calculated by the timing module with reference to the optical sensor 8 corresponding to the aforementioned positioning zone A, with at least one reference threshold. Furthermore, such second comparison module is designed to recognize a determined type of bottle 100 with the aforementioned parameter substantially equal to the reference threshold.

[0108] For example, the electronic control unit is designed to obtain - from the time interval calculated by the timing module - the height of the bottle 100 (knowing the overall height of the box-like body 3 between the upper wall 10 and lower wall 15) and the reference threshold used by the second comparison module preferably indicates the height of the type of bottle 100 provided for returning the empty bottle to be returned.

[0109] Preferably, the electronic control unit is also further provided with a signaling module, which is configured to emit a warning signal indicating an incorrect type of bottle 100.

[0110] Particularly, such signaling module is configured to emit the warning signal should the second comparison module detect that the parameter obtained starting from the time interval calculated by the timing module diverges more than a pre-established tolerance range from the reference threshold.

[0111] This allows to warn the user or an operator who works at the supermarket where the automated cabinet 1 in question is advantageously installed, that the bottles 100 inserted into the space 5 of a compartment 2 are not of the correct type.

[0112] In greater detail, the control module, the detection module, the timing module, the first comparison module and preferably also the second comparison module and the signaling module are integrated in the electronic control unit by means of suitable functional software. Advantageously, the automated cabinet 1 in question comprises a load cell (not shown) mounted on the box-like body 3 of each compartment 2 and designed to detect the weight of the transportation case 101 with the bottles 100, the load cell preferably being operatively connected to the electronic control unit.

[0113] Preferably, the load cell is integrated in the lower wall 15 of the box-like body 3 of the corresponding compartment 2.

[0114] In particular, the electronic control unit comprises, alternatively or additionally to the second comparison module, a recognition module (preferably integrated in the electronic control unit by means of a suitable functional software) configured to establish whether the bottles 100 contained in the transportation case 101 inserted into one of the spaces 5 are of the correct type as a function of the weight detected by the load cell, preferably having stored in the memory the weight of the transportation case 101 intended to be inserted into the spaces 5 and the weight of the correct type of bottle 100.

[0115] In greater detail, the provision of both the second comparison module and the recognition module allows the electronic control unit to establish whether the detected bottles 100 are of the correct type with a high reliability, in particular cross-checking the data for example relating to the height of the bottle 100 and to its weight, and without having to use a high calculation power.

[0116] Therefore, the invention thus conceived attains the pre-set objects.

Claims

1. Automated cabinet (1) for bottles (100), which comprises multiple compartments (2) adjacent to each other, each of which is provided with:

   - a box-like body (3), which is frontally provided with an access opening (4) and therein defines a space (5) intended to house at least one transportation case (101) arranged for containing at least one series of bottles (100); said box-like body (3) comprising:

     - an upper wall (10) placed as upper delimitation of said space (5);
     - a lower wall (15) placed as lower delimitation of said space (5);
     - a side wall (18) extending protruding from said lower wall (15) to said upper wall (10), on which side wall (18) said access opening (4) for said space (5) being obtained;

   - a door (6) mounted on said box-like body (3) and movable between an opening position, in which said door (6) frees said access opening (4) to allow said user to insert or remove a said transportation case (101) of bottles (100), and a closing position, in which said door (6) occludes said access opening (4);
   - a detection system (7) arranged for detecting the presence of said bottles (100) in said transportation case (101) inserted into said space (5);
   said automated cabinet (1) being **characterized in that** said detection system (7) comprises at least one series of optical sensors (8) arranged at the box-like body (3) of the respective said compartment (2), each said optical sensor (8) being provided with an optical axis (Z) passing through said space (5) in a corresponding positioning zone (A) of said space (5);
   each compartment (2) comprising positioning means (9) associated with said box-like body (3) and arranged for positioning at least one said transportation case (101) in said space (5) with said bottles (100) in said transportation case (101) arranged in corresponding said positioning zones (A) to intercept each of said optical axis (Z) which passes through said corresponding positioning zone (A).

2. Automated cabinet (1) according to claim 1, **characterized in that** the optical sensors (8) of each said detection system (7) are positioned on a substantially horizontal lying plane arranged on one side of said box-like body (3) and the optical axes (Z) of said optical sensors (8) are substantially orthogonal to said lying plane.

3. Automated cabinet (1) according to claim 2, **characterized in that** the series of said optical sensors (8) is organized according to a matrix (M) having at least two columns (X) and at least two rows (Y).

4. Automated cabinet (1) according to claim 2 or 3, **characterized in that** said optical sensors (8) are arranged at said upper wall (10).

5. Automated cabinet (1) according to claim 4, **characterized in that** the detection system (7) of each said compartment (2) comprises at least one support structure (11) fixed to the upper wall (10) of the box-like body (3) of the corresponding said compartment (2) and arranged inside said space (5), which support structure (11) at least partially delimits a housing volume (12) and is provided with a bottom wall (13) on which multiple viewing openings (14) are obtained; said optical sensors (8) being arranged within said housing volume (12) and each being positioned aligned with a corresponding viewing opening (14), which is traversed by the optical axis (Z) of the corresponding said optical sensor (8).

6. Automated cabinet (1) according to any one of the preceding claims, **characterized in that** the optical sensors (8) of each said detection system (7) are of time-of-flight type and each comprise at least one emitter device, arranged for emitting an electromagnetic radiation beam inside said space (5), and an optical detector, which is arranged for detecting a reflected electromagnetic radiation beam.

7. Automated cabinet (1) according to claim 6, **characterized in that** it comprises an electronic control unit operatively connected to the optical sensors (8) of the detection system (7) of each said compartment (2) and provided at least with:

   - a drive module, which is configured to actuate the emitter device of each said optical sensor (8) to emit a corresponding electromagnetic radiation beam;
   - a detection module, which is configured to receive, from the optical detector of each said optical sensor (8), a detection signal containing information relative to a reflected electromagnetic radiation beam;
   - a timing module, which is configured to calculate, for each said optical sensor (8), a time interval extending between the actuation of the corresponding said emitter device by said drive module and the generation of one said detection signal by the corresponding said optical detector;
   - a first comparison module, which is configured to compare, for each said optical sensor (8), said time interval with a limit threshold and

- to detect the presence of a bottle (100) in the positioning zone (A) corresponding to a pre-established said optical sensor (8) with said time interval, calculated by said timing module with reference to the pre-established said optical sensor (8), lower than said limit threshold and
- to detect the absence of a bottle (8) in the positioning zone (A) corresponding to a pre-established said optical sensor (8) with said time interval, calculated by said timing module with reference to the pre-established said optical sensor (8), substantially equal to said limit threshold.

8. Automated cabinet (1) according to any one of the preceding claims, **characterized in that** said positioning means (9) are arranged on said lower wall (15).

9. Automated cabinet (1) according to claim 8, **characterized in that** said positioning means (9) comprise at least one positioning seat (16) obtained on the lower wall (15) of the corresponding said box-like body (3) and intended to receive, substantially to size, the bottom of said transportation case (101).

10. Automated cabinet (1) according to any one of the preceding claims, **characterized in that** it comprises a load cell mounted on the box-like body (3) of each said compartment (2) and arranged for detecting the weight of said transportation case (101) with said bottles (100).

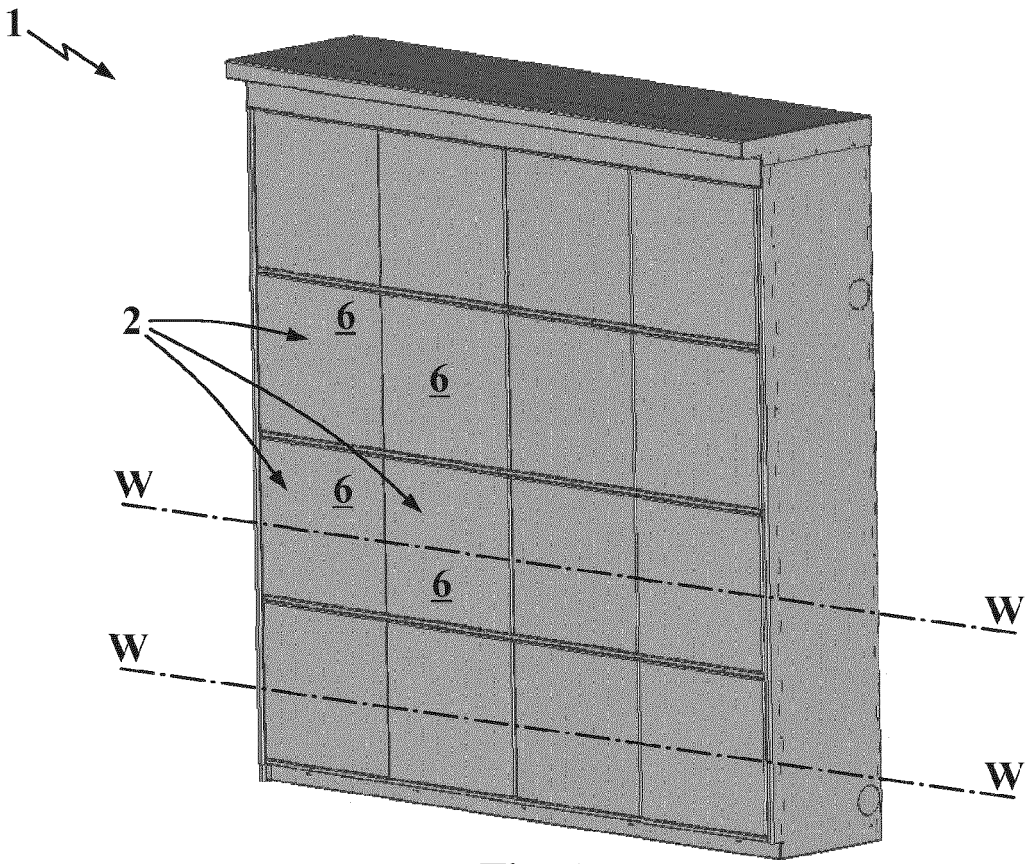

Fig. 1

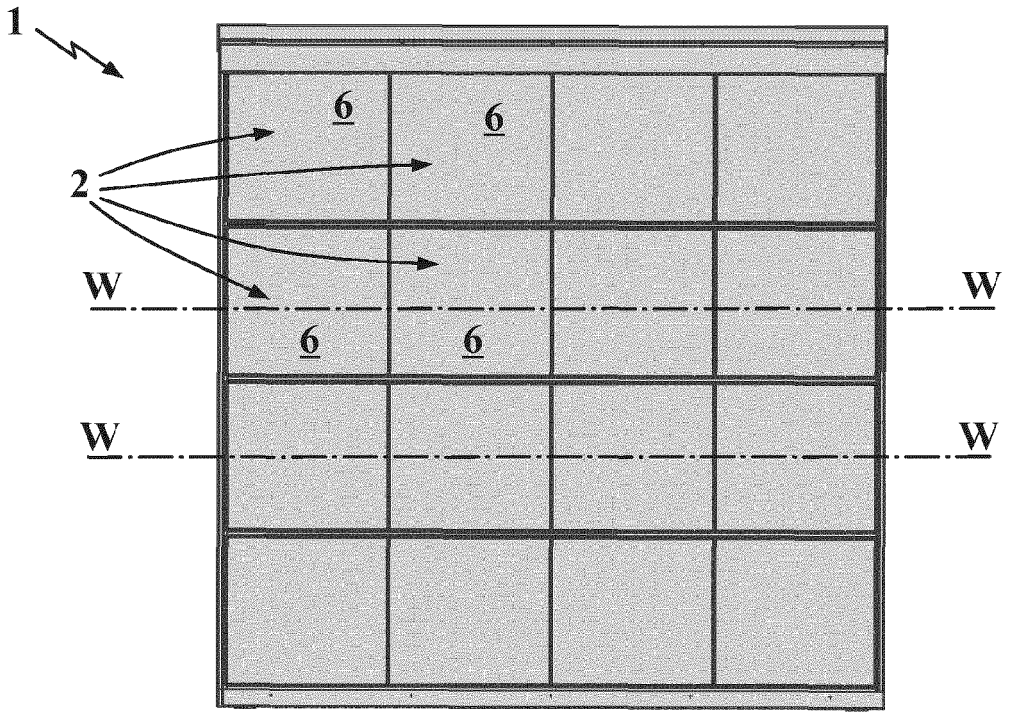

Fig. 2

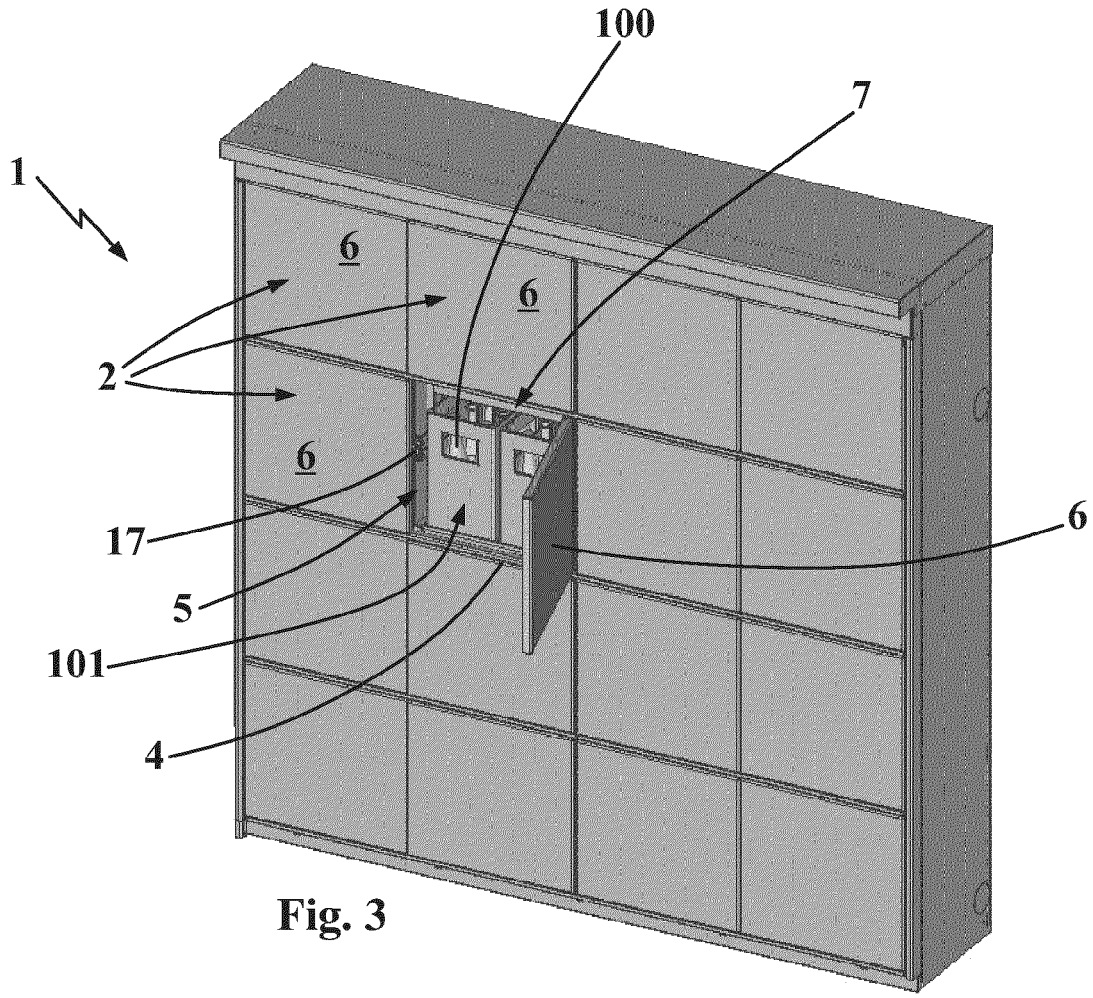

Fig. 3

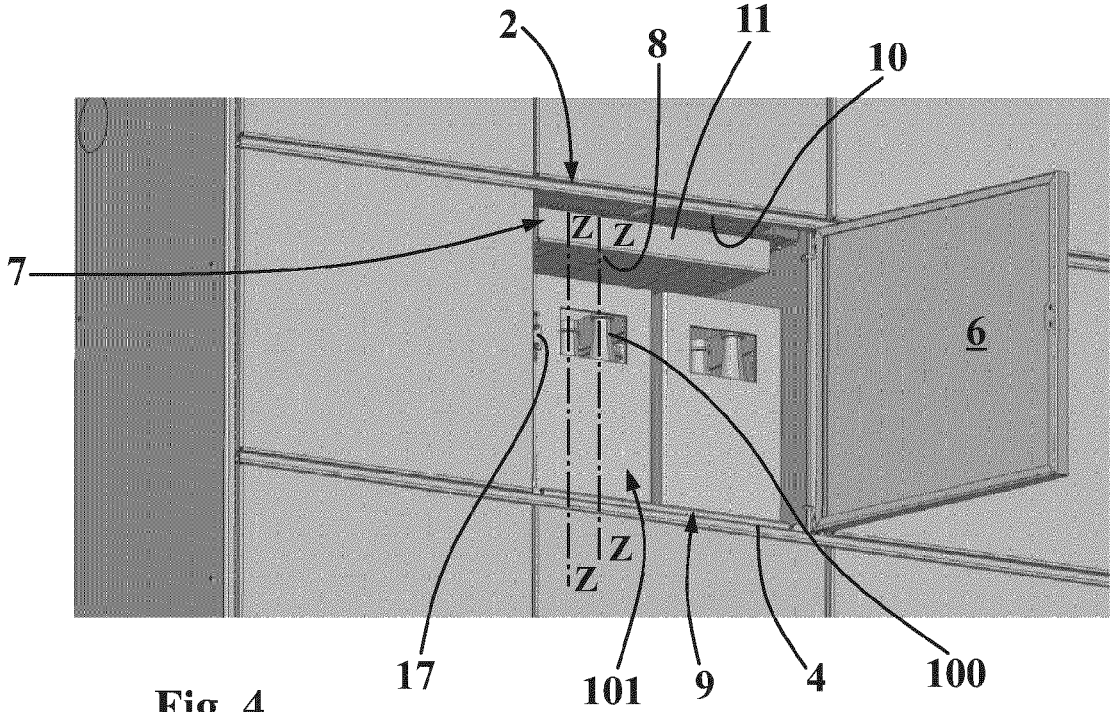

Fig. 4

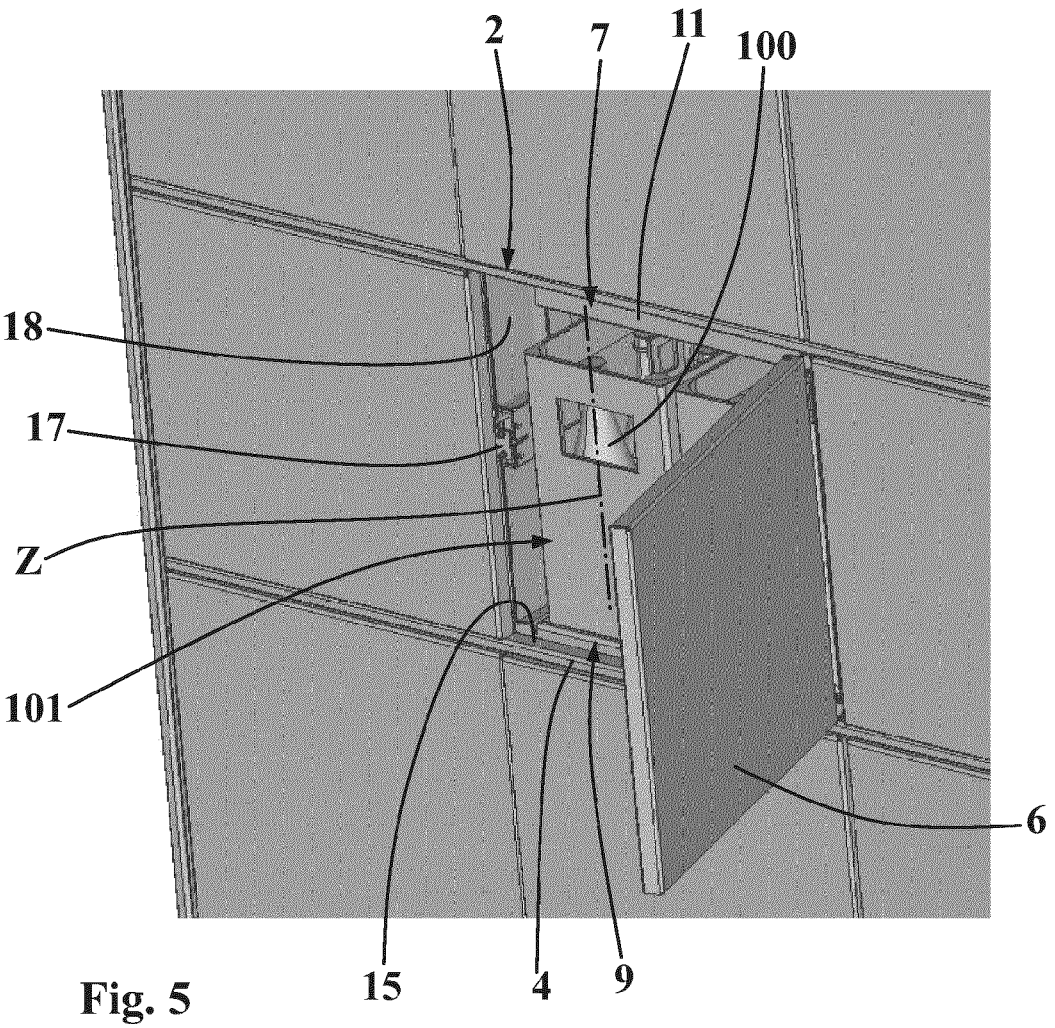

Fig. 5

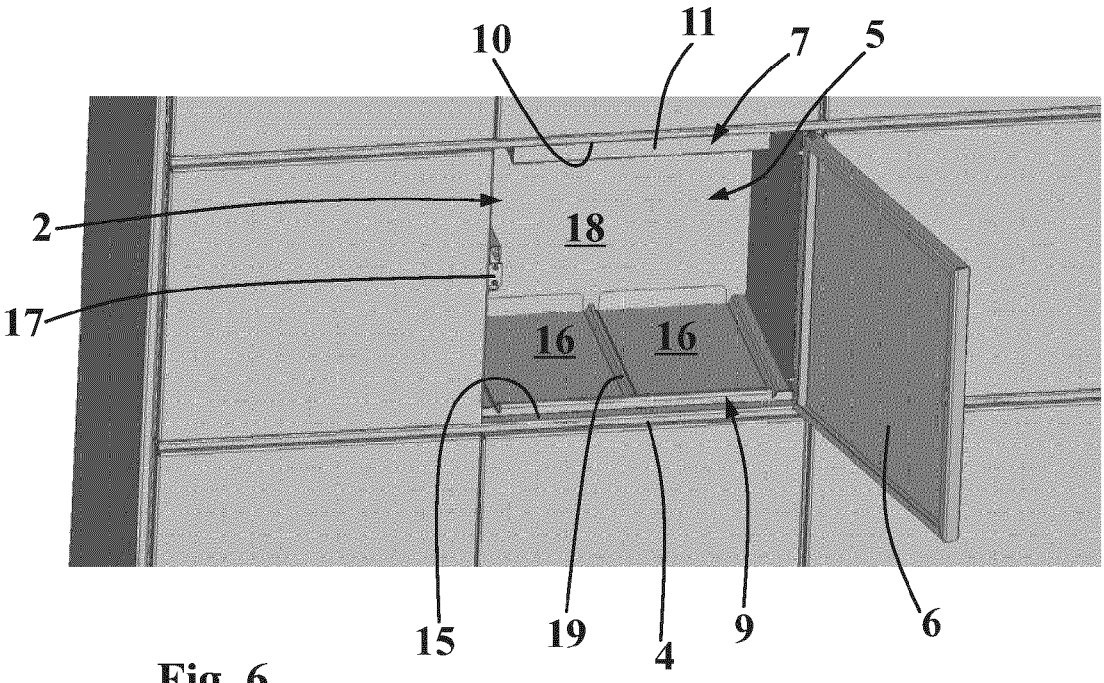

Fig. 6

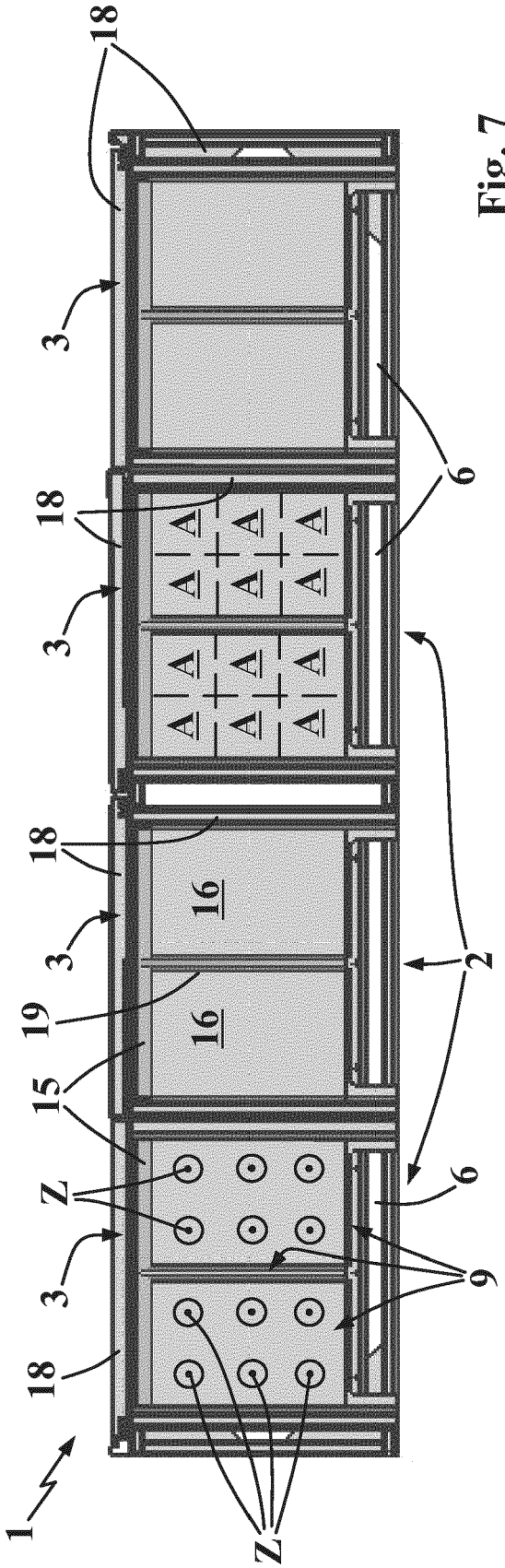
18
3
18
3
18
3
19
15
Z
3
18
1
Z
6
2
6
9
16
16
A

Fig. 7

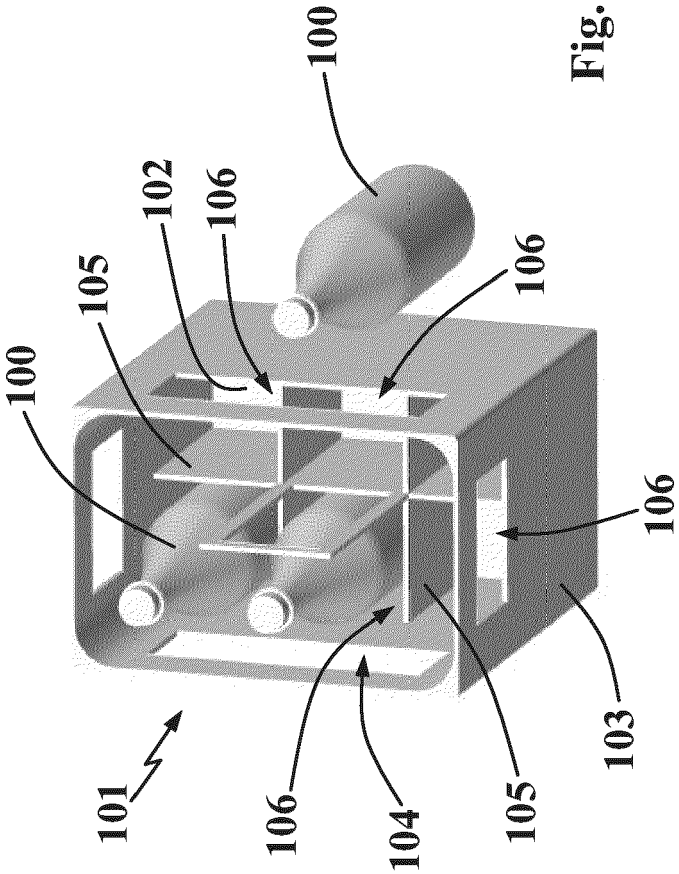
100
102
106
105
106
100
106
101
106
104
105
103

Fig. 8

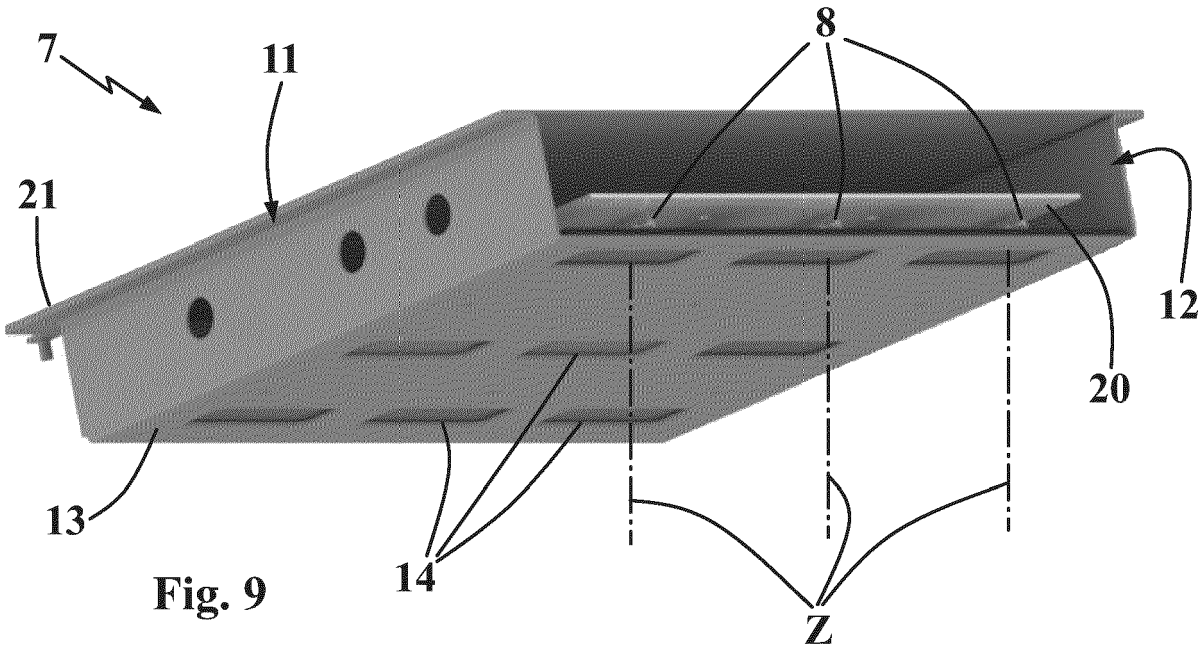

Fig. 9

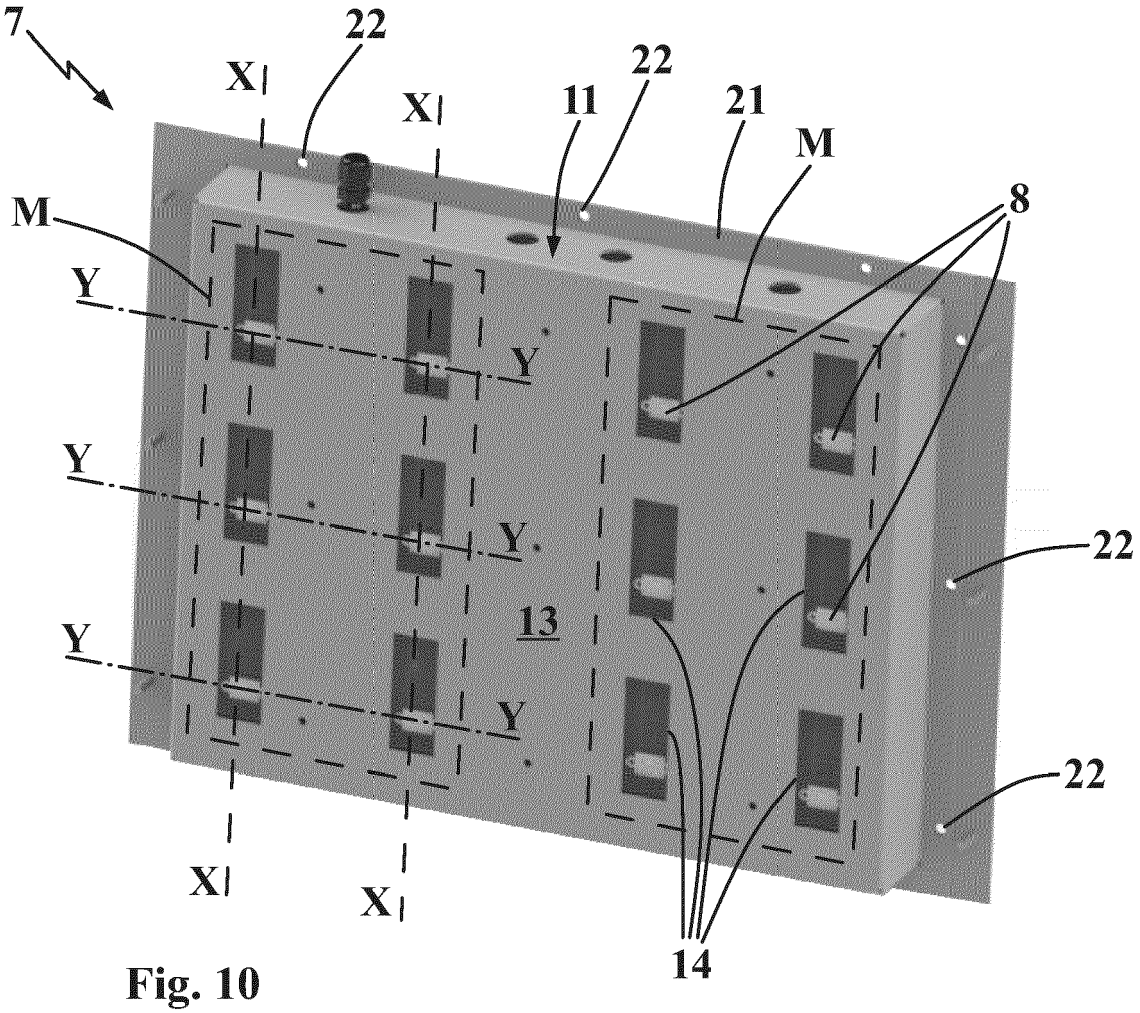

Fig. 10

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 23 16 5740

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	CN 208 909 340 U (ZHENGZHOU YOUYIDA ELECTRONIC TECH CO LTD) 31 May 2019 (2019-05-31) * the whole document * -----	1-10	INV. G07F7/06 G07F11/04 G07F11/40 G07F17/00 G07F17/12

TECHNICAL FIELDS SEARCHED (IPC)

G07F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	14 July 2023	Verhoef, Peter

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons
.....
& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 16 5740

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-07-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 208909340 U	31-05-2019	NONE	

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- CN 108257297 **[0005]**