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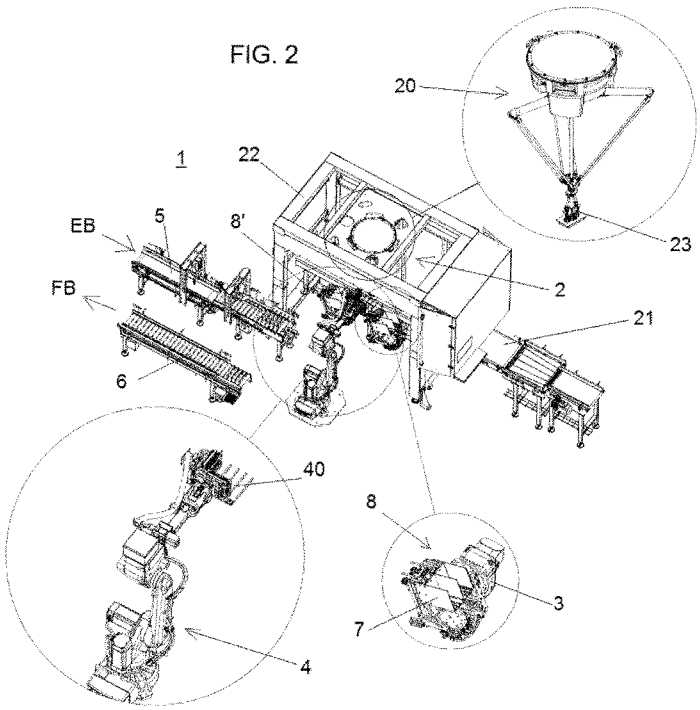
(54) Title: PACKING CELLS AND METHODS

FIG. 2



(57) Abstract: A packing cell for packing products in boxes comprises a picking system for picking products and stacking them according to a stacking pattern, a support unit (3) for the stacking process, with a rotatable horizontal shaft for placing a support platform (30) in a predetermined angular position for the stacking process, and a box handling robot (4) to transfer empty boxes EB towards the support unit and full boxes FB away from the support unit. A method comprises placing the support platform in a predetermined angular position adjacent a product picking system, picking and stacking a number of products according to a stacking pattern on the support unit, and removing from the support unit, with a box handling robot, a box containing the stacked products.

[Continued on next page]

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Packing cells and methods

The present disclosure relates to packing cells for packing products in boxes, with a picking system for picking products and stacking them according to a stacking pattern, as well as to packing methods. Such packing cells and methods provide a flexible and efficient packing operation, which may be easily and quickly adapted to different product types, box types and stacking patterns.

BACKGROUND ART

It is known to pack a number of products into a box of a certain shape and type, for example “A box” case, wraparound case, display box case, etc. The products may be arranged in each box according to different stacking patterns, e.g. vertical, horizontal, single or double array, etc. In a packing system, products may for example be fed on a conveyor and transferred by a picking robot into boxes of a certain case type, according to a certain stacking pattern; in other examples the products may be collated into a packing pattern on a blank, and the blank may then be wrapped around the products.

In known packing systems and solutions, the change from working with one case kind and stacking pattern to working with a different case kind and/or a different stacking pattern involves making substantive changes in the configuration of the system in order to position the boxes in a suitable way, allow the movements of the picking robot required for a certain stacking pattern, etc. Even in simple changes such as from horizontal stacking pattern to vertical stacking pattern the system model needs to be changed; for different sizes of the same case type the whole mechanism of belts, stoppers, flaps etc. must be changed in order to shift from one size to another.

The changes from one case kind and stacking pattern to another are therefore time consuming, involving significant downtimes of the line, require having available several different and sometimes cumbersome units which are only used part of the time and need to be stored when not in use, etc.

It would therefore be desirable to improve the flexibility and efficiency of known packing and stacking systems, such that they are able to work with different case types and stacking patterns with minimum and quick adaptations.

SUMMARY

According to one aspect, the present disclosure provides a packing cell for packing products in boxes, comprising a picking system for picking products and stacking

them according to a stacking pattern, a support unit for the stacking process, the support unit comprising a support platform and a rotatable horizontal shaft for placing the support platform in a predetermined angular position for the stacking process, and a box handling robot arranged to transfer empty boxes towards the support unit and full boxes away from the support unit.

Such a packing cell, where a support unit intended for stacking products thereon, has a rotatable support platform that can be placed in different angular positions, allows adapting the cell to different stacking patterns, e.g. horizontal stacking or vertical stacking, simply by rotating the support platform, without the need to make any further change, and therefore provides a flexible and efficient packing system, which can be easily and quickly to adapted to different packing operations. Furthermore the box handling robot, by virtue of its programming potential, allows feeding and removing boxes in any suitable position of the support unit.

The box handling robot may be adapted to transfer empty boxes towards the support unit prior to the stacking operation, so the boxes are filled with products according to a stacking pattern and then removed by the robot; alternatively, the box handling robot may be adapted to transfer empty boxes towards the support unit after the stacking operation, such that products that are stacked on the support unit itself are then transferred to the empty boxes, and then the boxes are removed by the robot. In examples of the present disclosure, the support platform may comprise a tool changer master plate, and the packing cell may further comprise one or more build-up bases, each provided with a tool changer tool plate adapted to be coupled to the tool changer master plate of the support unit.

The support unit together with a build-up base mounted thereon constitute an easily configurable stack positioner, on which a stack of products may be formed by the picking system in a desired stacking pattern.

The provision of several build-up bases each configured for a box type and/or stacking pattern, which may be selectively coupled to the support unit, results in a very flexible packing cell, which is suitable to handle different types of boxes and stacking patterns, and for which any new arrangement may be added simply by providing a build-up base, without the need for changes in the overall layout and configuration of the cell. The attachment of the build-up bases to the support unit using a tool changer system, with mating parts on the support platform of the support unit and on the build-up bases, allows for fast and efficient changes from working e.g. with one box type to working with another.

The build-up base or bases may comprise a bottom and one or more walls defining between them a holding space: the holding space may be configured to hold products stacked in it by the picking system and intended to be transferred into a box in a subsequent step, or may alternatively be configured to hold a box, so the box may directly receive the products from the picking system.

In some examples one or more of the walls may be rotatable and/or linearly displaceable. This allows adapting the build-up base to different kinds and sizes of products, stacking patterns, etc., and also moving the walls between a stacking position in which they allow some tolerance in the stacking operation, so the picking system may operate faster, and a transfer position in which they are moved closer to each other to enclose the products in a smaller volume, so a smaller box may be used, so transport and storage costs may be saved.

In examples of packing cells according to the present disclosure, a cell may comprise two or more stack positioners, i.e. two or more support units, such that one may be in operation to receive products from the picking system while boxes may be uploaded and/or downloaded from the other. Furthermore, in some examples the two stack positioners may be provided with different build-up bases and/or have the support platform arranged in different positions, to allow simultaneously packing different types of boxes and stacking patterns.

According to another aspect, the present disclosure also provides a packing method for packing products in boxes, comprising operating a support unit to place a support platform mounted on a rotatable shaft in a predetermined angular position adjacent a product picking system, operating the picking system to pick and stack a number of products according to a predetermined stacking pattern on the support unit, and operating a box handling robot to remove from the support unit a box containing the stacked products.

In some examples, at least two build-up bases, adapted to different box types, may selectively be mounted on the support platform of the support unit to form different stack positioners. The mounting of the different build-up bases on the support unit may be made by providing mating tool changer elements, as disclosed herein for embodiments of the packing cell, so the method may allow packing products in several types of boxes and in several desired stacking patterns, efficiently and with minimum downtimes.

In examples of the method, the handling robot may be operated to place an empty box on the stacked products once they have been stacked on the support unit, for

example at least partly around the walls of a build-up base on which the products are stacked, and the support platform may then be rotated such as to transfer the stacked products into the empty box, before the handling robot removes the box from the support unit. In some embodiments of the method, the handling robot may rotate the box synchronized with the rotation of the support platform; in alternative examples, the box handling robot may place the empty box on the stacked products and withdraw (for example to load or remove a full box from another support unit of the same packing cell), while the support platform rotates to transfer the stacked products into the empty box, with a gripper of the support unit at the same time retaining the box to prevent its disengagement, and the box handling robot may then remove the full box after it is released in a lower position by the support unit.

In other examples of the method, the box handling robot may first place an empty box on the support unit so the box receives the products from the picking system, and the box handling robot may then remove the box from the support unit after the products have been stacked therein by the picking system.

DESCRIPTION OF THE DRAWINGS

Non-limiting examples of the present disclosure will be described in the following, with reference to the appended drawings, in which:

Figure 1 is a schematic diagram of a packing cell according to examples disclosed herein.

Figure 2 is a perspective view of an example packing cell according to the present disclosure.

Figures 3a and 3b show an example of a support unit as disclosed herein;

Figure 4 shows an example of a build-up base as disclosed herein;

Figures 5a and 5b show the build-up base of Figure 4 coupled to the support unit of Figures 3a, 3b;

Figure 6 shows a partial front elevation view of a packing cell according to an example of the present disclosure, having two support units; and

Figures 7, 8 and 9 are flowcharts of example methods for packing products in boxes, according to the present disclosure.

DETAILED DESCRIPTION

A packing cell according to embodiments of the present disclosure may be operated to pack products, for example personal articles, objects, cans, bottles, packaged food products, or any other kind of product, in boxes of several different kinds and shapes.

Throughout the description and claims, the word "boxes" is employed to refer to boxes, cases, cartons or any similar container, which may be made of cardboard, plastic or other materials and employed for storing, transporting, shipping or otherwise handling a number of articles or products. The products may be arranged in each box according to different stacking patterns, e.g. vertical or horizontal, in single array, in double array, etc. Products may for example be fed to the packing cell on a conveyor, and transferred by a picking robot or other handling device into the boxes in the packing cell.

As shown very schematically in the diagram of Figure 1, a packing cell 1 may comprise a picking system 2 for picking products and stacking them according to a stacking pattern; a support unit 3 for the stacking process, and a box handling robot 4. The support unit 3 may comprise a rotatable support platform 30, i.e. a support platform mounted on a rotatable shaft (not shown in Figure 1), which may adopt a suitable angular position for the stacking process: for example, it may be placed in horizontal position for a horizontal stacking pattern, or in a position inclined at an angle, suitable for stacking products in a vertical stacking pattern.

In such a packing cell 1, the support platform 30 of the support unit 3 may be placed in a suitable angular position adjacent the product picking system 2, and the picking system 2 may operate to pick and stack an array of products P according to a predetermined stacking pattern, using the support platform 30. The box handling robot 4 may transfer empty boxes EB towards the support unit 3, to be filled with stacked products, and transfer full boxes FB away from the support unit 3.

Figure 2 shows in perspective view and in more detail a packing cell 1 according to an example. The packing cell 1 in Figure 2 comprises a picking system 2 which may comprise a picking robot 20 (see enlarged detail of Figure 2); a product feeding conveyor 21, to feed the products to be packed to the position of the picking robot 20; a frame 22, to hold the picking robot 20, the support unit 3, a camera and a control unit (not shown), etc.; as well as a tool 23, which can hold the products and can quickly be connected/changed by a tool changer device to the picking robot 20. In this example the picking robot 20 may be a parallel robot, for example a model known as ABB FlexPicker™, available from ABB, Sweden.

The packing cell 1 also comprises a box handling robot 4 (see enlarged detail of Figure 2), in this case an articulated serial robot, e.g. a six-axis robot, provided with a box handler 40 as an end effector, for example provided with a vacuum system on one or two sides, to hold a box in place during its movement. As shown, the box handling robot 4 may be mounted at one side of the product feeding conveyor 21 and the picking robot 20. A box feeding conveyor 5 may be arranged within reach of the box handling robot 4, for feeding empty boxes EB to the packing cell 1 with the robot 4, and a box output conveyor 6 may be similarly arranged within reach of the box handling robot 4, for removing full boxes FB from the packing cell 1 with the robot 4.

A support unit 3 (see enlarged detail of Figure 2) may be arranged between the picking robot 20 and the box handling robot 4. In Figure 2 one such support unit 3 is shown enlarged, but a second support unit may be provided adjacent the support unit 3.

Each support unit 3 may have coupled to it a build-up base 7, as shown in the enlargement of Figure 2 for support unit 3. The build-up base 7 will be described in more detail below.

The assembly of the support unit 3 and the build-up base 7 constitutes a stack positioner 8, as shown in the enlarged detail of Figure 2. A second stack positioner 8' is also shown in the packing cell 1 in Figure 1.

A support unit 3 according to an example is shown in more detail in Figures 3a and 3b.

Figures 3a and 3b show in perspective view and side view a support unit 3 comprising a support platform 30. The support platform 30 may be attached to a mounting plate 31, which in turn may be keyed in rotation to a rotatable shaft 32 (not visible in the figures and indicated with a dotted reference line), driven by a motor 33 and intended to be arranged horizontal during use. The support platform 30 may therefore be rotated around a horizontal axis, and oriented or placed in a suitable angular position for a stacking operation.

The support unit 3 may be attached to the structure of the packing cell, for example at one side of the product feeding conveyor 21 or on a profile of the frame 22, with the rotatable shaft 32 horizontal and at right angles to the direction of advance of the conveyor 21; the support platform 30 may therefore rotate in a vertical plane parallel to the direction of advance of the conveyor 21.

The rotatable support platform 30 may have attached to it a tool changer master plate 34. By tool changer, also known as a quick-change device, it is meant a coupling

device with two mating parts, usually referred to as master plate and tool plate, which are designed to lock or couple together, either manually or automatically, and have the ability pass from one side to the other utilities such as electrical signals, pneumatic, and/or other. They may also be designed to carry a payload. The master plate usually carries a locking mechanism, for example mechanical or pneumatic, and the tool side carries suitable elements to be engaged by the locking mechanism. A tool changer employed in examples of the present disclosure may be of any known type, for example it may be an automatic tool changer that uses pneumatics to lock the two parts together.

Figure 4 shows in perspective view a build-up base 7 according to one example, which may be mounted on a support unit such as support unit 3 of Figures 3a and 3b to form a stack positioner 8, as shown by way of example in Figure 2, for packing products conveniently stacked in boxes.

As shown, the build-up base 7 may comprise a bottom 70 and a number of walls 71a, 71b, 71c, 72a, 72b, defining between them a holding space 73. When the stack positioner 8 is in operation in a packing cell 1 such as shown in Figure 2, the picking robot 20 may take products from the product feeding conveyor 21 and stack them according to a programmed stacking pattern in the holding space 73 of the build-up base 7: in this case, in a double array separated by wall 71b.

Furthermore, the build-up base 7 shown in Figure 4 may be suitable for example for vertical stacking, since the absence of one side wall allows the picking robot 20 to enter the holding space 73 from the open side and place the products vertically, one next to the other in each row of the array.

Moreover, the build-up base 7 shown in Figure 4 may be suitable for example for horizontal stacking, by adding a displaceable and/or rotatable wall (not shown) to the top side of the build-up base 7, and rotating the support platform 30 with the build-up unit 7 (Figure 5a) until the walls 72a and 72b are arranged horizontal and parallel to the direction of advance of the conveyor 21 (Figure 2).

Still with reference to Figure 4, it may be seen that in the lower side, the build-up base 7 may comprise a tool changer tool plate 74, adapted to mate with the tool changer master plate 34 of the support unit 3, such that mounting or removing the build-up base 7 to or from the support unit 3 may be fast and easy.

The build-up base 7 may further have handles 75 for gripping and carrying it.

At least some walls of the build-up base 7, such as walls 71a, 71b, 71c, 72a, 72b, may be linearly displaceable or rotatable, and suitable motors or actuators may be

provided to change the position as convenient, for example to provide holding spaces of different sizes. For example, linear actuators 76a and 76b visible in Figure 4 may be provided for displacing walls 72a and 72b, respectively.

Figures 5a and 5b show in perspective view and side view a stack positioner 8, comprising a support unit 3, such as that of Figure 3a, 3b, and a build-up base 7 such as that of Figure 4, attached to each other by the coupling of the master plate 34 of the support unit 3 and the tool plate 74 of the build-up base 7, like visible also in the packing cell 1 of Figure 2.

A packing cell 1 according to examples of the present disclosure may comprise more than one support unit 3, and therefore more than one stack positioner 8.

Figure 6, for example, is a partial view in elevation of a packing cell 1 showing more clearly than Figure 2 the two stack positioners 8 and 8', arranged side by side and adjacent to the frame 22 under the product feeding conveyor 21. In the figure, the supports 3 and 3' of the two stack positioners 8 and 8' have attached to them identical build-up bases 7 and 7', but they may also be provided with different build-up bases and may be operated with their support platforms arranged in different positions, such that the packing cell 1 may stack products in two different boxes and/or with different stacking patterns, in the same operation.

Turning back to Figure 2, an example packing cell 1 such as shown in this figure and with a stack positioner 8 as described with reference to Figures 5a and 5b may operate according to the following example method, as illustrated in the flowchart of Figure 7, to stack products vertically and in a double array in a box of the type illustrated by way of example in Figure 1 (EB and FB).

The support unit 3 of the stack positioner 8 is fixed in the packing cell 1, on the side of the product feeding conveyor 21 from which the picking robot 20 may pick the products to be packed, with the rotatable shaft 32 in horizontal position.

In block 700, the build-up base 7 is attached to the support platform 30 of the support unit 3 by coupling together the master plate 34 and tool plate 74 of the tool changer system.

In block 710, the motor 33 and shaft 32 of the support unit 3 may be rotated through an angle, to arrange the support platform 30 and the build-up bases 7 in a stacking position, for example inclined a suitable angle for vertical stacking, as shown in Figures 2, 5a, 5b.

Then, in block 720, the picking robot 20 may start picking products from the conveyor 21 and stacking them vertically and in double array in the holding space 73 of the build-up base 7, between walls 72a and 72b, and between walls 72b and 72c.

Once the predetermined number of products to fill a box are stacked on the build-up base 7, in block 730 the box handling robot 4 may take an empty box EB from the box feeding conveyor 5, and place it, upside down, over and around the build-up base 7, e.g. around at least part of the walls and the stacked products.

In block 740 the motor 33 and shaft 32 of the support unit 3 may rotate the support platform 30 with the build-up base 7, the stacked products and the box, through an angle of between 90° and 180°, until the build-up base 7 and the box are substantially inverted, and the products may be transferred from the build-up base 7 into the box.

According to one example, the box handling robot 4 may hold the box in position on the build-up base 7 during the rotation of the build-up base 7, in a synchronized operation. According to other examples, the robot 4 may withdraw after placing the box on the build-up base 7, and the base itself may hold the box attached to it during the rotation, for example by means of a gripper (not shown).

In both these examples, at the end of the rotation, in block 750, the box handling robot 4 transfers the box, which is now full, to the box output conveyor 6, which removes the full box FB from the packing cell 1.

In block 760 the support platform 30 and the build-up bases 7 are rotated to place them back in the stacking position for the next cycle.

In order to assist in transferring the products from the build-up base 7 into the box, instead of relying only on gravity, the build-up base 7 may comprise a pusher (not shown) for pushing the stacked products away from the bottom 70 of the build-up base 7.

Moving walls of a build-up base 7, such as walls 72a and 72b in Figure 4, may also be employed to first configure the build-up base 7 in a stacking condition, in which the holding space is larger, allowing some tolerance in the stacking operation, so the picking system may operate faster, and then, once the products are stacked in the holding space, configure the build-up base 7 in a product-transfer condition, in which some walls may be moved to reduce the holding space, enclosing the products in a smaller volume. This may allow packing the same number of products in a smaller box to reduce transport and storage costs

When a packing cell comprises two stack positioners 8 and 8', such as in Figure 6, the picking robot 20 may stack products on one stack positioner 8, while the products previously stacked in the other build-up base 7' of the other stack positioner 8' are transferred into a box, the box is removed, and the stack positioner 8 rotates back to the suitable stacking position, ready to receive products.

A packing cell 1 may comprise several different build-up bases 7, each provided with a tool changer tool plate 74, adapted to be coupled to the tool changer master plate 34 of a support unit 3, to form different stack positioners 8. Each build-up base 7 may be constructed with different dimensions, walls, actuators, etc., for example adapted to one kind of box. A build-up base 7 may also be able to adapt for example to a number of different boxes, e.g. by rotating, linearly displacing or adding/removing one or more walls.

One build-up base or another may be coupled to a support unit 3 of the packing cell 1 for a certain packing operation, depending on the boxes to be filled, the stacking pattern, etc. When a different kind of boxes has to be filled in a subsequent packing operation, the build-up base may be easily replaced with a different one by virtue of the tool changer system.

A packing cell 1 may also comprise stack positioners (not shown) where the holding space of the build-up base is configured and dimensioned for holding a box, such that the box may directly receive the products from the picking system 2.

Such build-up base or bases may comprise a bottom and a holding space over the bottom, configured to hold a box.

A packing cell 1 such as shown in Figure 2 and with a support unit 3 as described with reference to Figures 3a, 3b but with a build-up base (not shown) configured for holding a box, may operate according to the example method illustrated in the flowchart of Figure 8, to stack products directly in the box, for example a box of the type illustrated by way of example in Figure 1 (EB and FB).

The support unit 3 is fixed in the packing cell 1, connected to the frame 22 below or on the side of the product feeding conveyor 21 from which the picking robot 20 may pick the products to be packed, with the rotatable shaft 32 in horizontal position.

In block 800, the build-up base is attached to the support platform 30 of the support unit 3 by coupling together the master plate 34 of the support unit and the tool plate of the build-up base.

In block 810, the motor 33 and shaft 32 of the support unit 3 may be rotated through an angle, to arrange the support platform 30 and the build-up base inclined a suitable angle for vertical stacking; or arrange the support platform 30 and the build-up base horizontal, for horizontal stacking.

In block 820 the box handling robot 4 may take an empty box from the box feeding conveyor 5 and place it on the build-up base on the support unit 3.

Then, in block 830, the picking robot 20 may start picking products from the conveyor 21 and stacking them vertically inside the box placed on the build-up base.

Once a predetermined number of products are stacked in the box, in block 840 the box handling robot 4 may take the full box from the build-up base and place it on the box output conveyor 6, which removes the full box FB from the packing cell 1.

Next, in block 850, the box handling robot 4 may take a new empty box from the box feeding conveyor 5 and place it on the build-up base on the support unit 3, for the next cycle.

A packing cell with two support units, such as 3 and 3' in Figure 2, may also operate as described with reference to Figure 8; in such a case, for example, the picking robot 20 may stack products in a box placed on the build-up base on one support unit 3, while the box-handling robot 4 is removing a full box FB from the build-up base of another support unit 3', and providing a new empty box EB thereon.

Further example methods for packing products in boxes, which may employ a packing cell according to any of the examples disclosed above, may generally comprise, as illustrated in the flowchart of Figure 9:

- In block 900, operating a support unit to place a support platform mounted on a rotatable shaft in a stacking position, e.g. in a predetermined angular position adjacent a product picking system,
- In block 910, operating the picking system to pick and stack a number of products according to a predetermined stacking pattern on the support unit, and
- In block 920, operating a box handling robot to remove from the support unit a box containing the stacked products.

In some examples, at least two build-up bases, adapted to different box types, may selectively be mounted on the support platform of the support unit, depending on the box to be filled. The mounting of the different build-up bases on the support unit may

be made by providing mating tool changer elements, as disclosed herein for embodiments of the packing cell.

Although only a number of examples have been disclosed herein, other alternatives, modifications, uses and/or equivalents thereof are possible. Furthermore, all possible combinations of the described examples are also covered. Thus, the scope of the present disclosure should not be limited by particular examples, but should be determined only by a fair reading of the claims that follow. If reference signs related to drawings are placed in parentheses in a claim, they are solely for attempting to increase the intelligibility of the claim, and shall not be construed as limiting the scope of the claim.

CLAIMS

1. A packing cell for packing products in boxes, comprising:

- a picking system for picking products and stacking them according to a stacking pattern,
- a support unit for the stacking process, the support unit comprising a support platform and a rotatable horizontal shaft for placing the support platform in a predetermined angular position for the stacking process, and
- a box handling robot arranged to transfer empty boxes towards the support unit and full boxes away from the support unit.

2. A packing cell according to claim 1, wherein the support platform comprises a tool changer master plate, and the packing cell further comprises one or more build-up bases, each provided with a tool changer tool plate adapted to be coupled to the tool changer master plate of the support unit.

3. A packing cell according to claim 2, wherein one or more of the build-up bases comprise a bottom and one or more walls defining between them a holding space.

4. A packing cell according to claim 3, wherein one or more of the walls are rotatable and/or linearly displaceable.

5. A packing cell according to any one of claims 2 to 4, wherein one or more of the build-up bases comprise a pusher for pushing stacked products away from the build-up base.

6. A packing cell according to any one of claims 2 to 5, wherein one or more of the build-up bases are adapted to support boxes for receiving the products from the picking system.

7. A packing cell according to any one of the preceding claims, comprising at least two support units for the stacking process, each comprising a support platform with a tool changer master plate and a rotatable horizontal shaft for rotating the support platform.

8. A packing cell according to any one of the preceding claims, further comprising a box feeding conveyor, arranged within reach of the box handling robot, for feeding empty boxes to the packing cell.

9. A packing cell according to any one of the preceding claims, further comprising a box output conveyor arranged within reach of the box handling robot, for removing full boxes from the packing cell.

10. A packing cell according to any one of the preceding claims, wherein the picking system comprises a product feeding conveyor and picking robot arranged to pick products from conveyor and stack them on the support units.

11. A packing method for packing products in boxes, comprising:

- operating a support unit to place a support platform mounted on a rotatable shaft in a predetermined angular position adjacent a product picking system,
- operating the picking system to pick and stack a number of products according to a predetermined stacking pattern on the support unit, and
- operating a box handling robot to remove from the support unit a box containing the stacked products.

12. A method according to claim 11, further comprising providing at least two build-up bases adapted to different box types, and mounting one of the build-up bases on the support platform of the support unit before placing the support platform of the support unit in a predetermined angular position.

13. A method according to any one of claims 11 or 12, wherein the step of operating the box handling robot to remove from the support unit the box containing the stacked products comprises:

- operating the handling robot to place an empty box on the stacked products on the support unit, and
- operating the support unit to rotate the support platform such as to transfer the stacked products into the empty box, and
- operating the handling robot to remove the box from the support unit.

14. A method according to claim 13, wherein the step of operating the support unit to rotate the support platform such as to transfer the stacked products into the empty box further comprises operating the box handling robot to rotate the box synchronized with the rotation of the support platform.

15. A method according to any one of claims 11 or 12, further comprising, before the step of operating the picking system to pick and stack products on the support unit, the step of operating the box handling robot to place an empty box on the support unit to receive the products from the picking system.

FIG. 1

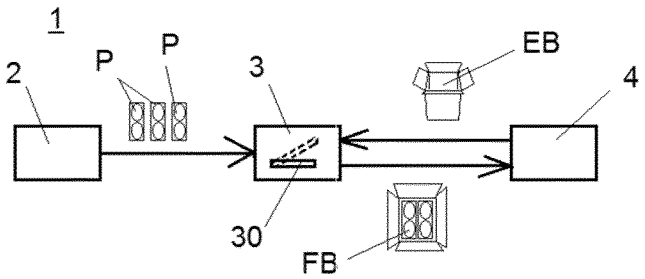


FIG. 2

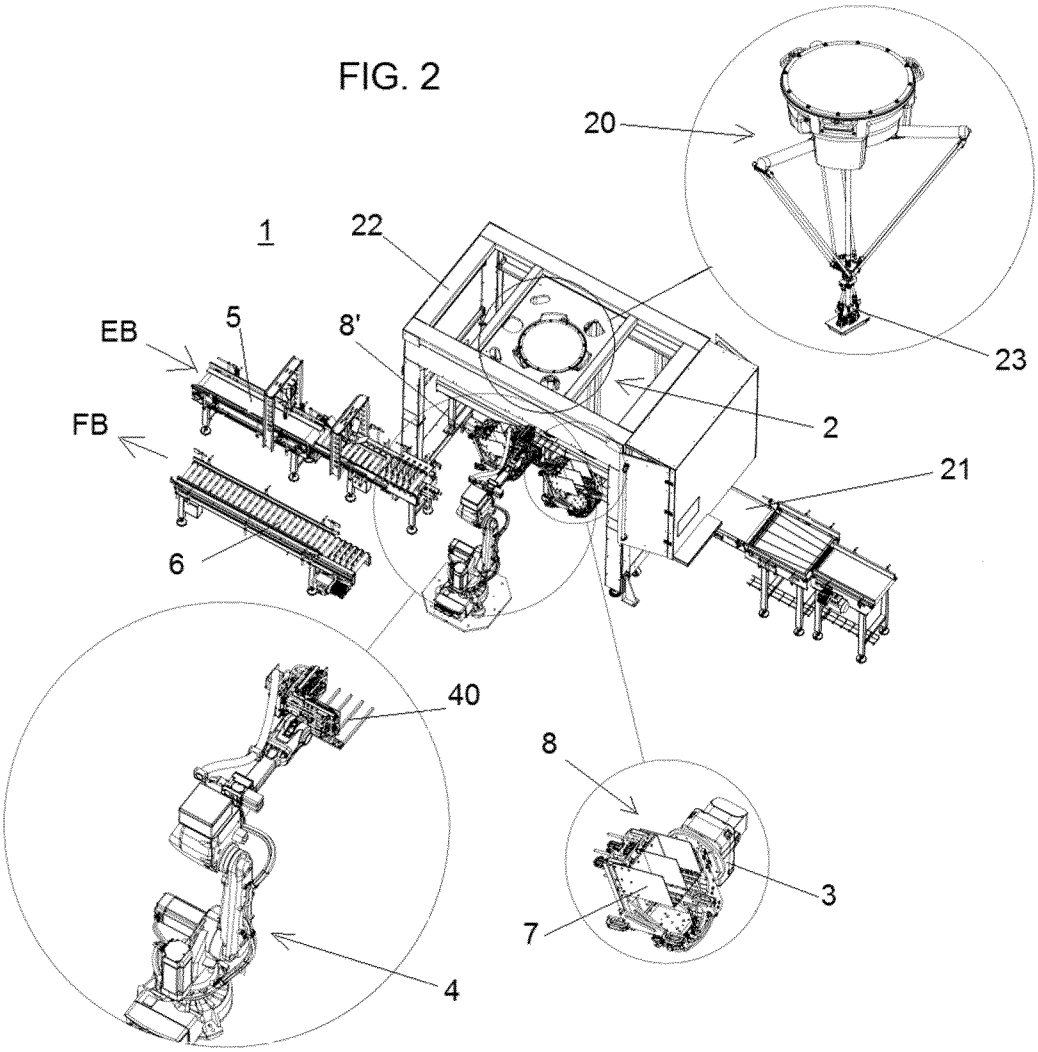


FIG. 4

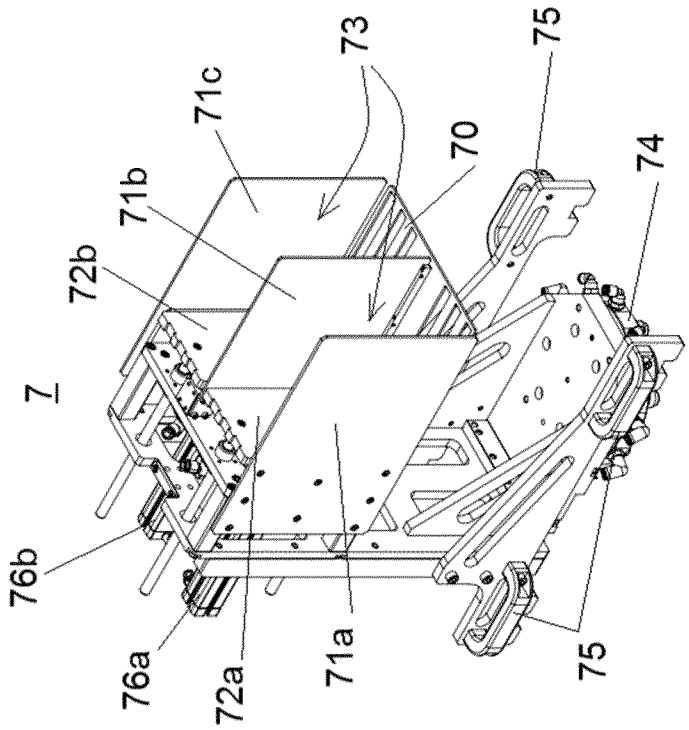


FIG. 3a

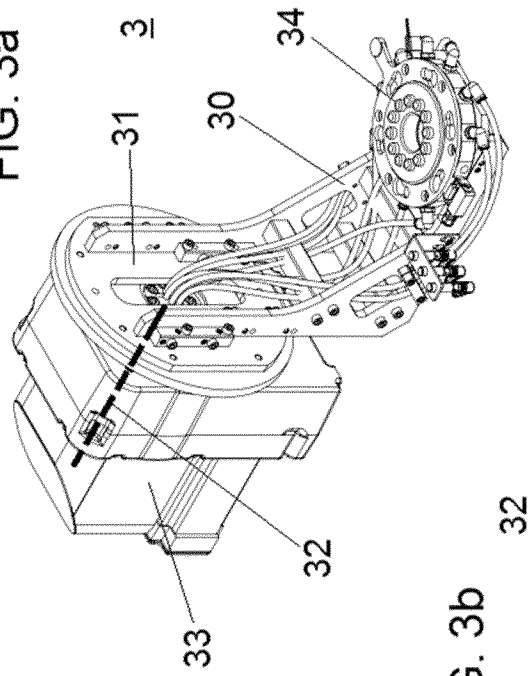


FIG. 3b

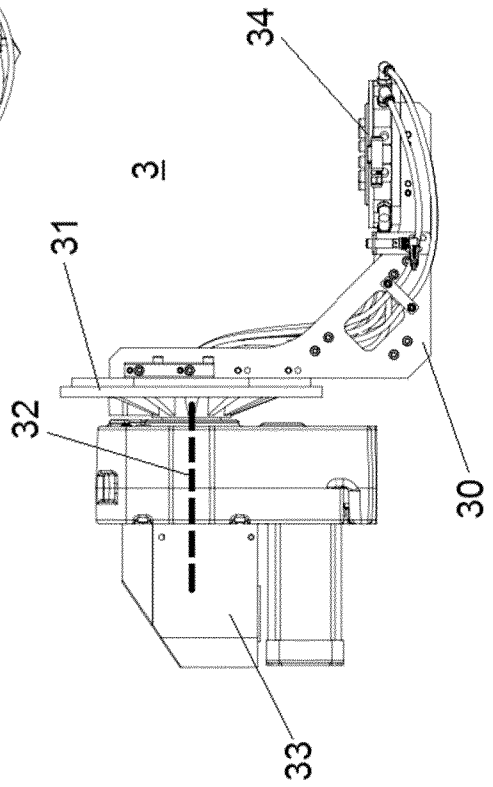


FIG. 5a

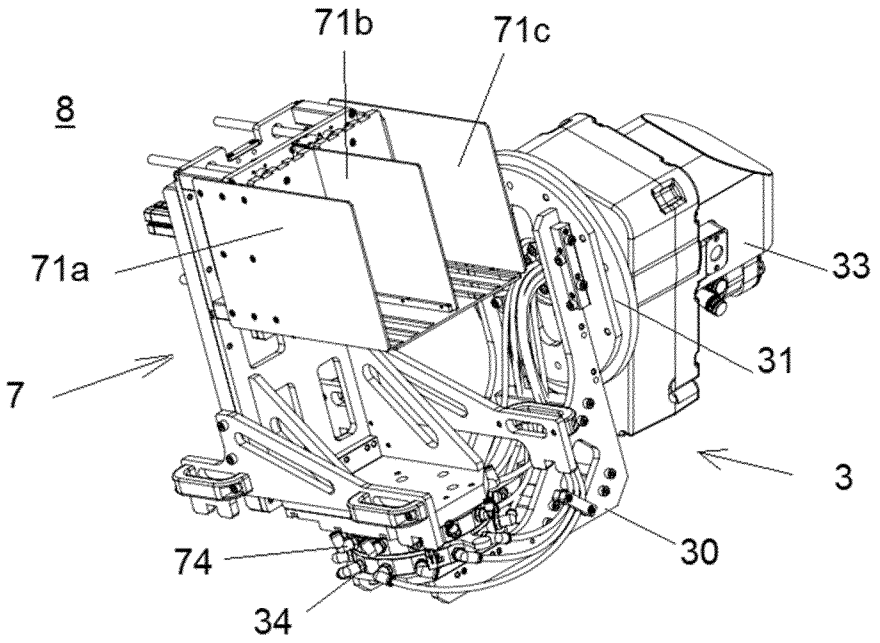
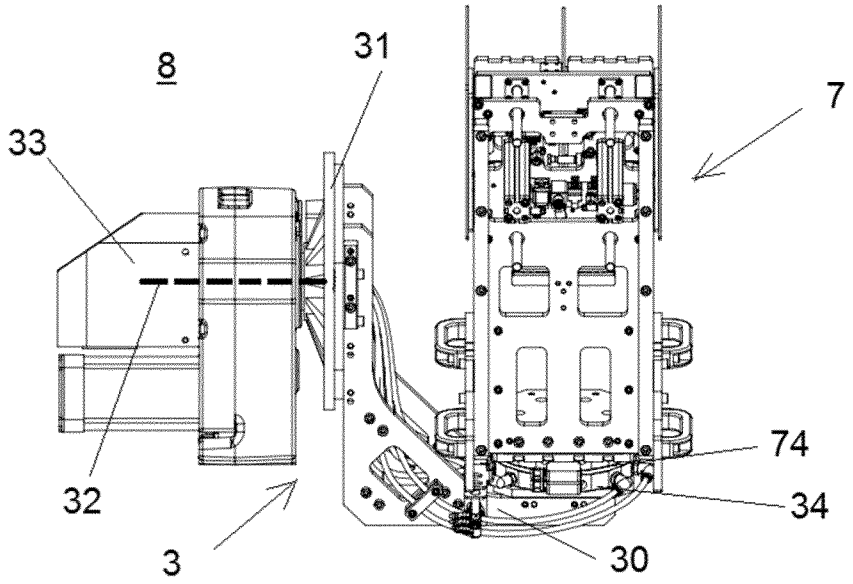


FIG. 5b



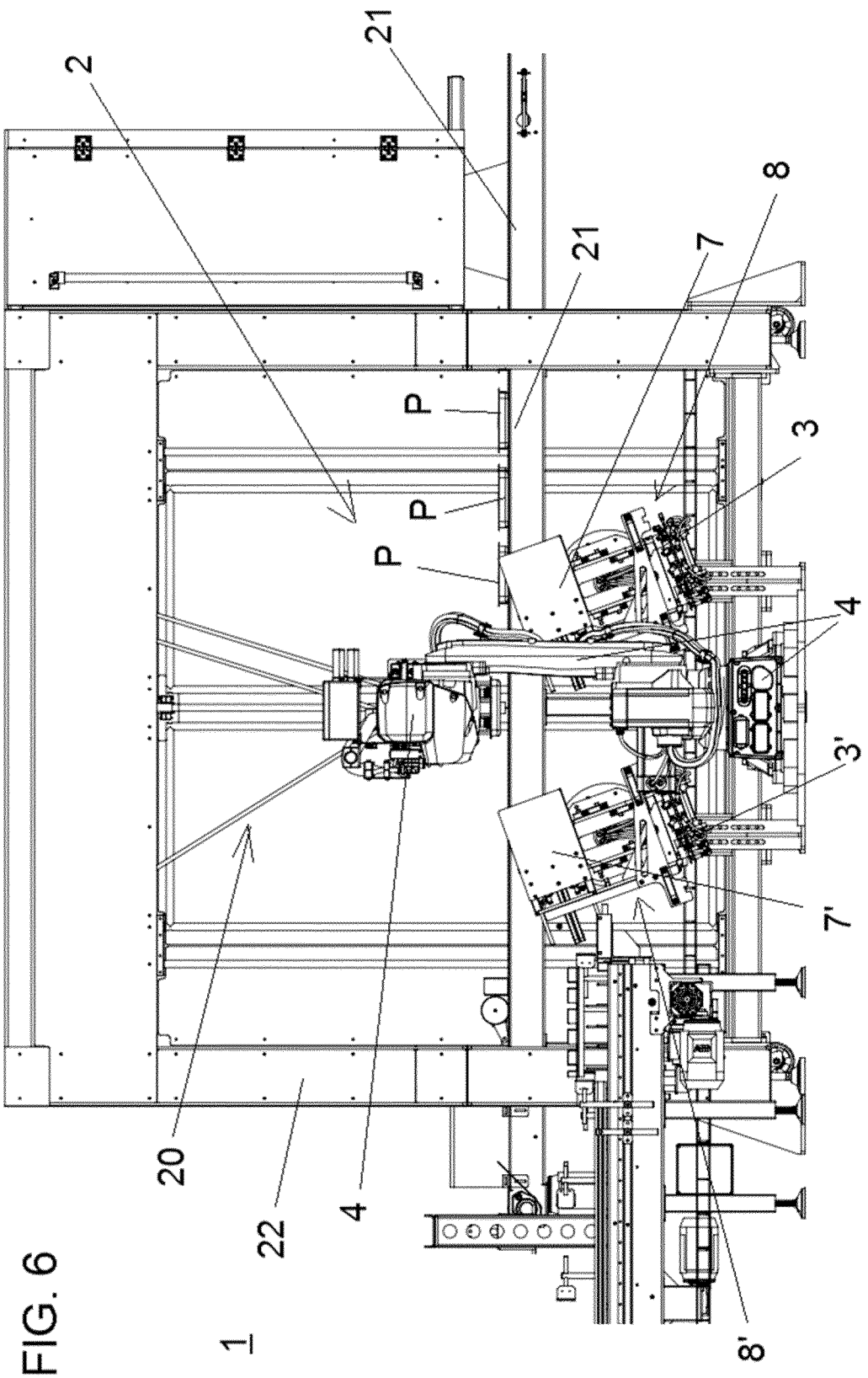


FIG. 6

FIG. 7

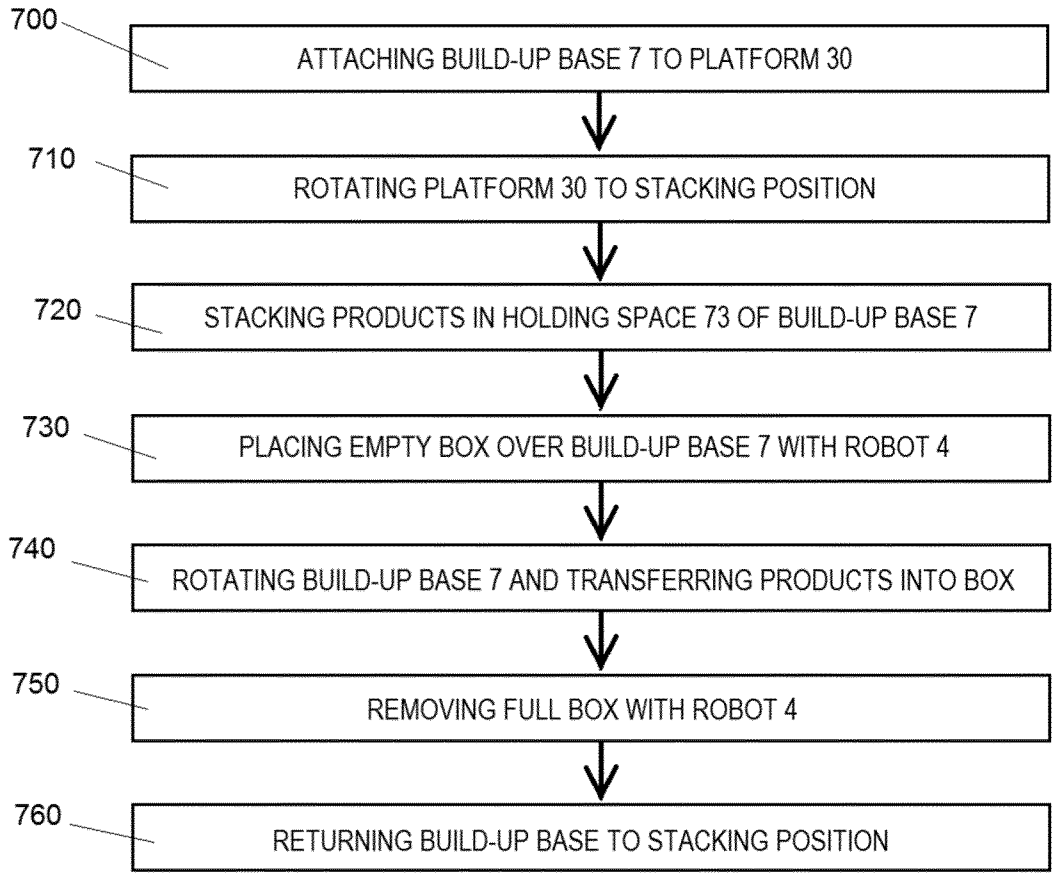

700
ATTACHING BUILD-UP BASE 7 TO PLATFORM 30
710
ROTATING PLATFORM 30 TO STACKING POSITION
720
STACKING PRODUCTS IN HOLDING SPACE 73 OF BUILD-UP BASE 7
730
PLACING EMPTY BOX OVER BUILD-UP BASE 7 WITH ROBOT 4
740
ROTATING BUILD-UP BASE 7 AND TRANSFERRING PRODUCTS INTO BOX
750
REMOVING FULL BOX WITH ROBOT 4
760
RETURNING BUILD-UP BASE TO STACKING POSITION

FIG. 8

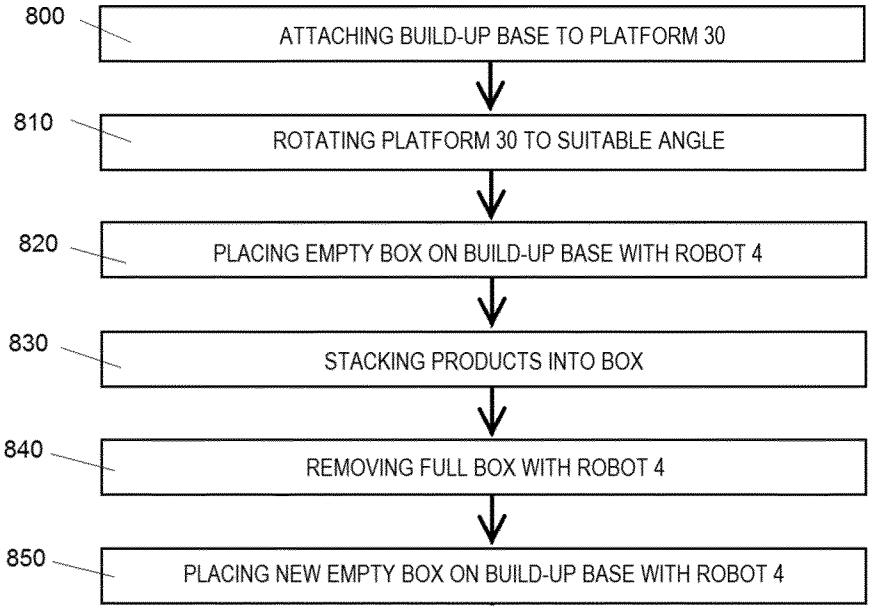
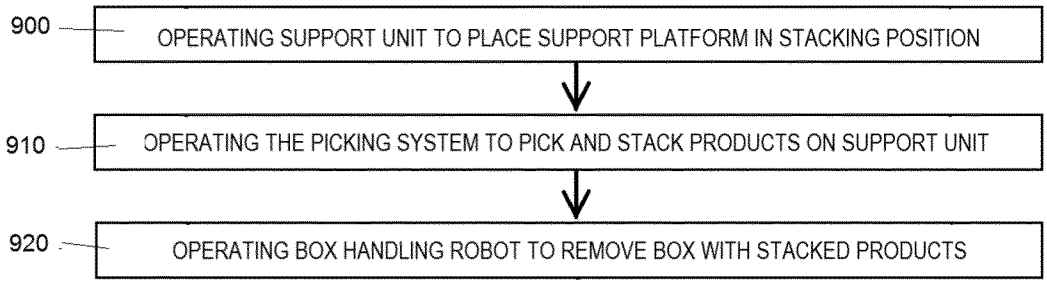

800
ATTACHING BUILD-UP BASE TO PLATFORM 30
810
ROTATING PLATFORM 30 TO SUITABLE ANGLE
820
PLACING EMPTY BOX ON BUILD-UP BASE WITH ROBOT 4
830
STACKING PRODUCTS INTO BOX
840
REMOVING FULL BOX WITH ROBOT 4
850
PLACING NEW EMPTY BOX ON BUILD-UP BASE WITH ROBOT 4

FIG. 9


900
OPERATING SUPPORT UNIT TO PLACE SUPPORT PLATFORM IN STACKING POSITION
910
OPERATING THE PICKING SYSTEM TO PICK AND STACK PRODUCTS ON SUPPORT UNIT
920
OPERATING BOX HANDLING ROBOT TO REMOVE BOX WITH STACKED PRODUCTS

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/050588

A. CLASSIFICATION OF SUBJECT MATTER
INV. B65B35/50 B25J9/00 B65B5/10 B65G47/96 B65B59/04
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B65B B25J B65G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2014/075151 A1 (ADAPTAPACK PTY LTD [AU]) 22 May 2014 (2014-05-22)	1,11
A	paragraphs [0056], [0057]; figures 1-20	2-10, 12-15
Y	US 9 227 323 B1 (KONOLIGE KURT [US] ET AL) 5 January 2016 (2016-01-05) column 4, lines 14-23	1,11
A	US 2013/283731 A1 (KOMP RAINER [DE]) 31 October 2013 (2013-10-31) paragraphs [0034] - [0035]; figures 6-8	1-15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 October 2019	17/10/2019

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Dick, Birgit

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2019/050588

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