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(54) **IMPROVED APPARATUS FOR AUTOMATICALLY OPENING CRATES OF DIFFERENT DIMENSIONS**

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(57) **ABSTRACT**

Apparatus for opening in an automatic mode and in a continuous sequence the closed side walls of a plurality of crates, preferably for horticultural products, and preferably lying vertically one on another so as to form a relative first stack, suitable for carrying out the operations for carrying a first stack to a first arrival and loading station, lifting vertically said two pairs of opposite walls, transferring said open crates to a second stack, and subsequently carrying said stack outside the apparatus; the apparatus includes command and control means suitable to store the parameters that correspond to a plurality of types of crates having different dimensions, enter into said command and control means a coded instruction representative of a particular type of crate, and automatically make it so that said command and control means process and transmit to the controls, structures, operating bodies, devices, actuators present in the apparatus appropriate signals that are suitable to determine therein the correct operation corresponding to the type of selected crate.

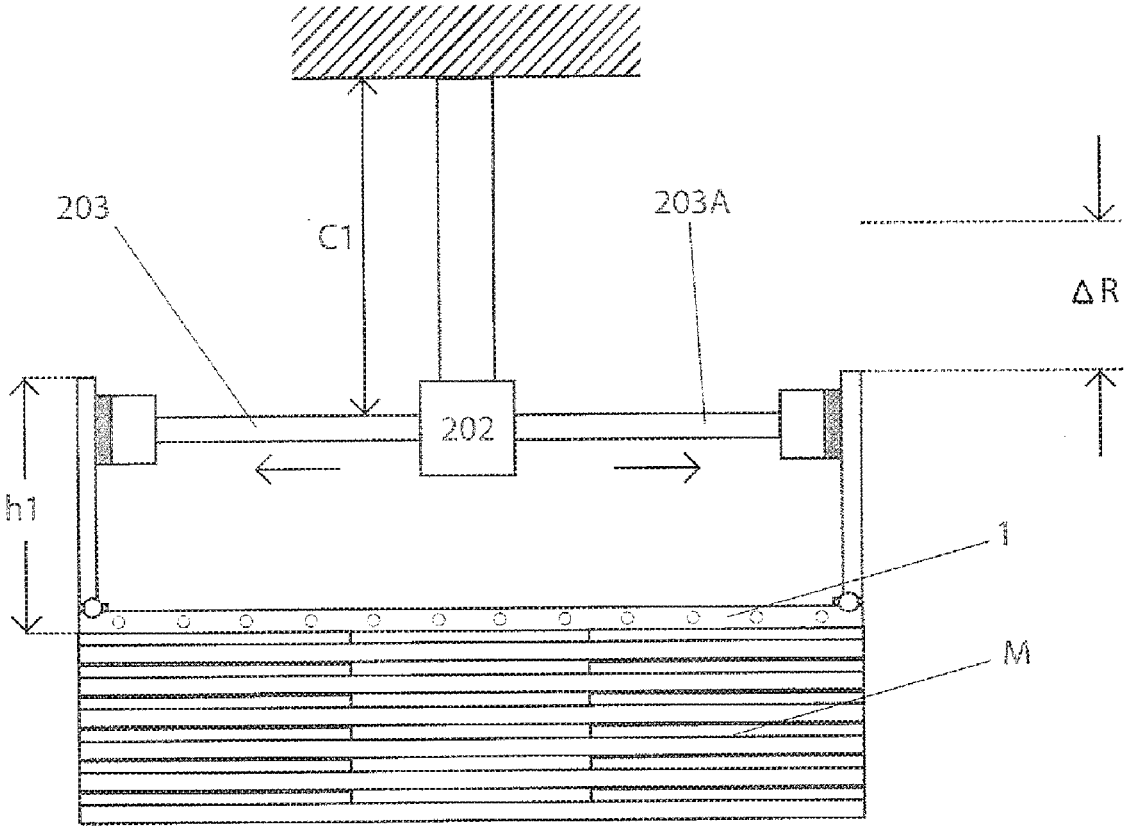
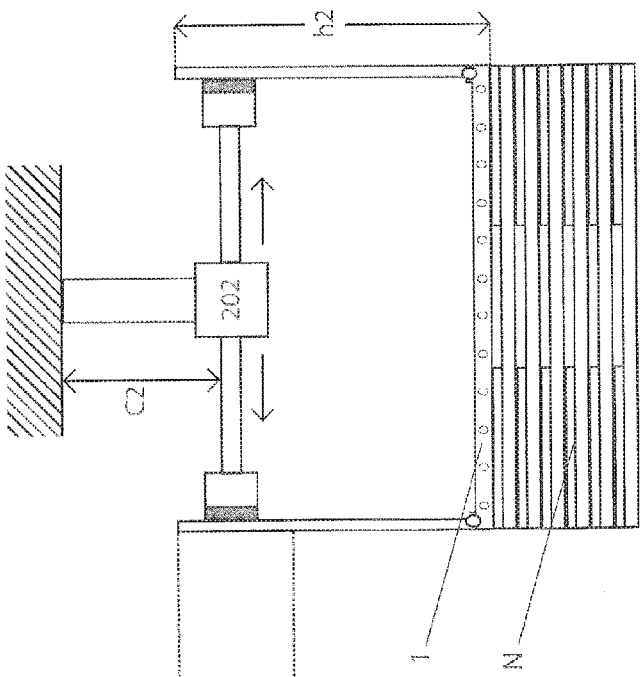


FIG. 2



S-1

FIG. 1

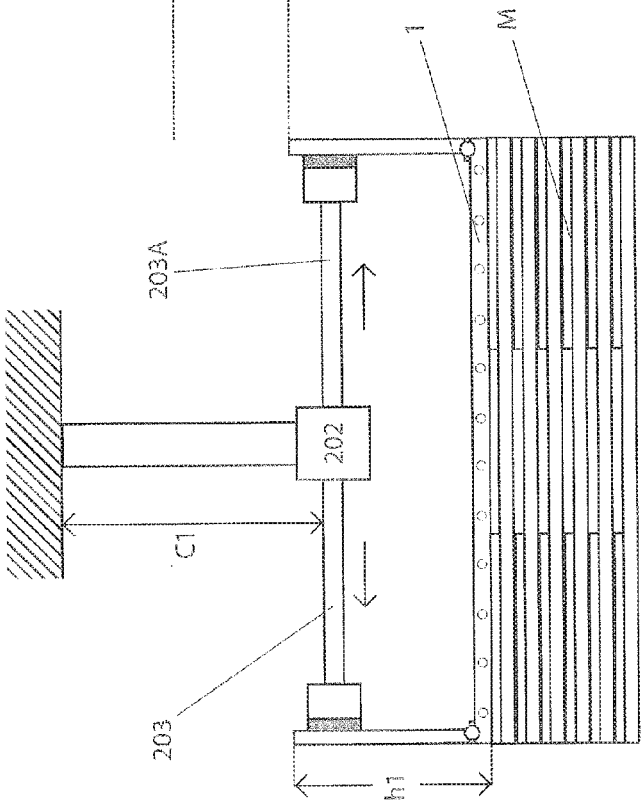


FIG. 3

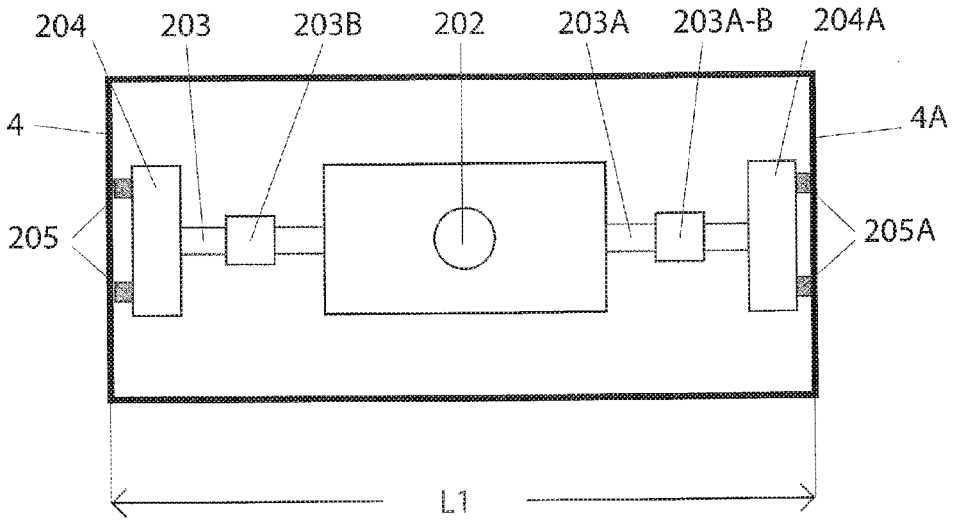

204
203
203B
202
203A
203A-B
204A
4
4A
205
205A
L1

FIG. 3A

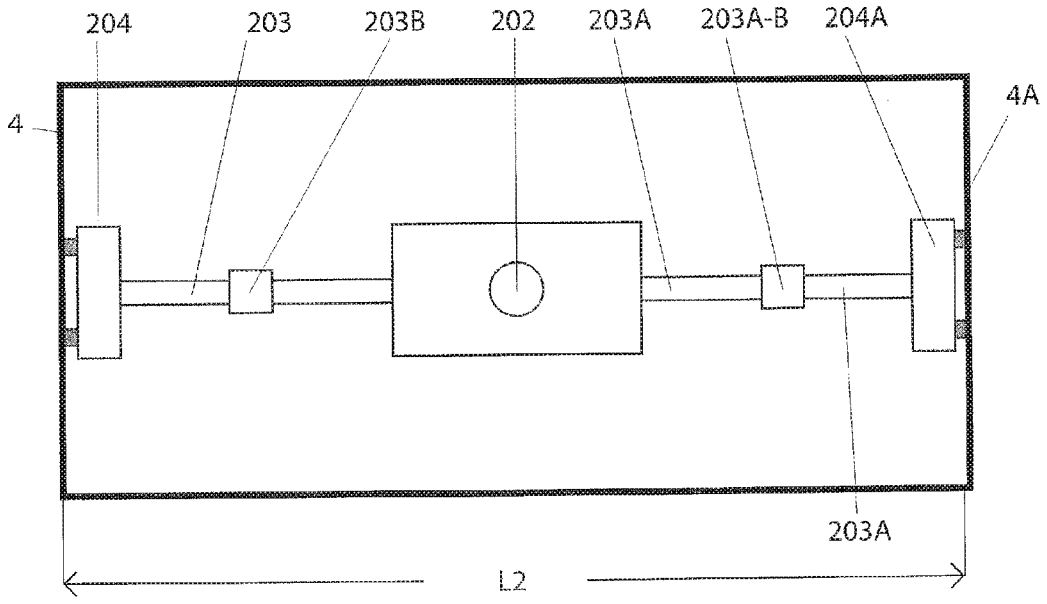

204
203
203B
202
203A
203A-B
204A
4
4A
203A
L2

FIG. 4

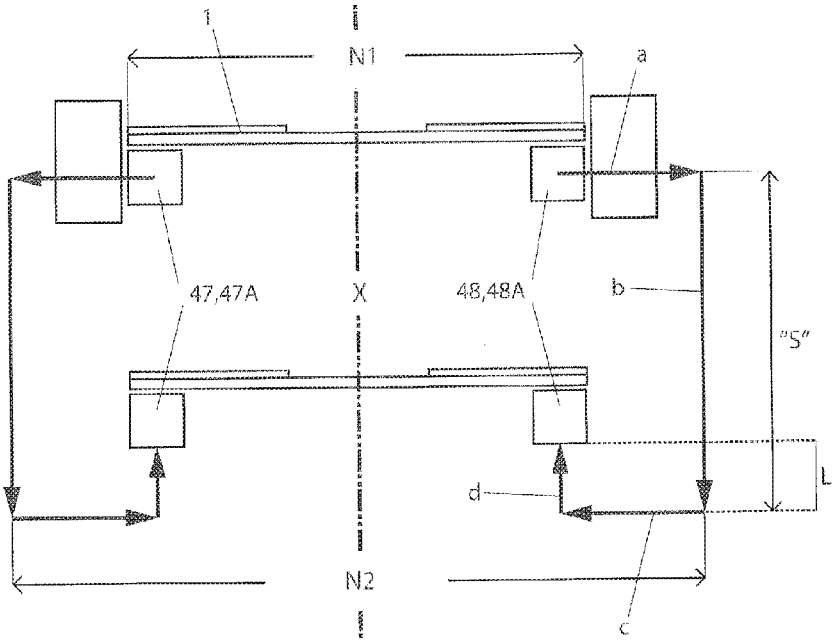


FIG. 4A

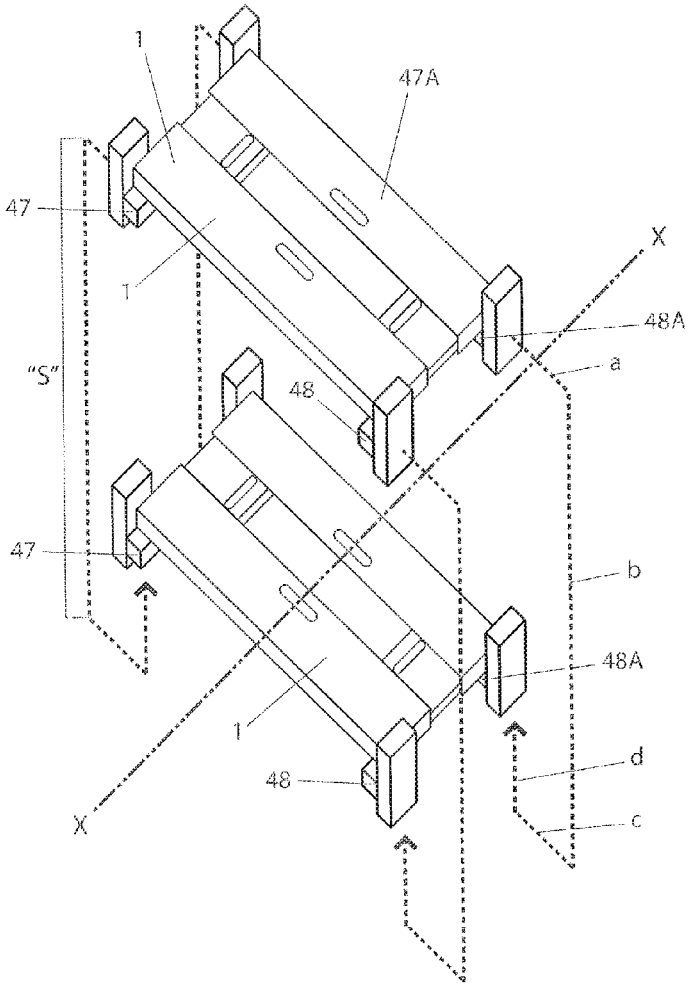


FIG. 5

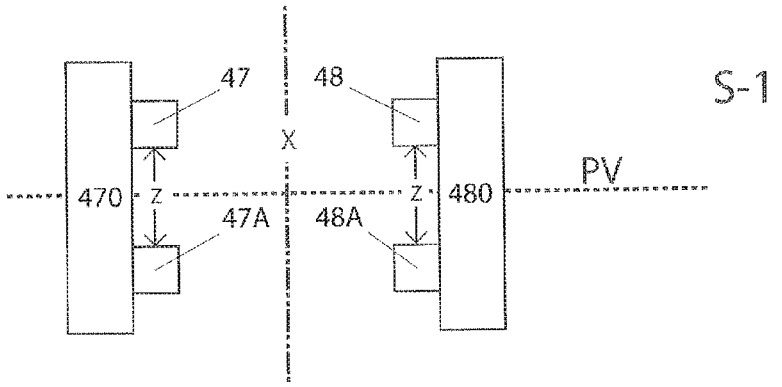


FIG. 5A

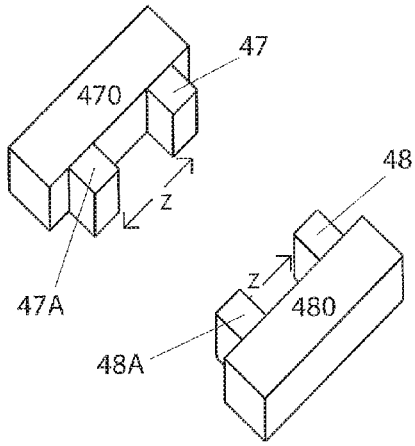


FIG. 5B

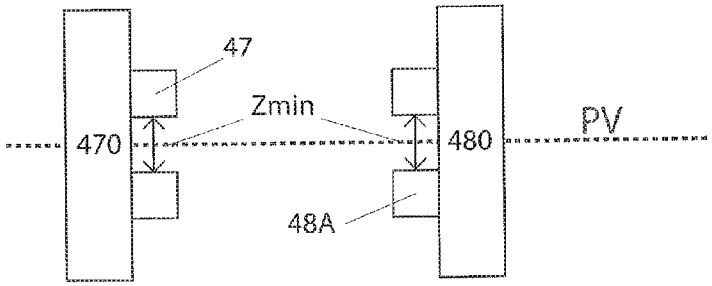


FIG. 5C

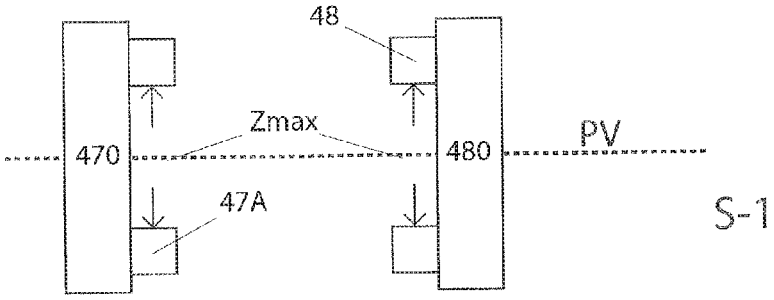


FIG. 6

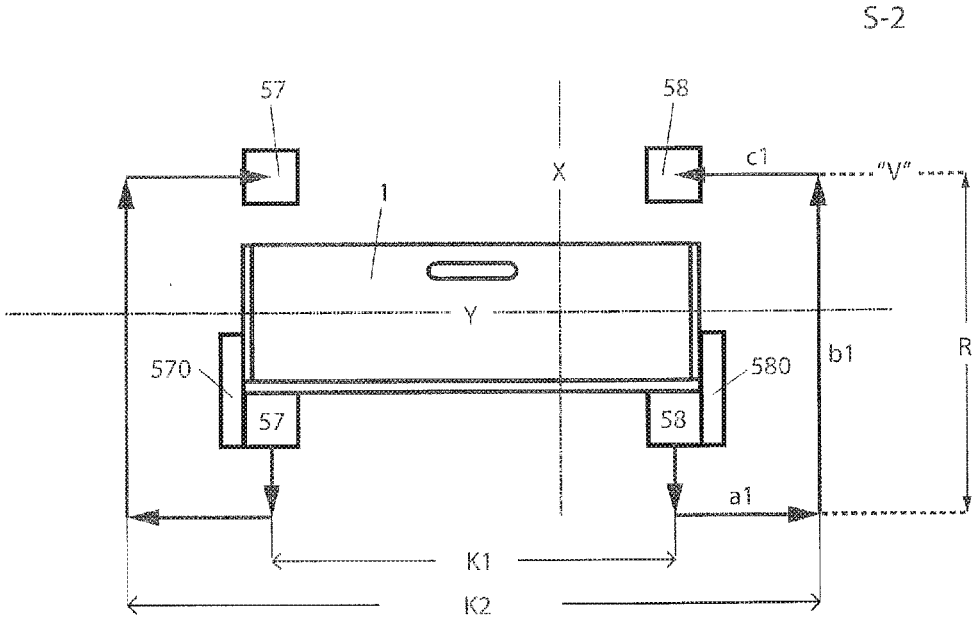

S-2
57
58
X
c1
"V"
1
Y
570
580
b1
R
57
58
a1
K1
K2

FIG. 6A

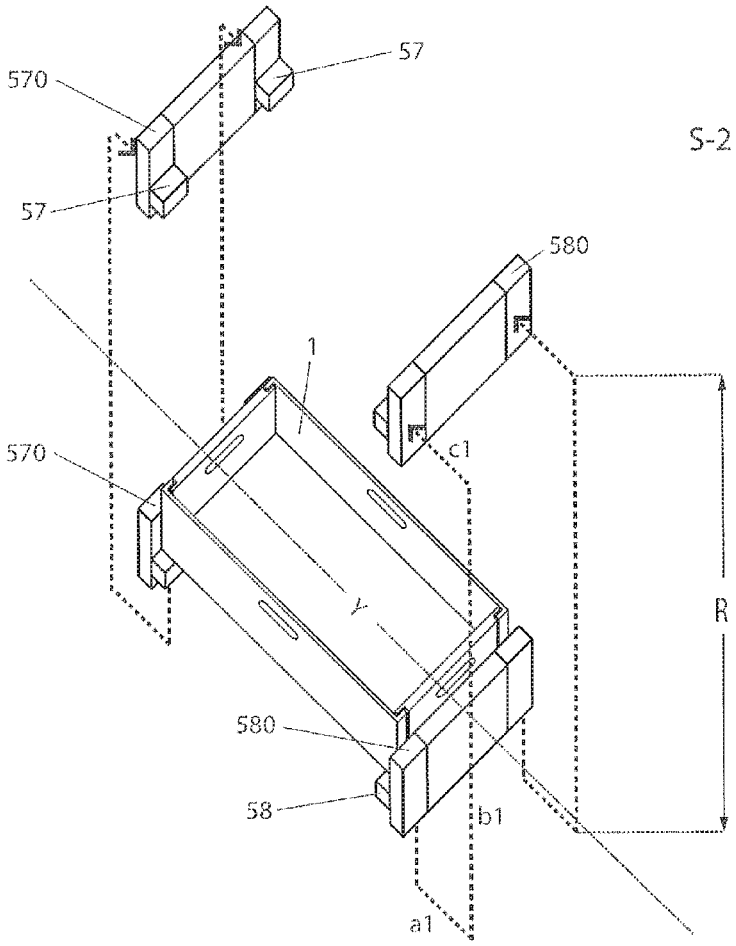

S-2
570
57
57
580
1
c1
570
R
580
58
b1
a1

FIG. 7

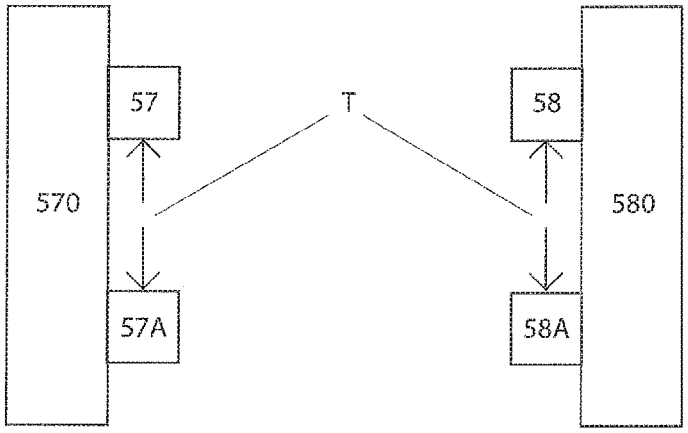


FIG. 7A

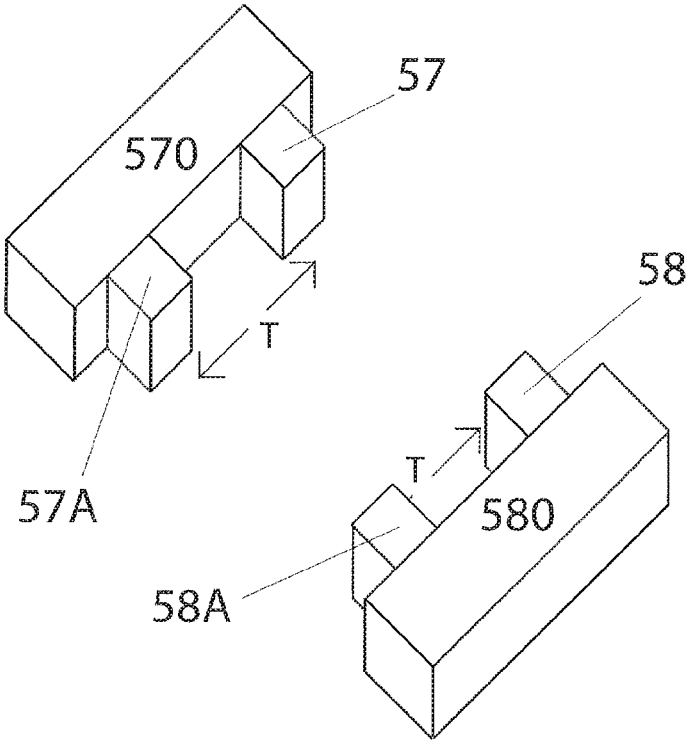


FIG. 8

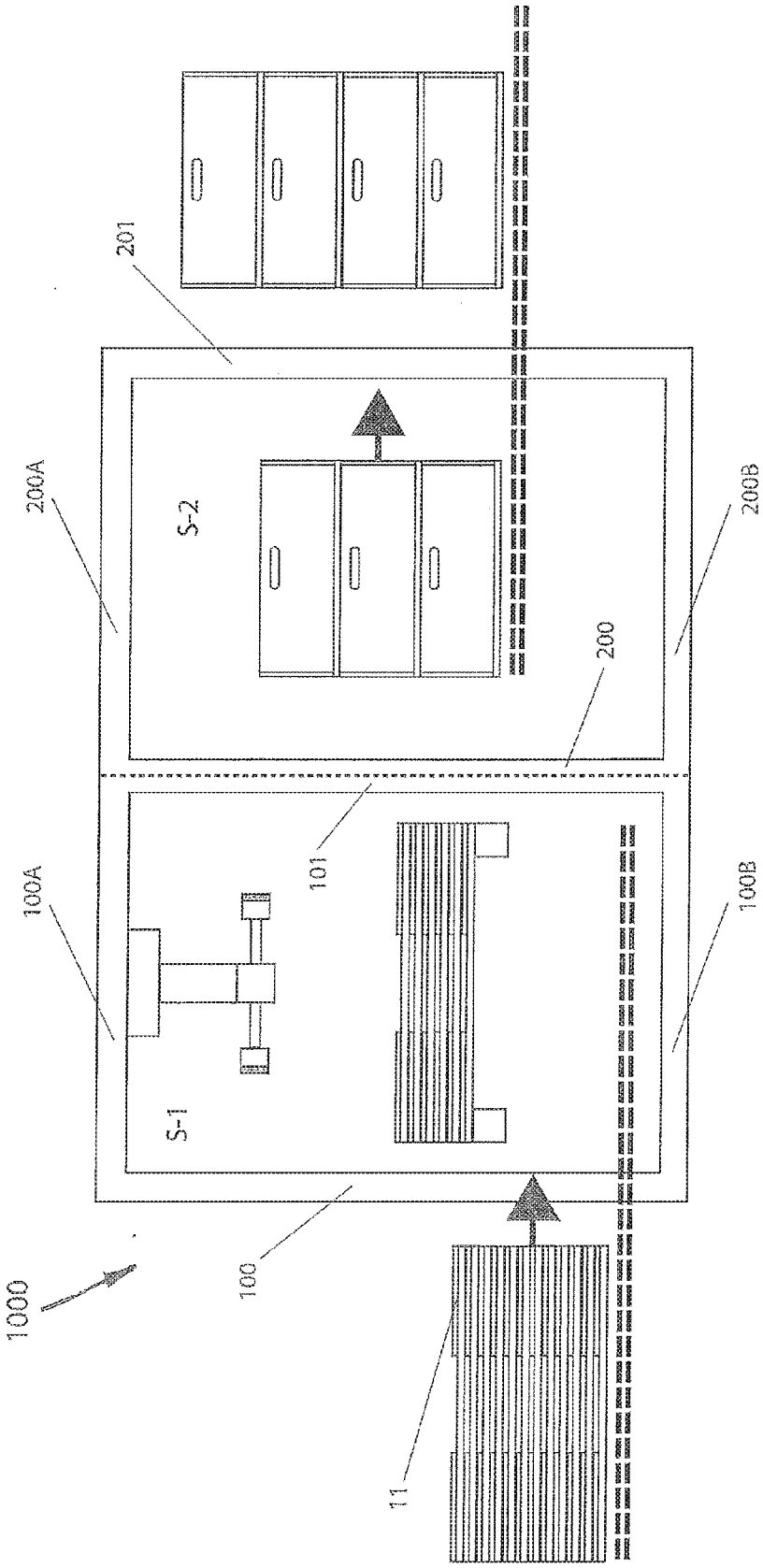


FIG. 9

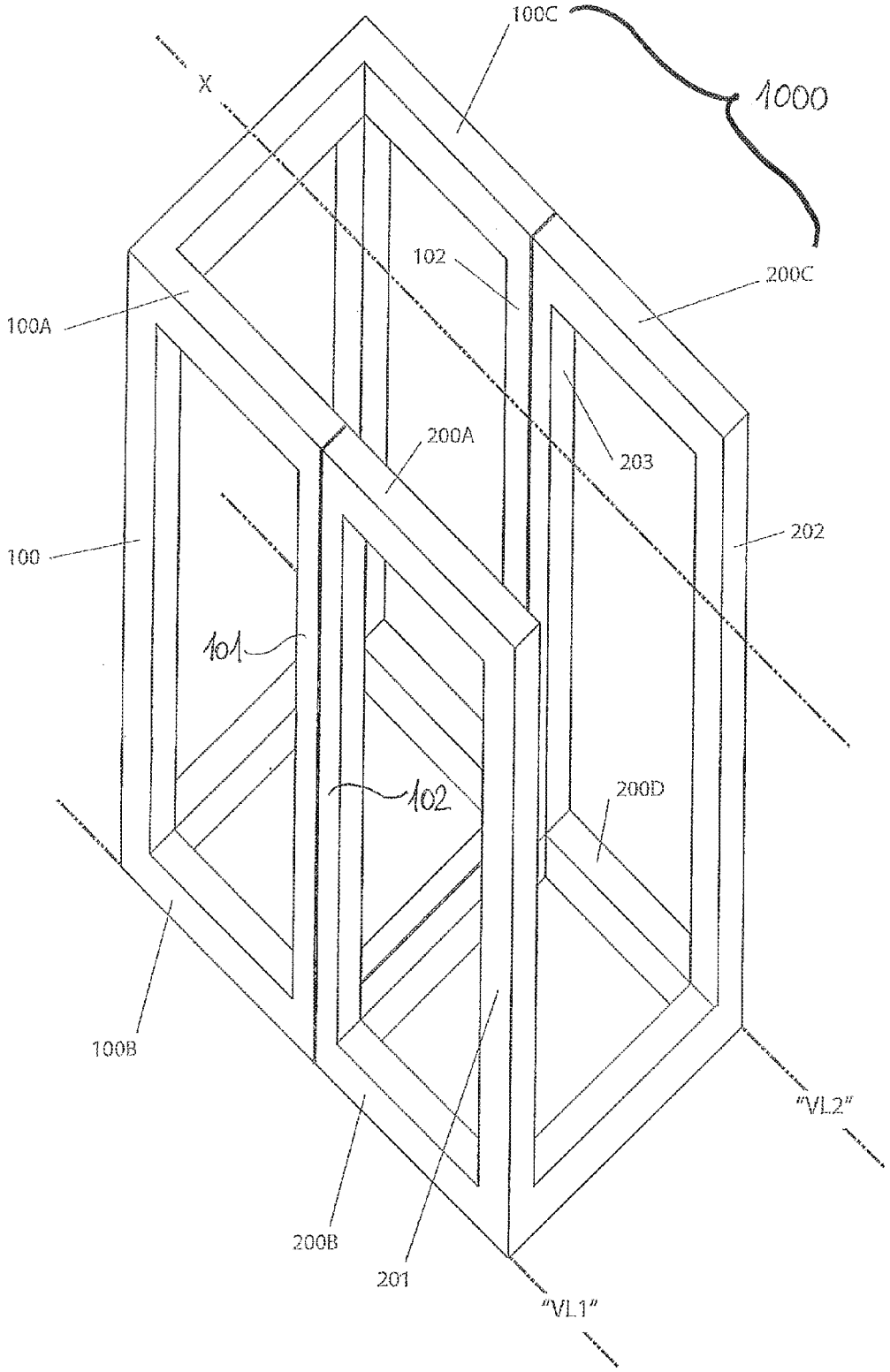

100C
X
1000
102
200C
100A
200A
203
202
100
101
102
200D
100B
"VL2"
200B
201
"VL1"

FIG. 10

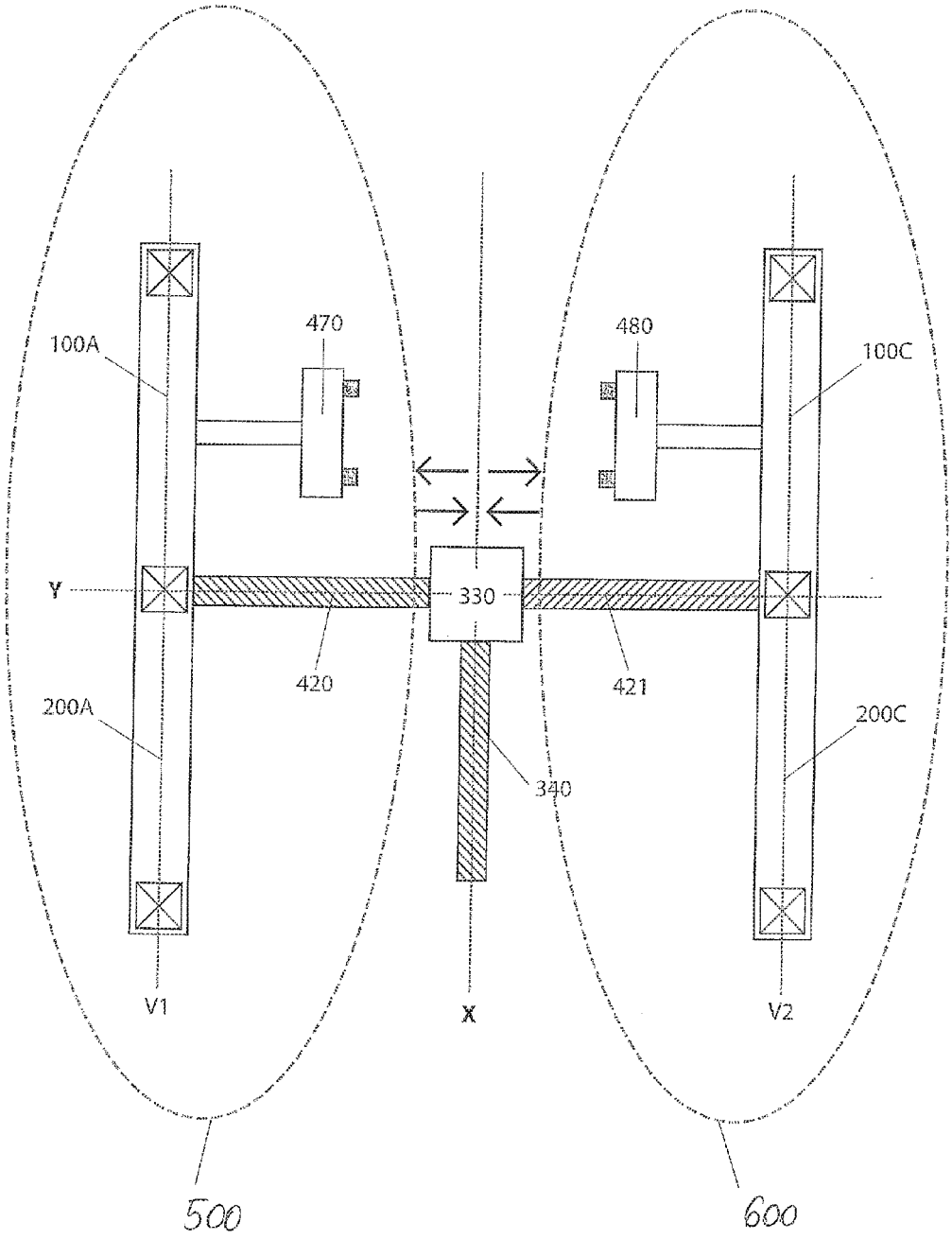
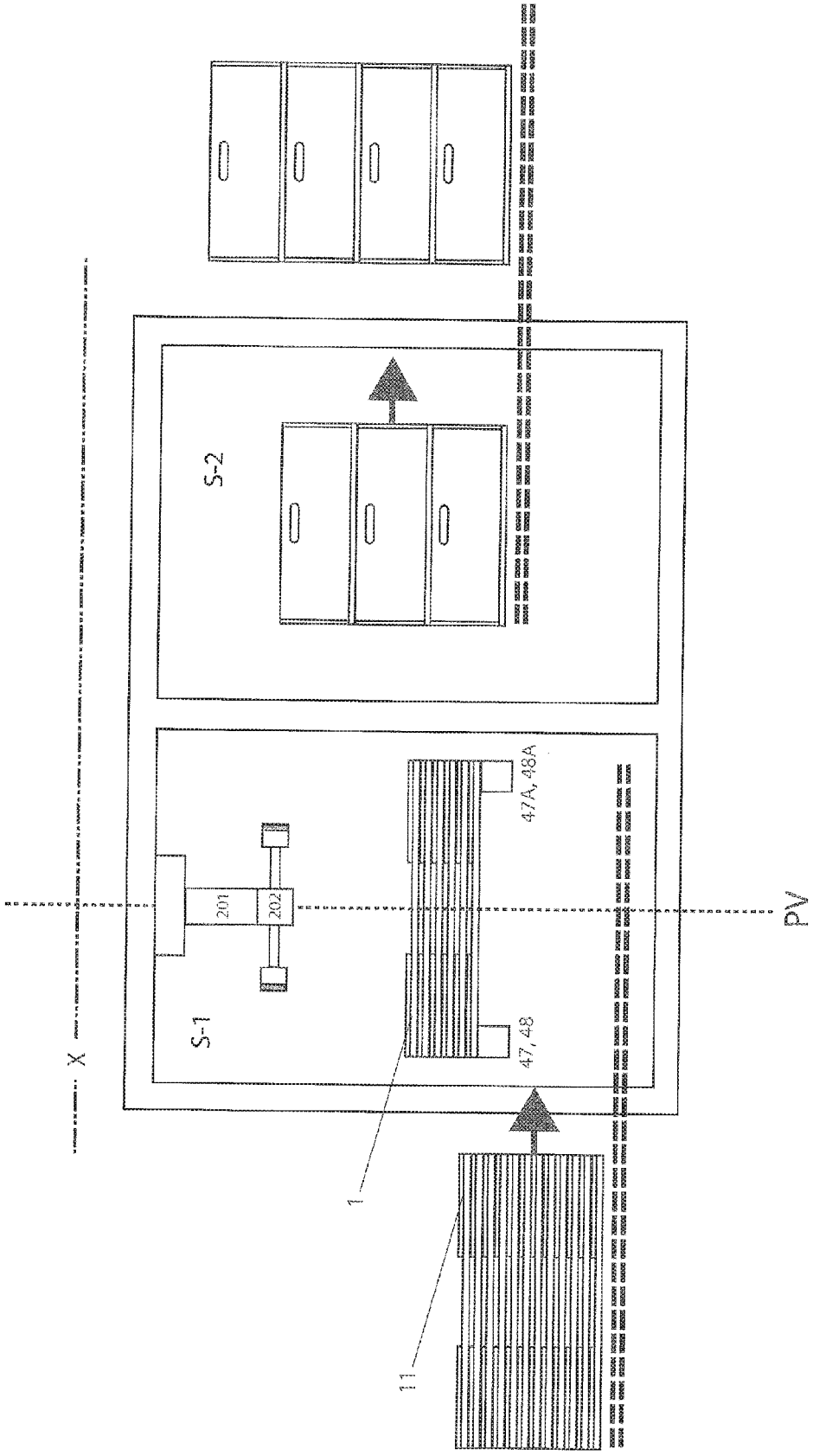


FIG. 11



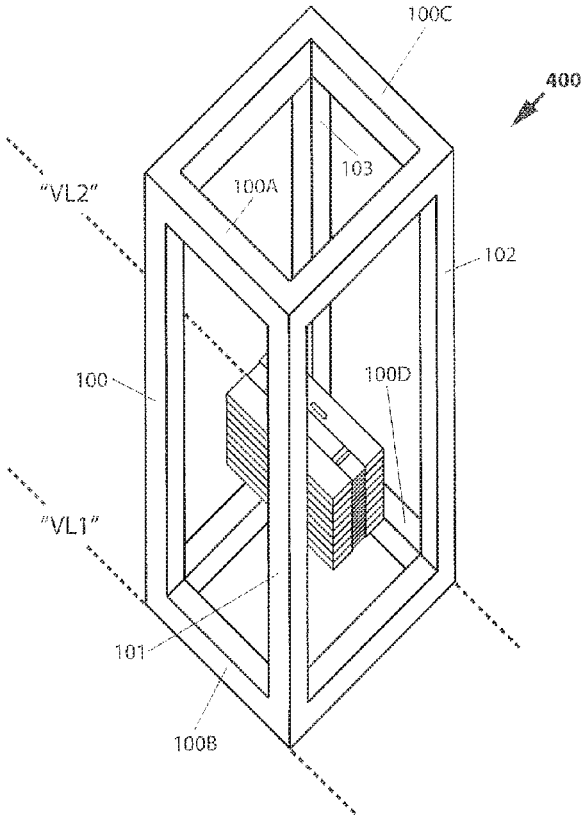


FIG. 12

S-1

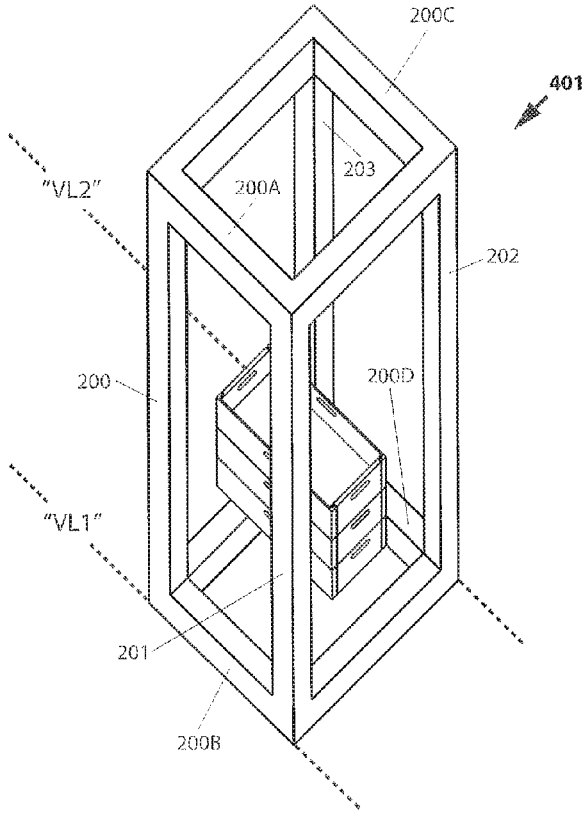


FIG. 13

S-2

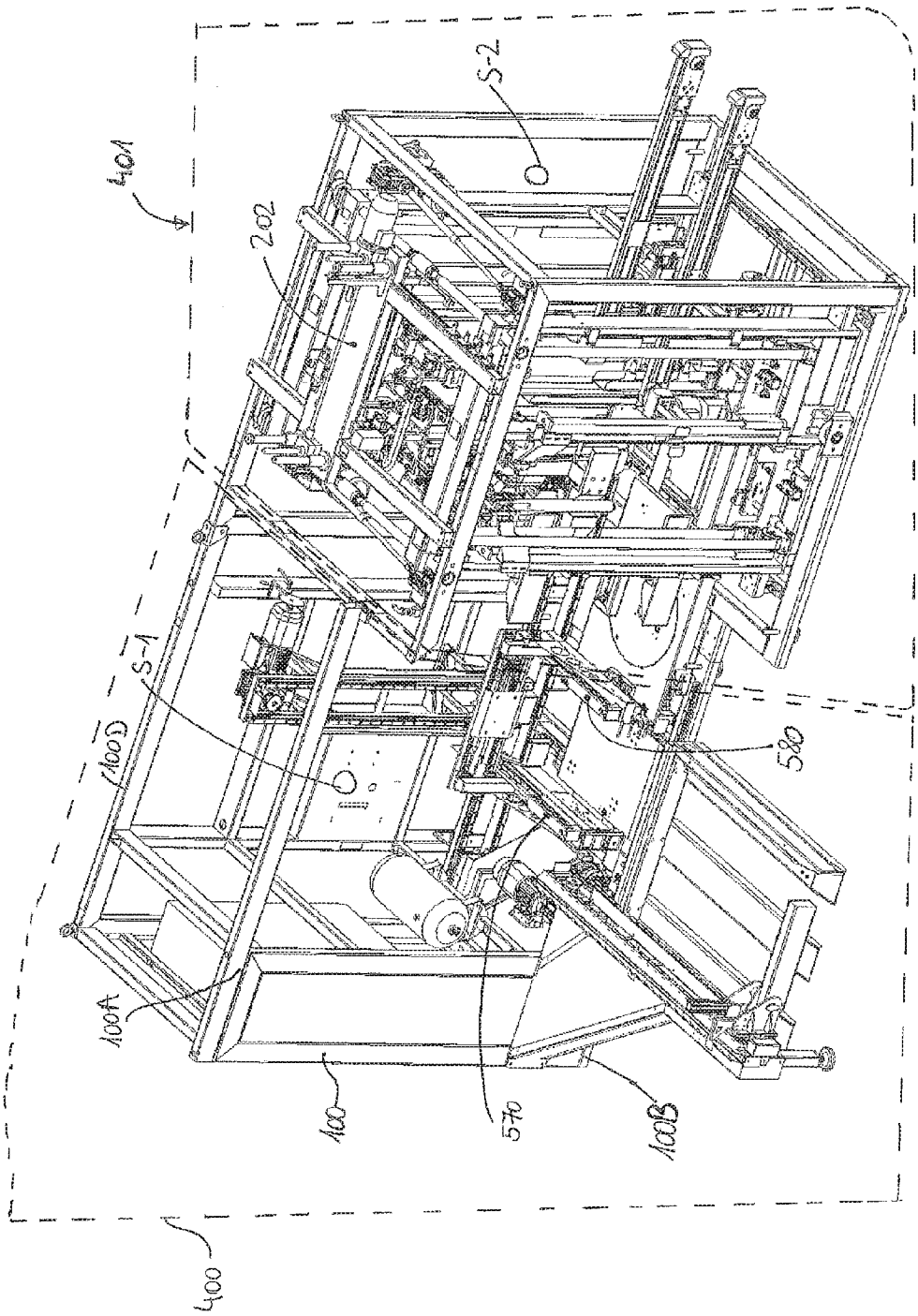


FIG. 14.

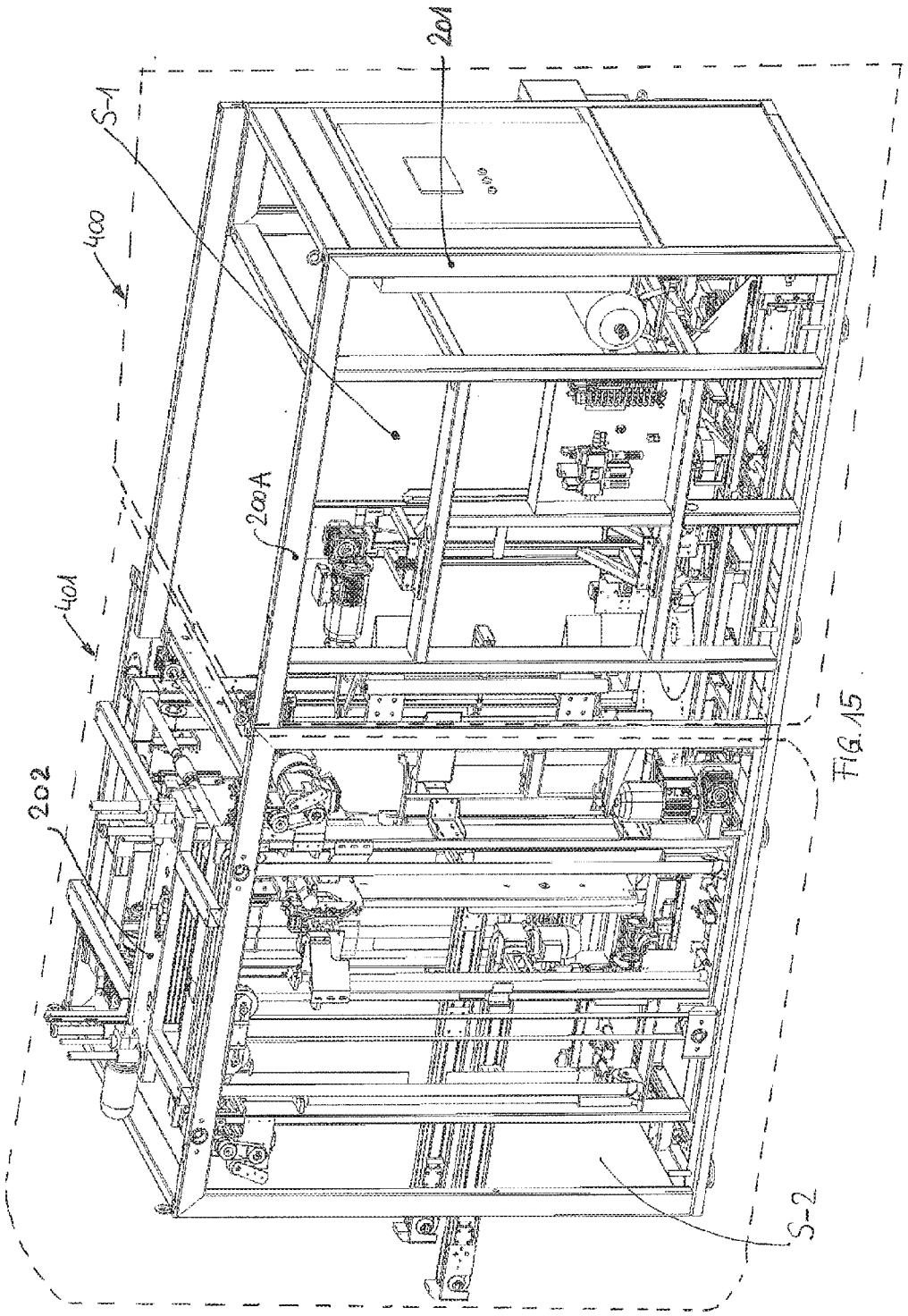


FIG.15

IMPROVED APPARATUS FOR AUTOMATICALLY OPENING CRATES OF DIFFERENT DIMENSIONS

[0001] The present invention refers to an improved apparatus for opening the crates that are normally used to contain horticultural products; after being used and emptied, said crates are closed again by collapsing their vertical walls inward.

[0002] These crates can be of different sizes, both due to the type of contents and mostly for their different uses and the requirements of the market.

[0003] The purpose of this operation is to decisively reduce the overall volume of said crates, because after being used they must be rearranged so they can be returned to the collection and filling centres.

[0004] This requirement has been clearly explained in patent WO 2012/156375 filed by the present patent holder, and which is referred to here for the sake of brevity and thus will not be discussed further.

[0005] The same patent also introduces a relative method for opening in a fully automatic mode the folded side walls of a plurality of crates, preferably for horticultural products, provided with a bottom plane and with two pairs of opposite walls, individually hinged on said bottom plane, that are arranged in an identical and ordered manner, and lie vertically one on top of the other so as to form a relative first stack, in which said method comprises the following operations:

[0006] a) transportation of said first stack to a first arrival and loading station;

[0007] b) vertical lifting of two opposite front walls of the upper crate by their respective rotation with respect to said bottom plane;

[0008] c) vertical lifting of the other two front walls of said upper crate through their respective rotation with respect to said bottom plane;

[0009] d) blocking at least one of said side walls with an adjacent side wall;

[0010] e) transfer of said open crate horizontally to a position external to the vertical projection of said first stack;

[0011] f) in which, preferably between the previous operations a) and b), said first stack is lifted up to a level where the upper crate, with the walls reclined, reaches a predetermined level (L) in a first working station;

[0012] g) and after said lifting to said level, said upper crate is blocked with respect to said first working station through means that operate laterally on said first bottom plane of the upper crate.

[0013] Said procedure and the relative apparatus have proven to be fully effective and adequate in all the working environments where they are used to solve the problem as defined above.

[0014] However, it was also frequently found that, in actual operation, said apparatus poses working limits that are increasingly evident as its application is extended and optimized, both in relation to the type of horticultural products carried and, in particular, in relation to the fact that the marketing and distribution chain downstream of the phase of opening and filling the crates is extremely fragmented and diversified, in the sense that it is necessary to load crates having very different dimensions and capacity, including also the height of the crate walls.

[0015] To meet this requirement, it would obviously be sufficient to provide, install and use a single machine for every crate type and size; however, this would not really be an acceptable solution on the economic and operating plane, also because of the waste of spaces that could be used in other ways, as can be immediately appreciated by an expert in the field.

[0016] The optimal solution would consist in fact of providing a single apparatus for opening the crates and their subsequent stacking that is capable of operating with crates of very different sizes, including their relative height.

[0017] It would thus be desirable, and it is the main objective of the present invention, to realize an apparatus that is suitable to carry out, according to known methods, the completely automatic opening and blocking of a plurality of closed crates, specifically for use as containers of horticultural products, supplied in succession and associated as respective individual stacks, and, after their opening, to supply said open crates still associated as respective stacks; according to the invention, this apparatus must be provided with devices suitable to be adapted to the size of crates having different dimensions, including the relative heights, in which said devices, and the actuators of the same, can be operated and adjusted so as to "process" crates of different dimensions, in a simple, immediate, safe and economic manner.

[0018] This objective is achieved with an apparatus made according to the enclosed claims.

[0019] Characteristics and advantages of the invention will be evident from the description which follows, given by way of non-limiting example, with reference to the enclosed drawings, wherein:

[0020] FIGS. **1** and **2** illustrate a vertical plan view of a first sub-assembly of the inventive apparatus in two distinct operating modes.

[0021] FIGS. **3** and **3**A illustrate two views from above of the sub-assembly of the previous figures, in two different and respective states of operation.

[0022] FIG. **4** is a plan view on a vertical plane and symbolic of the movement of the crates and of the relative support mountings, in their extreme positions, in the first stack of closed crates.

[0023] FIG. **4**A illustrates a simplified perspective view of the crates in the two extreme positions of FIG. **4**.

[0024] FIG. **5** illustrates a plan view from above of another sub-assembly of the inventive apparatus.

[0025] FIG. **5**A shows a simplified perspective view of the sub-assembly of FIG. **5**, relative to the stacks of closed crates.

[0026] FIGS. **5**B and **5**C illustrate respective views, similar to FIG. **5**, of the same sub-assembly in two distinct states of operation.

[0027] FIG. **6** illustrates a plan view on a vertical and symbolic plane of the movement of the crates and of the relative support mountings, in the relative extreme positions, in the final stack of open crates.

[0028] FIG. **6**A is a simplified and perspective view of the crates in the two extreme positions of FIG. **6**.

[0029] FIG. **7** shows a plan view from above of another sub-assembly of the inventive apparatus, relative to the stacks of open crates.

[0030] FIG. **7**A shows a simplified perspective view of the sub-assembly of FIG. **7**.

[0031] FIGS. **7**B and **7**C illustrate respective views, similar to FIG. **7**, of the same sub-assembly in two different states of operation.

[0032] FIG. **8** is a concise, plane, vertical and side view of the inventive apparatus.

[0033] FIG. **9** illustrates a diagonal perspective view from above of the apparatus of FIG. **8**.

[0034] FIG. **10** is a plan view from above of the apparatus of FIGS. **8** and **9**.

[0035] FIG. **11** illustrates a particular constructive mode of the apparatus, viewed as in FIG. **8**.

[0036] FIGS. **12** and **13** illustrate respective perspective views of the apparatus shown generally in FIG. **9**, but separated into its two component work stations.

[0037] FIGS. **14** and **15** illustrate two perspective views of the inventive apparatus seen from two viewing points almost diagonally opposite to each other.

[0038] Although the present invention refers specifically to an apparatus and a process that theoretically could be disposed in different attitudes and orientations, it will still be evident that it can be in its best and typical embodiment in an apparatus supported on a horizontal plane and with the crates piled vertically, both when closed and when open; therefore, the description should be read with particular reference to the drawings, and thus the terms "above", "below", "upper", "lower", etc. that could be used refer logically to this normal arrangement of the apparatus.

[0039] Since an apparatus according to the invention is very complex and articulated in construction due to the quantity of components and devices, and of the support and connecting means etc. in general that must be assembled, the following description will refer to schematic and symbolical drawings and/or figures that are very different, in their representation, from the corresponding means and devices used in the actual apparatus of the invention; the purpose of such a choice of the type of representation is aimed exclusively at facilitating the understanding of the invention for the reader, focusing the reader's attention only on the elements that are being described.

[0040] On the other hand, if the aptness of said representations is to be checked with an actual apparatus according to the invention, the enclosed FIGS. **14** and **15** provide an expert in the field with the necessary and sufficient information to distinguish in said figures the main assemblies or functional groups that are represented in the detailed but symbolic figures, and described one by one.

[0041] In the description which follows, the numerical indications between parentheses refer to the already cited patent WO 2012/156375; moreover, here it is explicitly explained that the present invention consists of a markedly improved evolution of the apparatus described in the cited patent.

[0042] Herein will be described in detail only the parts, devices and operating procedures that are individually and specifically comprised in the various aspects of the present invention; thus it remains understood that the parts, subassemblies functional devices and operating procedures not expressly described herein are the same as those extensively described in the cited patent WO 2012/156375, and therefore for the sake of concision and simplicity they are omitted in the present patent.

[0043] And, as in the cited patent, the apparatus of the present invention is made up—from the functional, but not constructive point of view—of two distinct working stations, that is, a first station S-**1**, where the succession of stacks of closed crates arrives and that is provided with devices and mechanisms to open the individual crates one at a time, and to carry them to a second station S-**2**, where the same succession of crates, which now however are open, are stacked again and finally carried outside the whole apparatus.

[0044] From the cited patent WO 2012/156375 is known an apparatus suitable to open in a fully automatic mode the reclined side walls of a plurality of crates (**1**), preferably for agricultural products, provided with a bottom plane (**2**) and with two pairs of opposed walls (**3**, **3**A,-**4**, **4**A), each of them hinged on said bottom plane, arranged in an identical and ordered manner, and lying vertically upon each other so as to form a first relative stack (**11**).

[0045] Such apparatus is designed to carry out the following operations:

[0046] a) carrying said first stack (**11**) to a first arrival and loading station (S-**1**),

[0047] b) vertical lifting of two opposed front walls (**3**, **3**A) of the upper crate by rotating them with respect to said bottom plane (**2**);

[0048] c) vertical lifting of the other two opposed front walls (**4**, **4**A) of said upper crate by their respective rotation with respect to said bottom plane (**2**);

[0049] d) locking in place at least one (**4**A) of said side walls with at adjacent side wall (**3**A);

[0050] e) transferring said open crate (**1**) horizontally to a position outside the vertical projection of said first stack (**11**).

[0051] For what concerns this last phase "e", that is, the transfer of said open crate (**1**) horizontally to a position outside the vertical projection of said first crate (**11**), the same cited patent teaches that said transferring operation e) is carried out through the use of a blocking and transferring device that can:

[0052] be initially lowered until it is inserted inside the open crate;

[0053] be operated so as to increase one of its horizontal dimensions so as to contact the side edges (**4**S, **4**S**1**) of two opposite walls, and to engage by pushing said two edges (**4**S, **4**S**1**) with corresponding edges (**3**C, **3**C-A) of the other two walls;

[0054] remain engaged by pressure with said crate and be transferred on a horizontal plane, possibly also after a lifting operation, so as to also automatically transfer said crate.

[0055] Said blocking and transferring device comprises an operating body (**202**) on which are applied, from opposite sides, two respective horizontal rods, (**203**, **203**A) that support respective command boxes (**204**, **204**A), each of which is provided with at least one respective blocking means (**205**, **205**A) that can move selectively and controllably inward, that is, toward said operating body **202**, or in the opposite direction, that is, outward.

[0056] Said operating body (**202**) is supported and moved by a vertical rod (**201**) that can be telescopically and controllably extended and retracted and that is in turn supported by a central body (**200**), that can be controllably lifted and lowered vertically, and that can be translated on a horizontal plane.

[0057] What is described above is prior art disclosed in the cited patent WO 2012/156375.

[0058] With reference to FIGS. **1** and **2**, according to a first aspect of the present invention, said central body **200** and said underlying vertical rod are moved vertically not only for a downward stroke, and subsequent upward stroke, with a travel of preset length for each type of crate included in the underlying stack of closed crates, so as to push against a pair of opposed vertical walls of the newly-opened underlying crate, but the length of the downward and upward stroke of

said travel of preset length is made dependent on the height of the same crate, that is, in practice, on the height of the respective vertical walls.

[0059] In FIG. **1** is symbolically illustrated the case in which at a first stack of crates "M", the top crate has a height h**1**, while in FIG. **2** is symbolically illustrated the case in which at a second stack of crates "N", the top crate has a height of h**2**>h**1**.

[0060] Thus, when changing from one type of crate to another type having different heights of the respective vertical walls, the two respective overall downward travels C**1**, C**2** of said vertical rod **201** and thus of said operating body **202**, and therefore of the respective sub-assemblies comprising the operating body **202** and the relative horizontal operating rods (**203**, **203**A), relative to the two different types of crates, must be differentiated by an extent ΔR=C**1**−C**2**.

[0061] This characteristic, that is, the capacity of regulating the extent of the lowering/lifting travel and therefore the position of the central body **200** and of the operating body **202** is not only defined by predefined standardized parameters, such as principally the position of the crate to be opened located on the top of the relative stack, but according to this first aspect of the invention said lowering/lifting travel extent is obtained through command and control means, in themselves known and not further illustrated, that regulate said lowering/lifting travel based on specific commands and instructions sent to said command and control means and that naturally include the information, possibly coded, representative of the height of the vertical walls of the type of crate being processed.

[0062] More generally, the summary information concerning the type of crate being processed is entered, which information includes not only the information regarding the height of the vertical walls, but also the information on the plan dimensions of the crate.

[0063] The fundamental aspect of said command and control means actuated according to the type of crate will be dealt with later, as this is an essential factor for the present invention.

[0064] A second aspect of the invention regards the manners in which said horizontal rods engage and push against the vertical walls **4** and **4**A (see FIG. **3**) of the open crate on top of the stack, which must be held and lifted.

[0065] For this purpose, to adjust to the various possible widths of the crate being processed, said horizontal rods **203** and **203**A are provided with respective distancing members **203**B and **203**A-B, each capable of extending and selectively shortening the length of the respective rod **203** and **203**A.

[0066] Said distancing members are in turn controlled by suitable command and control devices, known in the field and which will be described in detail later.

[0067] The two FIGS. **3** and **3**A illustrate schematically but clearly the case of two distinct crates that are already opened but provided with different widths "L**1**" and "L**2**".

[0068] Moreover, as shown in FIGS. **3** and **3**A, said horizontal rods **203** and **203**A support respective command boxes (**204**, **204**A), each of which is equipped with at least one respective blocking means (**205**, **205**A), which can be moved selectively and controllably toward the inside, that is, toward said operating body **202**, or in the opposite direction, that is, toward the outside.

[0069] In this manner, by suitably operating on said respective distancing members **203**B and **203**A-B, said horizontal rods **203** and **203**A can be selectively dimensioned in their horizontal extension so that the respective blocking means (**205**, **205**A) can come into contact with, and controllably push against, the opposite walls **4**, **4**A of the respective crate (for the sake of simplicity, the same numerals **4** and **4**A are used to indicate the two opposite walls of crates, even when the crates have different widths L**1** and L**2**).

[0070] The difference with respect to the previous situation, when said distancing members **203**B and **203**A-B are moved to increase and selectively shorten the length of the respective rod **203** and **203**A, lies in the fact that, in the case of the prior art apparatus, the stroke to reciprocally increase and shorten the length of the respective rod **203** and **203**A is a predefined stroke, that is, a fixed extent, while in the present case the extent of said stroke is varied in a selectively controllable manner, through command and control means that will be better specified later, naturally on the basis of the width L**1**, L**2**, etc., of the type of crate being processed.

[0071] The manners and the means with which the successive stacks of closed crates are carried inside the first lifting and opening station S-**1** to be opened will now be considered.

[0072] As is known from the aforementioned WO 2012/156375, the individual stacks of closed crates are carried progressively by transportation means, particularly conveyors, and stacked in said first station S-**1**.

[0073] Here are arranged two distinct lowering structures and relative blocking means, which are used as means to support the individual and successive stacks of closed crates.

[0074] The means and manners for lifting one by one the successive stacks of closed crates are known from the above-mentioned patent, and consist of lifting at specific moments said lifting structures by an extent equal to the height of the closed crate, so that each closed crate is carried to the desired position for the subsequent opening operation, and then for the subsequent transportation to the next station S-**2**.

[0075] This operation is repeated for all the crates of the stack present in the first station S-**1**, until the stack is emptied.

[0076] At this point, naturally the support structures used to lift the stack are in the uppermost position of their movement and, to allow the cycle for the next stack to be repeated, said support structures must be lowered again to where they reach the lower position so as to make it possible to load on them a new stack of closed crates.

[0077] The composition and the operation of said blocking means and of the relative lifting structures will now be explained in detail.

[0078] With reference to FIGS. **4**, **4**A, the lifting means for the successive stacks of closed crates consist of pairs of lifting mountings **47**, **47**A-**48**, **48**A that are initially applied below the stack of closed crates to be lifted, and that are then lifted, with known means, so as to lift the stack lying on it for an upward travel that is equal to the total thickness, or vertical dimension, of each closed crate.

[0079] With reference to figures from **4** to **7**C, herein we will use the indicator numeral **47** to identify a first pair of lifting mountings that are aligned in a direction parallel to the feeding direction "X" of the crates and that are located, suitably separated horizontally from each other, substantially below a corresponding edge of the crates, and similarly we will use the indicator numeral **48** to indicate a second pair of lifting mountings that act on the other edges of the respective crates and that are substantially symmetrical to the first pair of lifting mountings **47** with respect to a plane of symmetry:

[0080] vertical and parallel to said direction "X";

[0081] and that intersects vertically the entire apparatus and passes typically through the centre line of the means (conveyors, roller tables, etc.) feeding the stacks of crates into and out of the apparatus.

[0082] In fact, as indicated in WO 2012/156375, the top crate on the stack is opened, lifted and removed from the stack; this frees the space occupied by the newly opened and removed top crate, and then each stack of closed crates is progressively lifted in a stepwise sequence or at subsequent moments, so that this space accommodates the subsequent underlying crate.

[0083] After all the crates in a stack have been lifted in succession and then opened and carried away, the space of the newly "processed" stack is taken by a new stack of closed crates to be opened.

[0084] However, it is clear that the same lifting mountings of the subsequent stacks of crates, after the last crate on top of the stack has been opened and carried elsewhere, must move back down to return to the initial position, which is where the same lifting mountings engage from below a newly arrived stack of closed crates.

[0085] It will however be evident that the movement downward of said lifting mountings cannot occur directly and with only a vertical displacement, because otherwise said lifting mountings would interfere, in their downward movement, with the new stack of empty crates, which in the meantime has been carried to the same crate opening station.

[0086] On the other hand, even if technically feasible, it is not absolutely useful to have a new stack of closed crates moving to the first station S-**1** only after the supports/mountings are lowered, since this procedure would require the various operations to be carried out in series (instead of in "masked time" as in the solution described here), which as is well known would "use up" a considerable amount of time, and as a final undesirable consequence would correspondingly lower the general productivity of the whole apparatus.

[0087] In order to return said lifting mountings downward, and with reference to FIGS. **4** and **4**A, the following characteristics and operating procedures are implemented:

[0088] Said lifting mountings are lifted according to the following sequence:

[0089] a) widening of the distance between the lifting mountings, from the first, initial distance N**1** to a second distance N**2**, in order to allow the insertion with a horizontal movement of a new stack between the two pairs of lifting mountings **47**, **47**A-**48**, **48**A;

[0090] b) synchronized lowering of the two pairs of lifting mountings **47**, **47**A-**48**, **48**A for an equal travel "S" so as to bring them again below the lower starting position;

[0091] c) re-approaching the same lifting mountings **47**, **47**A-**48**, **48**A to each other to bring them to the initial distance "N**1**"; this makes it possible to adjust the two pairs of lifting mountings according to a first plan dimension of the crates;

[0092] d) lifting of the same lifting mountings for a vertical travel "L" so that they intercept from below a new stack of crates and allow the subsequent stepwise lifting of the same, which determines the start of a new processing cycle.

[0093] For the sake of simplicity, in FIGS. **4** and **4**A the stack of crates is shown by illustrating only the top crate **1**; it is assumed that this simplification will not complicate the understanding of the explanation, considering also FIGS. **1** and **2**, in which the top crate in the stack of closed crates is identified by number **1**.

[0094] Thus it will be evident that such movements of the two pairs of lifting mountings make it possible to easily and quickly return them to the initial position, with the new stack already arrived in the first station S-**1**, which makes it possible to eliminate unnecessary wastes of time by making the various operating mechanisms and devices operate in "masked time", that is, by carrying out different operations in the same time interval.

[0095] It is pointed out that the main objective of the invention is to open crates that could be even significantly different in their dimensions on the horizontal plane, that is, in their relative width and length.

[0096] To take this fact into account, and thus to make it possible to lift the stacks of closed crates having different plan dimensions, it is necessary to be able to suitably and sequentially adjust the pairs or support and lifting mountings—which engage from below the lower crate of the stack and progressively lift them, so as to lift all the stack until the whole stack is depleted—both in the sense of adjusting the distance between the blocking means of different pairs, that is, in effect, to take into account the WIDTH of the crates, and in the sense of adjusting the distance between blocking means belonging to the same pair, that is, in practice, to take into account the LENGTH of the crates.

[0097] For what concerns the WIDTH, this has been already considered in the previous description; in fact, the spreading of the lifting mountings to the new distance (in width) N**2** will necessarily have to take into account the width of the crates, so as not to interfere with the lowering movement of the lifting mountings.

[0098] It goes without saying, as being too obvious to require further explanation, that if a stack is fed having crates that are, for example, very narrow compared to the previous ones, then said second distance N**2** will have to take this into account, that is, it must change, since the previous distance N**1** relative to wider crates may be completely insufficient to correctly engage the base of these latter, much narrower crates.

[0099] For what concerns the second dimension on the horizontal plane, that is the LENGTH of the crates, in order to adjust the distance "Z" between the blocking means of each pair of lifting mountings **47**, **47**A and **48**, **48**A, said lifting mountings are applied to respective support frames **470** and **480** (see FIGS. **5**, **5**A), which perform the double function of:

[0100] effectively transmitting the lifting/lowering movement to the relative ones of said lifting mountings, and

[0101] adjusting the distance "Z" between the blocking means of each pair of lifting mountings **47**, **47**A and **48**, **48**A.

[0102] In essence, each lifting mounting **47**, **47**A and **48**, **48**A belonging to one and the same pair of lifting mountings must be able to be distanced from/approached to the other lifting mounting in the same pair in order to make it possible to adjust, as explained above, the second horizontal dimension, that is, the length, of the support base as a function of the effective length of the bottom crate in the overlying stack of closed crates.

[0103] For this purpose, the position of said two pairs of lifting mountings **47**, **47**A and **48**, **48**A is made selectively controllable, on the horizontal plane, so that the reciprocal

distance from **47** to **47**A, and from **48** to **48**A can be modified, naturally on the basis of the "length" of the crates being processed, and with a direction substantially parallel to said plane of vertical symmetry and parallel to said direction "X".

[0104] This result is obtained by engaging in a mobile and translatable manner each of said lifting mountings **47**, **47**A and **48**, **48**A with respect to the corresponding support frame **470**, **480**, so that, for example, and with reference to figures from **5** to **5**C, the two pairs of lifting mountings, that is, the two lifting mountings of the pair **47**, **47**A, and the two lifting mountings of the pair **48**, **48**A can be reciprocally positioned at a distance that varies from the minimum value "Zmin" to the maximum value "Zmax".

[0105] For what concerns the requirement of also adjusting the support base relative to the stack of the already opened crates, this can be achieved with operating procedures, devices and manners in every way similar, although different in their implementation, to those just described above to adapt the support base of the stack of closed crates.

[0106] For this purpose, and with reference to FIGS. **6** and **6**A, the following characteristics are implemented: in the case of the upward/downward movement, that is, in practice, the controlled and progressive lowering of the stack of open crates, which are contained in the second station S-**2**, two pairs of suitable and respective pairs of lifting mountings **57**, **57**A and **58**, **58**A are arranged.

[0107] A first pair of lifting mountings **57**, **57**A is applied to a respective support and lowering frame **570**, and likewise a second pair of lifting mountings **58**, **58**A is applied to a respective lowering frame **580**.

[0108] As shown in the figures, said two lowering frames, and the relative lifting mountings, are used as a means of support of the open crates that are progressively carried there and stacked by said blocking and transferring device comprising the operating body **202** with respective horizontal rods **203**, **203**A and command boxes **204**, **204**A.

[0109] The means and manners for lowering the successive stacks of open crates are suitably completely similar to what is applied and explained for lifting the stacks of closed crates, but obviously the procedures for the vertical movements are reversed, because in the present case said second station S-**2** is realized for lowering the stacks of crates (and not for lifting them, as in the station S-**1**).

[0110] After having formed a stack of open crates through progressive piling of successive open crates, and thus corresponding lowerings of the relative stack being formed, the stack is completely lowered.

[0111] At this point, as is known, the stack is removed from the station S-**2** with known means, and the pairs of the respective lifting mountings must be lifted again to receive a new open crate and thus to form a successive stack.

[0112] With reference to FIGS. **6** and **6**A, this re-lifting operation consists essentially of the following individual and sequential phases:

a**1**) widening of the distance between the lifting mountings of a first pair **57**, **57**A and the lifting mountings of the second pair **58**, **58**A, in other words from a first distance K**1** to a second distance K**2**, in order to allow the extraction with a horizontal movement of the newly formed stack made up of open crates between the two pairs of lifting mountings, in a horizontal direction "Y" orthogonal to the direction "X" seen before;

b**1**) synchronized lifting of the two pairs of lifting mountings **57**, **57**A and **58**, **58**A for an equal travel "R" so as to return them to the level "V" of the starting upper position;

c**1**) re-approaching (again in the direction "Y") of the same lifting mountings to each other so as to return them to the initial distance "K**1**", this makes it possible to adjust the two pairs of lifting mountings according to a first plan dimension of the crates, and that is in this case based on the width of the same.

[0113] It will be fully evident, on the basis of the description supplied before for what concerns the support frames of the lifting mountings in the first station S-**1**, that said vertical and downward movement of the two pairs of lifting mountings **57**, **57**A and **58**, **58**A is obtained by applying the corresponding vertical movement to the respective ones of said support frames **570**, **580**.

[0114] In the present case, it is not necessary to also apply a final vertical travel to definitively level the position of the two pairs of lifting modules **57**, **57**A and **58**, **58**A, since the vertical lifting travel "R" of the same can already be stopped in the most appropriate position.

[0115] For what concerns the second horizontal dimension, that is, to also adjust the length of the support base formed by the two pairs of lifting mountings **57**, **57**A and **58**, **58**A, it becomes necessary to adjust consequentially the distance "T" between the lifting mountings of each pair of lifting mountings **57**, **57**A and **58**, **58**A; for this purpose, and in a manner completely similar to the previous case in the first station S-**1**, the effective lifting/lowering movement is first applied to said support frames **570** and **580** (see FIGS. **7** and **7**C), which transmit it to said two respective pairs **57**, **57**A and **58**, **58**A.

[0116] Each lifting mounting belonging to a same pair must thus be able to be separated from/approached to the lifting mounting of the same pair so as to be able to adjust, as mentioned above, the second dimension on the horizontal plane, that is the length, of the support frame which must support the bottom crate of the stack of open crates, that are to be carried outside the apparatus of the invention.

[0117] For this purpose, the position of said two pairs of lifting modules **57**, **57**A and **58**, **58**A is made selectively controllable, on the horizontal plane, that is, in length, and with a direction parallel to said direction "X" (obviously, the same as the direction "X" seen previously) orthogonal to the spreading/narrowing direction K**1**, K**2** defined above.

[0118] This result is obtained by engaging in a mobile and translatable manner each of said lifting modules **57**, **57**A and **58**, **58**A with respect to the corresponding support frame **570** and **580**, so that, for example and with reference to FIGS. **7**B and **7**C, the four lifting modules, in other words the two of the pair **57** and **57**A, and the two of the pair **58**, **58**A, can be reciprocally positioned at a distance that varies from the minimum value "Tmin" to the maximum value "Tmax".

[0119] With reference to FIGS. **8**, **9**, **10**, **11**, **12**, **13**, **14** and **15**, said apparatus can be advantageously formed by the joining of two component frames, as follows:

[0120] a first frame **400** (see FIG. **12**) is formed as a straight parallelepiped with a rectangular cross section and includes at least four vertical columns **100**, **101**, **102**, **103** arranged at the corners of the parallelepiped, in which its four faces are, two by two, parallel to each other or orthogonal to each other; these columns are joined at the top and at the bottom by four respective horizontal bars **100**A, **100**B, **100**C, **100**D; obviously, two horizontal bars are arranged on a first vertical plane

"VL1", while the other two horizontal bars are arranged on a second vertical plane "VL2", obviously parallel to said first plane "VL1"; said planes are represented by the respective straight lines "VL1" and "VL2" (see FIGS. 12 and 13) that simply indicate the corresponding intersecting straight lines of the same planes with a horizontal plane passing through the opposite bottom horizontal bars 100B and 100D.

[0121] It is essential that said first frame 400 has been described individually because it contains within it said first station S-1, which contains some of the devices described above, and contains in particular the four lifting modules relative to the stacks of closed crates, that is, the two of the pair 57 and 57A, and the two of the pair 58, 58A.

[0122] As will be better explained hereafter, these lifting modules will have to have a precise positioning with respect to said first frame 400.

[0123] Likewise, the second frame 401 (see FIG. 13) substantially similar to the first frame 400, comprises at least four vertical columns 200, 201, 202, 203 arranged at the corners of the parallelepiped, in which its four faces are, two by two, parallel to each other or orthogonal to each other at a same vertical plane "VL2"; these columns are joined at the top and at the bottom by four respective horizontal bars 200A, 200B, 200C, 200D; in this case, too, two horizontal bars are arranged on the first vertical plane "VL1", while the other two horizontal bars are arranged on the second vertical plane "VL2", obviously parallel to said first plane "VL1".

[0124] Said two frames 400, 401 are thus joined and integrated with further horizontal bars, not specifically indicated, in the sense that they are made to slide along said first vertical planes "VL1" and "VL2" so as to join and form a solid structure 1000, like two vertical, parallel and side-by-side walls.

[0125] Moreover, as can be seen and shown symbolically in FIG. 9, said parallel vertical planes "VL1" and "VL2" are also parallel to the common direction "X" of alignment of the stacks of closed crates that feed the apparatus, and of alignment of the stacks of open crates that are carried outside the same apparatus.

[0126] Essentially, the basic structure of the apparatus comprises a support frame shown symbolically in the figures from 8 to 11.

[0127] In particular, and with reference to FIG. 10, the various functions of the apparatus provided to adapt it to the different widths of the crates (where the term "width" means the transversal dimension "Y" exemplified by the dimensions L1 or L2, see FIGS. 3, 4, and that is orthogonal to said direction "X") can be easily obtained by simply moving apart or approaching selectively to each other by a preselectable distance the parts of said frame that are substantially included in the vertical and mutually parallel planes "VL1" and "VL2" of said two frames 400, 401 by means of a pair of worm screws 420, 421, aligned with each other and parallel to said transversal distance "Y", said screws 420, 421 being applied, on a respective side, to a gearing box 330, and on the other side to a respective lateral and reciprocally symmetrical portion 500, 600, as shown schematically in FIG. 10 (each of which being included in a respective one of said parallel planes "VL1" and "VL2"), of said frames 400, 401; in fact, these frames, once joined to one another, can also be separated into two side portions 500, 600, symmetrical with respect to the middle and parallel vertical plane of said direction "X".

[0128] Said gearing box 330 is in turn connected, in a known manner, to a drive shaft 340 suitable to be rotated so that its rotation determines, through said gearing box 330, the moving apart or the moving toward each other of the parts of said side portions 500, 600 of two frames 400, 401.

[0129] Said action of adjusting the distance between said two frames makes it possible to control in a stable and synchronized manner the distance, according to said direction "Y", of all the operating bodies in accordance with the different and variable widths of the stacks of crates that can follow each other in feeding the apparatus.

[0130] In particular, among other things, the adjustment of the distance between said two side portions 500, 600 makes it possible to widen or approach said frames 470, 480 to each other (for the stacks of closed crates) and similarly, and in a synchronized manner, also the frames 570, 580 for the stacks of open crates.

[0131] Thus it will be evident that all the eight lifting mountings included in the four pairs of lifting mountings, two pairs 47, 47A and 48, 48A in the loading station S-1 and two pairs 57, 57A and 58, 58A in the lowering station S-2, are spread apart or approached in a completely equivalent manner.

[0132] Finally, with reference to FIG. 11, it is advantageous that the overall crate opening station, comprising in particular said vertical axis 201, and the relative central body 200 and operating body 202, and naturally said pairs of lifting mountings 47, 47A and 48, 48A and the relative working devices, is symmetrical with respect to a vertical plane "PV" passing through the centre of said vertical axis 201 and orthogonal to said common direction "X".

[0133] For greater clarity, in FIGS. 5, 5B and 5C is symbolically shown with the straight line "PV" the line intersecting said plane of symmetry and a general horizontal plane.

[0134] This circumstance makes it possible in fact to maintain the position of said vertical axis 201 completely stable and invariable even if there are changes in the width and especially in the length (direction "X") of different crates of various stacks, since it is sufficient that:

[0135] said crates be "centred" on said plane "PV" and thus on said vertical axis 201;

[0136] and that said differences in the dimensions between one type of crates and another type are automatically transmitted to said command and control means, that recognize and adapt to the different dimensions of the crates simply by adjusting correspondingly said distances "Zmin and Zmax" between the lifting mountings 47 and 47A, and between the lifting mountings 48, 48A of the respective pairs of lifting mountings.

[0137] In addition, the positioning of the successive stacks of closed crates is done automatically by adjusting the feeding of the respective stack in said first station "S-1" up to the point in which the distance in length (axis "X") of the respective stacks is centred exactly on said vertical plane "PV".

[0138] Summing up, the operating bodies and devices described to adapt the apparatus to crates having different dimensions, including their height, are the following:

[0139] 1) means for lowering the central operating body 202 by adjustable strokes C1, C2,

[0140] 2) means for distancing and shortening 203B and 203A-B the respective horizontal bars;

[0141] 3) means for widening, lowering (S), narrowing and possible limited lifting (T) of the two pairs of lifting mountings 47, 47A and 48, 48A through the displace-

ment of the respective support frames **470**, **480** to which said pairs are respectively applied;

[0142] 4) adjustment of the distance (Z) between the lifting mountings of each pair of lifting mountings in the first station S-**1**,

[0143] 5) means for widening, lifting (R) and reciprocally approaching the two pairs of lifting mountings **57**, **57***a* and **58**, **58**A through the displacement of the respective support frames **570**, **580** to which said pairs are respectively applied;

6) adjustment of the distance (T) between the lifting mountings of each pair of lifting mountings in the second station S-**2**;

[0144] 7) adjustment of the distance between said two symmetrical portions **500**, **600** of said two similar and opposite frames **401**, **402** through said gearing box **330** and relative drive shaft **340**.

[0145] According to an improved embodiment of the invention, all said operating bodies, various actuators, lifting, lowering and rotation means, drive means, approaching and/or distancing means, etc., are connected to a command and control unit—not shown—in which are previously stored all the controls to actuate with a prearranged sequence and particularly by a predefined extent all said bodies, devices, means, etc., on the basis of the complete dimensions of each type of crate to be opened.

[0146] In this manner, it is immediately possible to enter a single instruction into said command and control unit so that said bodies, devices, actuators, etc., are positioned or are activated automatically on respective positions suitable to process a crate of predefined dimensions already converted into respective corresponding parameters stored in said command and control unit.

[0147] Moreover, the same unit is also made suitable to store in an ordered and appropriately combined manner the parameters corresponding to a plurality of types of crates having different dimensions, so that, as a person skilled in the field will have already understood, it is immediately possible to enter into said command and control means a simple coded instruction representative of a particular type of crate and to automatically have said command and control means process and transmit to said bodies, devices, actuators, etc., the appropriate signals suitable to determine their correct positioning or in general the operating mode corresponding to the type of crate selected.

[0148] The implementation of said command and control unit, and the programming of the relative memories and instructions, is however an activity that can be fully carried out by the expert in the field, and therefore it will not be explained further.

[0149] In addition, said controls, structures, operating bodies, devices, actuators generally described above and providing displacements, distances, rotations, operating sequences of control bodies, etc., can be implemented and operated through known means and modes, that can be realized ideally without any difficulty, on the basis of the existing requirements, by an expert in the field, and therefore they will not be expressly illustrated.

1. An apparatus to fully automatically open the side and reclined walls of a plurality of crates preferably for agricultural products, provided with a bottom plane and with two pairs of opposed walls, each of them hinged on said bottom plane, which are arranged in the same and ordered way, and vertically laid one on the other so as to form a respective first stack, and able of performing the following operations:

a) carrying said first stack into a first loading station,

b) vertically raising two opposed walls of the upper crate by respective rotation with respect to said bottom plane,

c) vertically rising of the other two opposed walls of the upper crate by respective rotation with respect to said bottom plane,

d) blocking of at least one of said side walls to an adjacent side wall,

e) horizontally transferring said open crate into a position outside the vertical projection of said first stack, wherein after said operation in a), and before said operation in b), said first stack is lifted to a level such as the crate in the upper position and with the reclined side walls, reaches a pre-determined level into said first working station,

f) lowering of said crate until a support level of the respective bottom plane on a second working station able of forming a train of opencrates,

wherein said blocking d) and transferring e) operations are carried out through the use of a centre operating body able:

of being initially lowered until it is introduced into an opened crate,

being acted so as to increase one horizontal size and to contact the side edges of two opposed walls, and to engage by pushing said two edges to corresponding edges of the other two walls,

to keep on engaged by pushing said crate and to be horizontally transferred, possibly after a lifting motion, so as to automatically transfer said crate,

wherein said centre operating body is able to be lowered for strokes, which can be selectively differentiated, with respect to a common initial level.

2. The apparatus according to claim **1**, wherein said operating body is connected to horizontal means for the motion transmission whose horizontal size is selectively controllable through respective distancing members, the opposed ends of which are joined to respective command boxes, each of them being provided with at least a respective blocking means horizontally oriented, said distancing members being able of selectively increasing a corresponding size so that said couple of supports do engage with two opposed walls of the upper crate so that said crate is lifted and successively transferred on an horizontal plane.

3. The apparatus according to claim **1**, wherein said first station is able of lifting, one by one, a train of stacks of closed crates, and comprising:

two supporting frames which are parallel and horizontally extended, each provided with a couple of respective lifting mountings able of supporting a respective stack of closed crates,

working devices able of impressing to said supporting frames a shifting train which includes:

increasing of the reciprocal horizontal distance from a first distance to a second distance,

synchronous lowering of said supporting frames,

re-approaching of said supporting frames to the starting distance,

incidental final lifting of same said supporting frames for a predefined amount.

4. The apparatus according to claim **3**, wherein said supporting frames comprise means able of changing, in a selec-

tively controlled way, the distance between the mountings of each respective mounting couple.

5. The apparatus according to claim **1**, wherein said second station is able of building-up and lowering, one by one, a train of stacks of open crates, and comprising:

two supporting frames two supporting frames which are parallel and horizontally extended, each provided with a couple of respective lowering mountings able of supporting a respective stack of open crates,

working devices able of impressing to said supporting frames a shifting train which includes:

increasing of the reciprocal horizontal distance from a first distance to a second distance,

synchronous lifting of said supporting frames,

re-approaching of said supporting frames to the starting distance.

6. The apparatus according to claim **5**, wherein said supporting frames comprise means able of changing, in a selectively controlled way, the distance between the mountings of a respective couple of mountings.

7. The apparatus according to claim **1**, wherein it comprises:

a first frame formed as a right parallelepiped with at least two vertical columns arranged on a same vertical plane, joined on the bottom and on the top by two respective horizontal bars, wherein said first frame is able of lodging said first station,

a second frame remarkably similar to the first frame with at least two vertical columns arranged on a same vertical plane, joined on the bottom and on the top by two respective horizontal bars, wherein said first frame is able of lodging said first station,

wherein said vertical planes, are parallel to each other and also parallel to the common direction of alignment of the stacks of closed crates,

wherein said two frames form two side, vertical and symmetrical portions

and means able of modifying the transverse distance between said side portions in the way orthogonal to said common direction through devices able of selectively adjusting said distance, preferably a couple of trimming set screws which are aligned to each other and parallel to said transverse distance engaged to a respective side to a gearing box, and to the opposed side to a respective of said structures, wherein said same gearing box is joined to a command axis able of being activated into rotation.

8. The apparatus according to claim **1**, wherein said vertical axis and relevant central body and said operating body, and said couples of lifting mountings re symmetrical with respect to a vertical plane passing on the centre of said vertical axis and orthogonal of said common direction.

9. The apparatus according to claim **1**, wherein it comprises control and command means able of:

storing the parameters/data corresponding to a plurality of crates types showing different sizes,

introducing into said control and command means a coded instruction representing a specific type of crate and automatically obtaining that said control and command means do elaborate and send to said operating devices, members, devices actuators, suitable signal able of determine in them the correct operations corresponding to the selected type of crate.

10. The apparatus according to claim **2**, wherein said first station is able of lifting, one by one, a train of stacks of closed crates, and comprising:

two supporting frames which are parallel and horizontally extended, each provided with a couple of respective lifting mountings able of supporting a respective stack of closed crates,

working devices able of impressing to said supporting frames a shifting train which includes:

increasing of the reciprocal horizontal distance from a first distance to a second distance,

synchronous lowering of said supporting frames,

re-approaching of said supporting frames to the starting distance,

incidental final lifting of same said supporting frames for a predefined amount.

11. The apparatus according to claim **2**, wherein it comprises:

a first frame formed as a right parallelepiped with at least two vertical columns arranged on a same vertical plane, joined on the bottom and on the top by two respective horizontal bars, wherein said first frame is able of lodging said first station,

a second frame remarkably similar to the first frame with at least two vertical columns arranged on a same vertical plane, joined on the bottom and on the top by two respective horizontal bars, wherein said first frame is able of lodging said first station,

wherein said vertical planes, are parallel to each other and also parallel to the common direction of alignment of the stacks of closed crates,

wherein said two frames form two side, vertical and symmetrical portions

and means able of modifying the transverse distance between said side portions in the way orthogonal to said common direction through devices able of selectively adjusting said distance, preferably a couple of trimming set screws which are aligned to each other and parallel to said transverse distance engaged to a respective side to a gearing box, and to the opposed side to a respective of said structures, wherein said same gearing box is joined to a command axis able of being activated into rotation.

12. The apparatus according to claim **3**, wherein it comprises:

a first frame formed as a right parallelepiped with at least two vertical columns arranged on a same vertical plane, joined on the bottom and on the top by two respective horizontal bars, wherein said first frame is able of lodging said first station,

a second frame remarkably similar to the first frame with at least two vertical columns arranged on a same vertical plane, joined on the bottom and on the top by two respective horizontal bars, wherein said first frame is able of lodging said first station,

wherein said vertical planes, are parallel to each other and also parallel to the common direction of alignment of the stacks of closed crates,

wherein said two frames form two side, vertical and symmetrical portions

and means able of modifying the transverse distance between said side portions in the way orthogonal to said common direction through devices able of selectively adjusting said distance, preferably a couple of trimming set screws which are aligned to each other and parallel to

said transverse distance engaged to a respective side to a gearing box, and to the opposed side to a respective of said structures, wherein said same gearing box is joined to a command axis able of being activated into rotation.

13. The apparatus according to claim **4**, wherein it comprises:

a first frame formed as a right parallelepiped with at least two vertical columns arranged on a same vertical plane, joined on the bottom and on the top by two respective horizontal bars, wherein said first frame is able of lodging said first station,

a second frame remarkably similar to the first frame with at least two vertical columns arranged on a same vertical plane, joined on the bottom and on the top by two respective horizontal bars, wherein said first frame is able of lodging said first station,

wherein said vertical planes, are parallel to each other and also parallel to the common direction of alignment of the stacks of closed crates,

wherein said two frames form two side, vertical and symmetrical portions

and means able of modifying the transverse distance between said side portions in the way orthogonal to said common direction through devices able of selectively adjusting said distance, preferably a couple of trimming set screws which are aligned to each other and parallel to said transverse distance engaged to a respective side to a gearing box, and to the opposed side to a respective of said structures, wherein said same gearing box is joined to a command axis able of being activated into rotation.

14. The apparatus according to claim **5**, wherein it comprises:

a first frame formed as a right parallelepiped with at least two vertical columns arranged on a same vertical plane, joined on the bottom and on the top by two respective horizontal bars, wherein said first frame is able of lodging said first station,

a second frame remarkably similar to the first frame with at least two vertical columns arranged on a same vertical plane, joined on the bottom and on the top by two respective horizontal bars, wherein said first frame is able of lodging said first station,

wherein said vertical planes, are parallel to each other and also parallel to the common direction of alignment of the stacks of closed crates,

wherein said two frames form two side, vertical and symmetrical portions

and means able of modifying the transverse distance between said side portions in the way orthogonal to said common direction through devices able of selectively adjusting said distance, preferably a couple of trimming set screws which are aligned to each other and parallel to said transverse distance engaged to a respective side to a gearing box, and to the opposed side to a respective of said structures, wherein said same gearing box is joined to a command axis able of being activated into rotation.

15. The apparatus according to claim **6**, wherein it comprises:

a first frame formed as a right parallelepiped with at least two vertical columns arranged on a same vertical plane, joined on the bottom and on the top by two respective horizontal bars, wherein said first frame is able of lodging said first station,

a second frame remarkably similar to the first frame with at least two vertical columns arranged on a same vertical plane, joined on the bottom and on the top by two respective horizontal bars, wherein said first frame is able of lodging said first station,

wherein said vertical planes, are parallel to each other and also parallel to the common direction of alignment of the stacks of closed crates,

wherein said two frames form two side, vertical and symmetrical portions

and means able of modifying the transverse distance between said side portions in the way orthogonal to said common direction through devices able of selectively adjusting said distance, preferably a couple of trimming set screws which are aligned to each other and parallel to said transverse distance engaged to a respective side to a gearing box, and to the opposed side to a respective of said structures, wherein said same gearing box is joined to a command axis able of being activated into rotation.

16. The apparatus according to claim **2**, wherein said vertical axis and relevant central body and said operating body, and said couples of lifting mountings re symmetrical with respect to a vertical plane passing on the centre of said vertical axis and orthogonal of said common direction.

17. The apparatus according to claim **3**, wherein said vertical axis and relevant central body and said operating body, and said couples of lifting mountings re symmetrical with respect to a vertical plane passing on the centre of said vertical axis and orthogonal of said common direction.

18. The apparatus according to claim **4**, wherein said vertical axis and relevant central body and said operating body, and said couples of lifting mountings re symmetrical with respect to a vertical plane passing on the centre of said vertical axis and orthogonal of said common direction.

19. The apparatus according to claim **5**, wherein said vertical axis and relevant central body and said operating body, and said couples of lifting mountings re symmetrical with respect to a vertical plane passing on the centre of said vertical axis and orthogonal of said common direction.

20. The apparatus according to claim **6**, wherein said vertical axis and relevant central body and said operating body, and said couples of lifting mountings re symmetrical with respect to a vertical plane passing on the centre of said vertical axis and orthogonal of said common direction.

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