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(54) **PACKAGING SYSTEM TO PACK ONE OR MORE OBJECTS IN BOXES**

(57) Packaging system (10) to pack objects (101) in boxes (11) comprising:
- a supply station (104) to supply objects (101) of a purchase order batch;
- an insertion station (105) to insert in a box (11) a specific batch picked up from said supply station;
- a closing station (106) to close said box (11);
- a storage unit (16, 17) configured to house a respective group of cartons (12) in a flattened-out state;
- a box-forming machine (100) configured to carry out both an automatic pick-up of a corresponding carton (12) in a flattened-out state from said storage unit (16, 17), and a subsequent automatic forming of the box (11) a starting from the picked-up carton (12), wherein said box-forming machine (100) comprises a first pick-up device (33) and a second pick-up device (52) respectively slidably mounted on said storage unit (16, 17) to slide along a respective linear path, said first pick-up device (33) remaining in a shared transfer space (25) when it moves the carton.

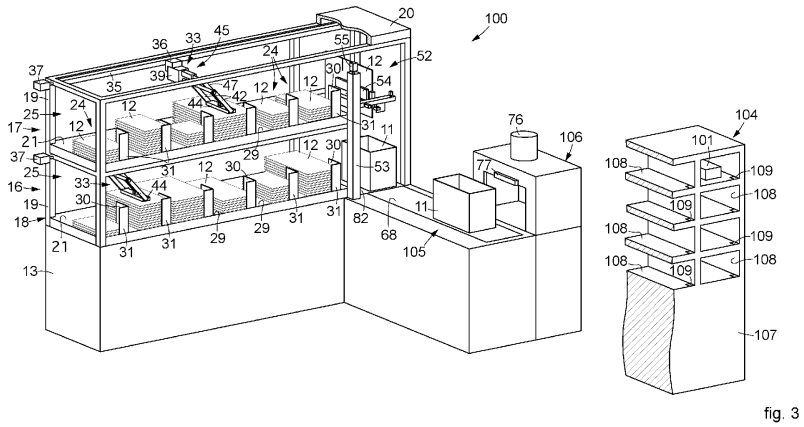

fig. 3

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Description

FIELD OF APPLICATION

[0001] This invention refers to a packaging system to pack, in an automatic, or semiautomatic manner, objects of various types and dimensions inside boxes, the dimensions of which are selected depending on the encumbrance of each batch, or set of objects, to be inserted in them. This invention may be applied, for example, but not only, for the packing of objects purchased by mail, including electronically, for example, through e-commerce.

STATE OF THE ART

[0002] Within the context of systems for the shipping of objects originating, for example, from online purchase orders, it is well known that it is necessary to insert the objects associated with a specific purchase order made by a customer into empty boxes, to then proceed with the shipping of the package to the address indicated by the customer.

[0003] Normally, since each purchase order may involve several items of different shapes and dimensions, the box must also be chosen appropriately, so that it is as small as possible, but still able to hold all the items associated with a given order.

[0004] For this reason, a plurality of types of boxes of different dimensions are usually prepared on the basis of their capacity.

[0005] Generally, a boxing station of the system is provided with both empty boxes of various types (formed starting from flattened-out boxes), and various batches of obj ects of different dimensions, each batch to be inserted in an appropriate box, wherein each batch is made up of an individual object or a plurality of objects belonging to a same purchase order.

[0006] Nowadays, big e-commerce companies, in particular, need to manage and process many thousands of purchase orders a day. Consequently, each boxing station must have a high level of productivity and flexibility and each boxing operation, including the selection of the adequate box, must be made as quickly as possible. Moreover, an optimization of the use of the volume of the box must be maintained, both to reduce the consumption of packaging material and to make transportation more efficient. In some solutions, the most appropriate box format is selected by the operator or suggested to the operator by a visual system, for example, through video instructions.

[0007] Normally, in a boxing station, an opportunely instructed operator will first select a carton having an adequate format from among a plurality of cartons having various standardized dimensions. These cartons generally have four consecutive sides, connected by folding lines, four bottom flaps (to create a bottom) and four top flaps (to create a top lid). Moreover, these cartons are typically supplied in flattened-out configuration that the operator draws upon. The operator then proceeds to the forming of the related box, first creating the bottom, then manually inserting a batch of objects associated with a specific purchase order into the box with one side open, and lastly they close the top of the box, by folding the four top flaps, so that each batch of objects is contained in the most appropriate box. After which, the box packaging with the batch of objects inside is sent to a storage and/or shipping station.

[0008] At the same time, another operator prepares the individual batches of objects, each corresponding to a specific purchase order, and they make them available to the boxing station operator.

[0009] A disadvantage in the preparation of the box is that, when done manually, it requires more time than the time used to prepare a new batch to be boxed.

[0010] Therefore, in prior art there are automatic systems for preparation of the boxes in an automatic manner with the help of robots, but these automatic systems often require ample available space, are complex and require adequate safety systems if an operator is in the vicinity.

[0011] Therefore, there is the need to perfect a packaging system to pack, automatically or semiautomatically, objects of various types and dimensions inside boxes, which can at least overcome one of the disadvantages of the prior art.

[0012] Therefore, one of the objects of this invention is to provide a packaging system to pack objects of various types and dimensions inside boxes, wherein, at least the boxes are produced in the most automated manner possible, that is, without substantial intervention or with minimal intervention on the part of workers.

[0013] A further object of this invention is to form the box in an automatic manner and for this to occur quickly so that the box-forming operation can be carried out while the operator is filling a previous box, so that the new box will already be ready when the operator takes the batch of objects to be inserted in the box associated with a specific order.

[0014] A further object of this invention is a packaging system to pack objects of various types and dimensions inside boxes, that has reduced encumbrance, is simple, safe and reliable.

[0015] In order to overcome the disadvantages of the prior art and to obtain these and additional objects and advantages, the Requesting Party has studied, tested and devised this invention.

SUMMARY OF THE INVENTION

[0016] This invention is presented and depicted in the independent claim. The dependent claims present other features of this invention or variants of the main solution idea.

ILLUSTRATION OF THE DRAWINGS

[0017] These and other aspects, features and advantages of this invention will appear clear from the following description of embodiments, provided by way of example, which are not limiting, with reference to the attached drawings wherein:

- Fig. 1 is a schematic plan view of a packaging system, according to this invention;
- Fig. 2 is a block diagram of a control circuit of the system of Fig. 1;
- Fig. 3 is a schematic and partial cross-sectional view from an axonometric perspective of the system of Fig. 1.
- Fig. 4 is view of a usable box from an axonometric perspective from the system of Fig. 1;
- Fig. 5 is a front view of a box-forming machine of system of Fig. 1;
- Fig. 6 is a left side view of the box-forming machine of Fig. 5;
- Fig. 7 is a partial cross-sectional left side view of the box-forming machine of Fig. 5;
- Fig. 8 to Fig. 11 are schematic representations of some operational phases of the box-forming machine of Fig. 5;
- Fig. 12 is a left side view of an enlarged detail of the box-forming machine of Fig. 5 in the operational phase shown in Fig. 8;
- Fig. 13a, Fig. 13b, Fig. 13c are schematic plan views of a forming device of the box-forming machine of Fig. 5 in different operational conditions;
- Fig. 14a, Fig. 14b are schematic side and front views of a box bottom closing unit of the box-forming machine of Fig. 5;
- Fig. 15 is a schematic front view of a closing station of the system of Fig. 1.

[0018] It is specified that in this description the expressions and terminology used, such as, for example, the terms horizontal, vertical, anterior, posterior, high, low, inside and outside, with their declensions, have the sole function of better illustrating this invention with reference to the figures of the attached drawings and are not to be used in any way to limit the scope of the invention itself, or the scope of protection defined by the attached claims.

[0019] Moreover, persons skilled in the art will recognize that certain dimensions, or features, in the figures can be enlarged, deformed or shown in an unconventional manner, or not in a proportional manner, in order to provide a more readily understandable version of this invention. When, in the description below, dimensions and/or values are specified, the dimensions and/or values are provided exclusively for illustration purposes and must not be understood to be limiting of the scope of protection of this invention, unless these dimensions and/or values appear in the attached claims.

[0020] In order to facilitate understanding, identical reference numbers are use, when possible, to identify identical common elements in the figures. It is to be understood that elements and features of one embodiment can conveniently be combined or incorporated in other embodiments without additional clarifications.

DESCRIPTION OF SOME EMBODIMENTS OF THIS INVENTION

[0021] Reference will now be made in detail to the possible embodiments of the invention, in which one or more examples are illustrated in the attached figures as a non-limiting examples. Even the expressions and terminology used herein are for illustrative, not limiting, purposes.

[0022] With reference to Fig. 1, a packaging system 10 according to this invention, to pack one or more objects 101 of various types and dimensions in boxes 11, comprises:

- a supply station 104 where the objects 101, even if only one object, are brought together in batches, or sets, that are part, for example, of a same purchase order, or are to be sent to a same recipient;
- an insertion station 105, where the objects 101 of each batch are inserted, manually or automatically, in a specific box 11 optimally sized on the basis of the dimensions and volume of the batch to be contained;
- a closing station 106 to close the boxes 11 after the objects 101 have been inserted in them;
- at least one storage unit 16, 17 defined by a fixed structure having a plurality of compartments 24, each compartment 24 of said plurality of compartments being configured to house a respective group of cartons 12 in a flattened-out state placed on a corresponding supporting surface 29; and
- a box-forming machine 100 configured to carry out both an automatic pick-up of a corresponding carton 12 in a flattened-out state from the at least one storage unit 16, 17, and a subsequent automatic forming of the box 11 starting from the picked-up carton 12.

[0023] The box-forming machine 100, supply station 104, insertion station 105 and closing station 106 and the at least one storage unit 16, 17 will be described in greater detail below.

[0024] According to the invention, the various compartments 24 of the at least one storage unit 16 or 17 are in communication with one another through a shared transfer space 25 (Fig. 6) defined within the fixed structure of the storage unit 16.

[0025] Moreover, the box-forming machine 100 comprises a first pick-up device 33 and a second pick-up device 52 respectively slidably mounted on the fixed structure of the storage unit 16, 17 in order to slide along a respective linear path.

[0026] In particular, the first pick-up device 33 moves between a pick-up position, where it picks up a respective

carton 12 in a flattened-out state from one compartment of the plurality of compartments 24, and a release position, where it releases the picked-up carton 12 to the second pick-up device 52, and vice versa.

[0027] Advantageously, the first pick-up device 33 remains in the shared transfer space 25 when it moves along the respective linear path, from the pick-up position to the release position.

[0028] In the example shown, the at least one storage unit is made up of two storage units, indicated with 16 and 17, both of which are mounted on a load-bearing structure 13. One of the two storage units, the first one (indicated by the number 16), is mounted on a, for example horizontal, flat surface S of the load-bearing structure 13 and the other storage unit, the second one (indicated by the number 17), is mounted on a flat surface Q, parallel to the flat surface S, above the first storage unit 16.

[0029] In other embodiments of this invention, the packaging system 10 can comprise one sole storage unit or a number of storage units greater than two.

[0030] Given the substantial similarity of the first storage unit 16 with the second storage unit 17, the description below will solely relate to a single storage unit 16.

[0031] In the example shown, the fixed structure on which the storage units 16, 17 are mounted consists of a shaped structure 18 (Fig. 5, Fig. 6 and Fig. 7) defining at least two uprights 19, a top panel 20 (Fig. 7), which is substantially horizontal and a base panel 21. The contained space 22 and the shared transfer space 25 are therefore contained inside said structure 18.

[0032] In particular, the plurality of compartments 24 is formed out of the base panel 21. Typically, a plurality of cartons 12 in a flattened-out state can be subdivided into groups, on the basis of their respective dimensions. Each group of cartons 12 is placed in the pertinent compartment 24. Each compartment 24 can, for example, house a group of cartons 12 of the same dimension, so that, on the whole, each compartment 24 contains a group of cartons 12 in a flattened-out state having the same dimension but different in relation to the dimensions of a group of cartons 12 in a flattened-out state contained in another compartment 24, as shown, for example, in Fig. 3, Fig. 5 and Fig. 6.

[0033] Each compartment 24 has a lower supporting surface 29 and a lateral supporting surface 30 substantially orthogonal to the supporting surface 29 and an abutment panel 31, that works as an end panel for the cartons 12 and which is substantially vertical. In this manner, the cartons 12 are arranged on the lower supporting surface 29 in a reference position that can be repeated and is automatically recognizable. In particular, the manual or automatic operator loading cartons 12 in each compartment 24 pushes them until they butt up against the abutment panel 31 and against the lateral supporting surface 30. In this way, all the cartons 12 are flush with this abutment panel 31 and therefore the position of their panels will be previously known.

[0034] In this manner, once the cartons 12 have been inserted in the compartment 24, the cartons are stacked and can be arranged lying down, as shown in the example in the figures, with their panels substantially parallel to the lower supporting surface 29.

[0035] As a whole, the compartments 24 of the first storage unit 16 and of the second storage unit 17 are arranged at various heights, for example, following a matrix with rows and columns, with the rows at various heights.

[0036] Each compartment 24 is suitable to contain a congruous number of cartons 12, preferably of the same dimension, for example standardized, each of which can be used to construct a box 11.

[0037] In possible embodiments, the compartments 24 can be equipped with sensors configured to detect and verify a fill level of the cartons 12 in the compartment 24 and provide a correlated signal, that is, for example, useful for the purposes of a re-supply of new cartons 12.

[0038] Furthermore, the aforementioned compartments 24 have a loading opening, for the loading of the cartons 12, and possibly an opening for the pick-up of the cartons 12, opposite the loading opening.

[0039] In the example shown, the shared transfer space 25 extends at least partially in a zone that is placed above the plurality of compartments 24.

[0040] In practice, the shared transfer space 25 is between the compartments 24 and the top panel 20 of the structure 18 and it is sized in such a way to allow the first pick-up device 33, when it moves from the pick-up position to the release position, to pass above the compartments 24 without interfering with the cartons 12 placed in them, remaining at the same time inside the contained space 22.

[0041] According to one aspect of this invention, each box 11 is automatically formed by the box-forming machine 100 starting from the flattened-out cartons 12 (Fig. 3), each one of which can form a box 11 having defined dimensions, as regards width and length.

[0042] For example, each carton 12 (Fig. 4 and Fig. 12) comprises a sheet, which is folded and glued with a tab, or flap, K in order to form two panels that are flattened-out against each other and suitable to be moved to take on an open three-dimensional state to form a box 11, for example in the shape of a parallelepiped with a rectangular base having two front panels 114 and 116 and two side panels, or sides 113 and 115, which are interrupted by folding lines F. Each flattened-out panel of each carton 12 comprises first cuts G1 (Fig. 12) which define four bottom flaps 117 (two of which are on the front when looking at Fig. 4), suitable to form, by folding along a first crease line M1 (Fig. 12), the bottom, or bottom panel, of the box 11, and second cuts G2 which define four top flaps 118, suitable to form, by folding along a second crease line M2, the top panel, or closing panel, of the same box 11. Moreover, each carton 12, on each of the two flattened-out panels, can eventually optionally be provided with one or more additional crease lines N1,

N2, so that it is possible to select at which height the folding of the top flaps 118 must be made in order to close the box 11. Therefore, with a same carton 12 it is possible to achieve a box 11 with a selectable height and therefore capacity, the height and capacity depending on where the carton is folded.

[0043] Said cartons 12 supplied in a flattened-out state are also called "flat pre-glued boxes" in the sector.

[0044] As previously seen, each purchase order identifies the objects 101 that a customer has purchased at a specific moment, which together define a same batch of objects 101, which will be inserted in a box 11 of an appropriate dimension, which, according to an aspect of this invention, is automatically formed by the box-forming machine 100 depending on the volume of the batch of objects 101 to be inserted into it.

[0045] According to a preferred embodiment of this invention, the first pick-up device 33 is operable with at least two degrees of freedom, a linear movement, along said linear path which the pick-up device performs when it moves from the pick-up position to the release position, and a rotation, the function of which will be clearer hereinafter.

[0046] The fixed structure of the storage unit 16 comprises a rectilinear first sliding guide 35 to which the first pick-up device 33 is slidably associated, which slides along this first sliding guide 35 to move from the pick-up position to the release position.

[0047] In the example shown, the first sliding guide 35 extends horizontally and is fixed to the top part of structure 18, inside the contained space 22 (Fig. 7) and substantially extends lengthwise from one part to the other of the contained space (Fig. 5), which is to say parallel to the base panel 21, along a longitudinal, or horizontal axis X.

[0048] A first carriage 36 is slidably mounted on the first sliding guide 35, which carriage is connected, by known means of connection and which are not represented in the drawings, to a first electric motor 37 configured to selectively make the first carriage 36 slide in the two directions, that is to the right or to the left, parallel to the longitudinal axis X.

[0049] The first pick-up device 33 is mounted on the first carriage 36 to move together with it along the rectilinear first sliding guide 35.

[0050] The rotation of the first pick-up device 33 is enabled by a rotating activation component 45 (Fig. 7) configured to rotate the first pick-up device 33 around an axis of rotation Z, preferably perpendicular to the linear path that the first pick-up device 33 completes in going from the pick-up position to the release position.

[0051] The first pick-up device 33 comprises a first gripping element 44 provided with one or more first gripping suction cups 48 configured to stably take a carton 12 in a flattened-out state from the stacked group of cartons 12 placed in one of the compartments 24.

[0052] The first gripping element 44 consists of an arm that extends transversally with respect to the first sliding guide 35.

[0053] When in operation, in order to establish a stable coupling between the first gripping element 44 and the carton 12 to be picked up, a vacuum pump, of a known type and not represented in the drawings, is activated, said pump, connected to the first gripping suction cups 48, being capable of generating a vacuum or a low pressure between them and an outside surface of the carton 12 to be picked up.

[0054] In the example shown, the first gripping element 44 can make a vertical movement which is achieved by combining the movement of the first carriage 36 on the first sliding guide 35 with the rotation around the axis of rotation Z obtained by means of the actuator 45.

[0055] For the purpose of keeping the picked-up carton 12 in a horizontal state during the lifting from the compartment 24, the first pick-up device 33 comprises an articulated parallelogram system, which helps to avoid that the first gripping element 44 rotates (and with it, the carton 12 which is held back by the first gripping suction cups 48) when the first pick-up device 33 is activated in rotation around the axis Z.

[0056] In the example shown, the activation component 45 of the first pick-up device 33 comprises a support 39 (fixed to the carriage) and a pair of arms 42 hinged to it, to which in turn the aforementioned first gripping element 44 is connected (at the opposite end). Moreover, an activation lever 47 is provided which is also connected to said first gripping element 44 and activated in rotation around the axis of rotation Z, to lift and lower the first gripping element 44.

[0057] In these embodiments, this vertical movement is necessary in order to pick up the carton 12 from compartment 24 and to lift it before bringing it to the release position where the second pick-up device 52 is present.

[0058] This second pick-up device 52 is slidably associated with a second sliding guide 53 fixed onto the fixed structure of the storage unit 16 in order to slide, along the respective linear path, between the aforementioned release position and a forming position, in which the box 11 is formed starting from the flattened-out carton 12.

[0059] In the example shown, the second sliding guide 53 extends vertically.

[0060] A second carriage 57 is mounted on the second sliding guide 53, and said carriage is connected, by means of known connection means which are not represented in the drawings, to a second electric motor 55 configured to make the second carriage 57 slide, in the two directions, which is to say downward and upward.

[0061] The second pick-up device 52 is mounted on the second carriage 57 to move along the second sliding guide 53.

[0062] In the example shown, the second pick-up device 52 comprises a second gripping element 54 which extends within the shared transfer space 25.

[0063] In particular, the shared transfer space 25 is in communication with a space obtained on the side, in order to allow the second pick-up device 52 to freely move

vertically.

[0064] In essence, this shared transfer space 25 does not only occupy a zone above the compartments 24 but also a side zone, wherein in the example shown, the side zone extends upwards putting the two superimposed storage units 16, 17 in communication.

[0065] This second gripping element 54 is provided with one or more second gripping suction cups 56 configured to stably take the carton 12 in a flattened-out state from the first gripping element 44 of the first pick-up device 33.

[0066] In practice, the flattened-out carton 12 is delivered by the first gripping element 44 to the second gripping element 54.

[0067] The second gripping element 54, for example, consists of an arm that extends transversally with respect to the second sliding guide 53.

[0068] In order to establish a stable coupling between the second gripping element 54 and the carton 12, a vacuum pump, of a type known in itself and not represented in the drawings, is activated and is connected to the second gripping suction cups 56, and is capable of generating a vacuum, or low pressure, between them and an external surface of the carton 12, which surface is opposed to the surface coupled to the first gripping element 44.

[0069] In embodiments, the second pick-up device 52 is mounted on a second carriage 57 in order to be able to move in a horizontal translational manner. This horizontal translation movement is achieved by means of a translation device 58, for example, made by means of a wound-up strap 58a, activated by a third electric motor 59.

[0070] In particular, the second pick-up device 52 is configured to be able to carry out an alternating linear movement along a direction that is substantially parallel to the aforementioned longitudinal, or horizontal axis, X, as schematically indicated by the arrow L in Fig. 5, Fig. 6 and Fig. 10.

[0071] This horizontal movement of the second pick-up device 52 allows for the position of the second gripping element 54 to be adjusted, in such a way as to achieve a stable grip of the carton released by the first gripping element 44, this regardless of the dimension of the carton 12.

[0072] According to the embodiment shown, the second pick-up device 52 can be made to rotate along an axis of rotation Z' that is parallel to the axis of rotation Z of the first pick-up device 33, for example, by means of a respective electric motor 51.

[0073] This rotating movement of the second pick-up device 52 allows for variation of the orientation of the carton 12, for example, from horizontal to vertical.

[0074] According to this invention, the box-forming machine 100 moreover comprises a forming unit 34 to open the carton 12 after having been picked up by the second pick-up device 52.

[0075] In the example supplied here, the forming unit 34 is mounted on a second pick-up device 52 and is therefore movable in uniform manner to it.

[0076] In particular, the forming unit 34 is supplied with one or more rotating lever elements 60 having one or more gripping portions 63 configured to couple with the flattened-out carton and form, by means of rotation, an open tubular carton. In the embodiment described here, the rotating lever element 60 (Fig. 13a, Fig. 13b, Fig. 13c) is mounted in a rotatable manner on a support block 61, by means of a spindle 65. The support block 61 is in turn arranged at an end of the second gripping element 54. The rotating lever element 60 is controlled in rotation by a fourth electric motor 62.

[0077] Once coupled to the carton 12, the gripping portion 63 rotates a panel of the carton 12, as indicated by arrow R in Fig. 13a, Fig. 13b, Fig. 13c and brings about an open three-dimensional state of the aforementioned carton 12 (see operating sequence of Fig. 13a, Fig. 13b, Fig. 13c). The gripping portion 63 can, for example, be a pick-up suction cup activated by a vacuum pump, not represented in the drawings, to generate a vacuum.

[0078] The rotating lever element 60 is configured to pass, while rotating, from a starting position, in which it is distanced from carton 12 (Fig. 13a) which is held by the second gripping element 54, to a coupling position (Fig. 13b) 10, in which it is in contact with the carton 12 which has been picked-up and is kept suspended by the second gripping element 54. In this coupling position, the activation of the gripping portion 63 combined with a new rotation of the rotating lever element 60 from the coupling position to the starting position (Fig. 13c) brings about the opening of the carton 12 by virtue of the articulation of the panels of the carton 12 around the respective folding lines.

[0079] Naturally, during the rotation of the rotating lever element 60, the carton remains held, on the opposite face, by the second gripping element 54.

[0080] Moreover, a closing unit 67 (Fig. 14a, Fig. 14b) is provided to close the bottom of each box 11. The second gripping element 54 transports the carton 12 toward said closing unit 67, where the forming unit 34 forms the open tube shape starting from the flattened-out carton before it is closed on the bottom.

[0081] The closing unit 67, which can be of any known type, is configured to rotate the four bottom panels, then, the box is moved by means of transport 68 (Fig. 1, Fig. 3), toward the insertion station 105 (Fig. 1), in which the manual or automatic insertion of the objects 101 to be packed is foreseen.

[0082] During the translation toward the insertion station 105, the panels that have been rotated are closed, for example, by means of adhesive tape, or the application of glue, so as to thus form the bottom of the box 11 in a stable manner.

[0083] The closing unit 67, represented schematically in Fig. 14a and Fig. 14b, comprises, for example, a pair of rotating levers, or folding devices, 66 arranged opposite each other to make the two respective bottom flaps

117 of the carton 12 rotate when open (arrows M in Fig. 14a). Each rotating lever 66 is mounted on a respective support block 79. One of the two support blocks 79 is coupled to the aforementioned means of transport 68 which can be, for example, straps or the like, this to bring about advancement along a sliding surface 82 (arrow C in Fig. 14a). In the case in point, the support block 79 that brings about advancement is the rear one, therefore working as pusher together with the means of transport 68. Alternatively, the advancement can be carried out using small bands.

[0084] The rotating lever 66 mounted on the support block 79 coupled to the means of transport 68 allows for adaptation to the dimensions of the box 11 and, in particular, to process boxes 11 of various lengths. The closing unit 67 also comprises a pair of opposing rods 78, linearly movable between the two positions, near and distant (Fig. 14b), to bring about the rotation and folding of the remaining two bottom flaps 117 (arrows and in Fig. 14b). In particular, each opposing rod 78 is associated with a transverse movement guide 80 by means of a related support 81.

[0085] After the folding of the first two bottom flaps 117 by the pair of rotating levers 66, the action of the pair of opposing rods 78 is provided, which rods are moved one toward the other to fold the second pair of bottom flaps 117. After which, the box 11 with the closed bottom is moved by the means of transport 68 toward the insertion station 105.

[0086] Alternatively, the rotating levers 66 can be elements bringing about a translation.

[0087] The closing unit 67 can be provided with adhesive tape applicators, for example, a roller applicator or the like, to apply the closing tape on the bottom panel once the second pair of bottom flaps 117 has been rotated. The application of said adhesive tape can be readily carried out while the box 11 is transported by the means of transport 68 toward the insertion station 105. In the event a tape application group is provided, the group is favorably configured in such a way to apply the tape centered along the center line of the box 11. The adhesive tape can be a water activated adhesive. Alternatively, it is conceivable to provide dispensation of a glue prior to the closure of the second pair of bottom flaps 117.

[0088] Advantageously, it is possible to move the second gripping element 54 and the associated forming unit 34 horizontally and in a selective manner thanks to the translation device 58, consequently also translating the formed carton 12, in order to adapt to the dimensions of the carton 12 for the purposes of the subsequent operation for the closing of the bottom panel, in particular, to favor the positioning of the closing tape that is centered along the center line of box 11. Indeed in this manner, it is possible to process boxes 11 with a different width while maintaining the center line set with respect to the closing unit 67. In particular, it is possible to form boxes 11 of different widths while keeping, as a fixed reference, the center line of the box 11 where the tape is applied for the closing of the bottom panel, even if the boxes 11 have different widths.

[0089] The closing station 106 is positioned close to the insertion station 105 (Fig. 1) and it is configured to receive the box 11 containing the objects 101 and to close its top using the top flaps 118 (Fig. 15).

[0090] Optionally, the closing station 106 can comprise cutting components 69 configured to reduce the dimension of the box 11, in particular reducing its height, prior to closing its top, for example, along one of the crease lines N1 or N2.

[0091] Advantageously, the insertion station 105 or the closing station 106 can present means 77 for the optoelectronic acquisition (Fig. 1 and Fig. 3) of the aforementioned box 11 and of the objects 101 it contains, for example, dimensions of box and of objects, in particular, at least the height, for the purposes of the subsequent resizing of the aforementioned box 11 by means of the cutting components 69.

[0092] The latter cutting components are configured to automatically cut part of the aforementioned box 11 on the basis of the aforementioned optoelectronic acquisition signal.

[0093] In particular, the cutting components 69 are configured to lengthen the second cuts G2 in order to lengthen each top flap 118, so as to reduce the height of the box 11, as known in the art with the term "downsizing," and then to be able to close box 11 itself to size.

[0094] The signal supplied by the aforementioned optoelectronic acquisition means 77 can also be used to verify if the insertion of the objects in the box 11 has occurred. If insertion of the objects has been verified, then the procedure allows for the formed box 11, and in which the objects have been inserted, to move forward toward the closing station 106. Additionally, the process advantageously also allows for advancement of the subsequent formed box 11 toward the insertion station 105.

[0095] Moreover, verification that no filling material protrudes from the box 11 can also be carried out by means of the optoelectronic acquisition means 77.

[0096] The closing station 106 can, moreover, comprise a vertical movement device 70, which comprises a horizontal support plate 71 that slides vertically on a rod 72, controlled by an actuator 73 between a raised position, represented with a continuous line in Fig. 15, in which each box 11 is found after the objects 101 have been inserted in it, and a lowered position, represented with dashed lines in Fig. 15.

[0097] After the box 11 has been lowered by means of the vertical movement device 70, the box that has already been filled with the objects is directed by means of a conveyor 75 in a direction indicated by the arrow T in Fig. 15, toward an additional closing device 83 to carry out the closing of the top flaps 118.

[0098] In the example shown, this additional closing device 83, that comprises a pair of closing levers, or folders, 84 and a pair of opposing rods 85, here represented

schematically and similar to those described using Fig. 14a and Fig. 14b, even though they act upon the top flaps 118.

[0099] The closing levers 84 are selectively rotatable as indicated by the arrow U in Fig. 15. Moreover, a first lever 84 (on the left in Fig. 15) is also movable horizontally, in the direction of advancement T and a second lever 84 is in fixed position (on the right in Fig. 15). The fact that the first lever 84 is horizontally movable allows adaptation to the dimensions of box 11 and, in particular, for the processing of boxes 11 of various lengths, similarly to the rotating lever 66 mounted on the movable support block 79 of which in Fig. 14a and 14b. Moreover, the opposing rods 85 can also be movable transversally to the direction of advancement T by means of an additional transversal movement guide 86 they are associated with by supports 87.

[0100] Alternatively, the box is brought to a fixed distance from the additional closing device 83 making the conveyor 75 vertically movable.

[0101] In particular, after the action of the cutting components 69, for the purpose of height adjustment, the box 11 is made to advance toward the right in Fig. 15 by the conveyor 75, until the first lever 84, on the left in a continuous line and in the center in a dashed line in Fig. 15, and the second lever 84 are in position to fold the first pair of top flaps 118. After which, in this position of box 11, the opposing rods 85 intervene to bring about the closing of two additional top flaps 118, concluding the sequential closing of all the top flaps 118, to then proceed with the application of the closing adhesive tape. In the event in which a closing tape application group is foreseen, it can be favorably configured as a movable group because, following the down-sizing operation, the position for application of the top tape might not necessarily be centered with respect to the center line of the box 11. Here too, it is conceivable, as an alternative, to provide glue prior to the closing of the pair of top flaps. After which, as stated, the closed box 11 is moved on in a definitive manner by an additional conveyor, that is not shown, which is transversal to conveyor 75, and which preferably passes below storage units 16,17 to be directed toward a warehouse, or a shipping station, of known type and not represented in the drawings.

[0102] In the embodiment described here, the insertion station 105 is advantageously placed in a position between the supply station 104 and the at least one storage unit 16, 17, using a horseshoe-shaped arrangement, in order to make the transfer of the objects 101 in the respective box 11 easier, for example, manually by an operator P.

[0103] The closing station 106 is arranged near the insertion station 105.

[0104] The supply station 104 is configured to contain, subdivided by batches, the various objects 101 to be packed into the boxes 11.

[0105] The system 10 can, moreover, comprise a central control unit 120 (Fig. 2), preferably of a programmable type, for the coordinated control of the box-forming machine 100 and of the stations 104, 105 and 106. The central control unit 120 can eventually be connected to a warehouse management system (WMS), which is, for example, run on a server 122, for the management of the purchase orders issued by a plurality of customers by means of any means of communication, for example, through the Internet.

[0106] In embodiments described here, the supply station 104 preferably comprises a temporary warehouse 107 (Fig. 3), for example, a shelving unit provided with a plurality of recesses 108, of the pass-through type, arranged, for example, in a matrix of rows and columns, with the rows being at different heights. Each recess 108 has an opening for loading, for example, placed on a panel of the temporary warehouse 107 (on the right in Fig. 1), from which the objects 101 can be inserted, and a pick-up opening, opposite the loading opening, easily accessible by an operator P in charge of the insertion station 105. In each recess 108, which has a horizontal supporting surface, the objects 101 of a same batch can temporarily be placed as they wait to then be inserted in the corresponding boxes 11 in the insertion station 105.

[0107] The loading of the recesses 108 with the objects 101 can be carried out both manually and automatically, for example, picking up the objects 101 themselves from another objects 101 warehouse, of known type and not represented in the drawings.

[0108] The temporary warehouse 107 and/or each recess 108 can be provided with at least one detection device 109 capable of detecting the presence and/or the volume of each of the objects 101 and/or of each batch of objects 101 in each recess 108.

[0109] The temporary warehouse 107 (Fig. 1) can, moreover, be provided with one or more display devices 111, of a known type, possibly placed in line with each recess 108 to visually indicate from time to time to the operator P in charge of the insertion station 105 which of the recesses 108 hold the objects 101 that are to be picked from the temporary warehouse 107 and inserted in the corresponding box 11. The aforementioned display devices 111 can also display the sequence with which the recesses 108 are to be unloaded by operator P in charge of the insertion station 105 and which is synchronized with the automatic preparation sequence of the boxes 11 on the part of the box-forming machine 100.

[0110] Favorably, the preparation of the box 11 takes place in a manner that is synchronized and sequential to the completion of the batch of objects of the order. There can be multiple complete batches in the temporary warehouse 107 and, according to this invention, it is foreseen to sequentially start forming the first box 11 and, in the temporary warehouse 107, the associated batch of objects to be inserted in box 11 under preparation when box 11 itself is ready will be indicated or displayed. Contemporaneously, the forming of box 11 for the subsequent order will start. Said last box 11 will remain in the storage unit 16, 17 until the preceding box 11 has been

completed.

[0111] In alternative embodiments of this invention, the supply station 104, instead of the temporary warehouse 107, can comprise a conveyor which conveys a plurality of containers each of which contains a different batch of objects 101, in an automatic and coordinated manner together with the forming of the boxes 11, toward the insertion station 105. In this case, this invention can provide for the information relating to the volume of the objects 101 to be packed and/or the dimensions of the box 11 to be processed and managed in such a way to give the necessary time for the pick-up and the sequential forming of the boxes 11, in particular, providing for a temporary accumulation warehouse, or buffer, of containers containing the objects 101 of each batch upstream of the insertion station 105,.

[0112] The insertion station 105, or the closing station 106 can also comprise a filler material dispensing device 76 (Fig. 1 and Fig. 3) configured to insert filling material, for example, paper or air bags in the box 11, to occupy, at least partially, the space inside the box 11 that is not taken up by one or more objects 101.

[0113] The operation of the system 10 described up to here is as follows.

[0114] In a first phase, the various batches of articles 101, each belonging to a specific purchase order, are prepared in the supply station 104 and each batch is inserted in one of the recesses 108 of the temporary warehouse 107.

[0115] In a second phase, the box-forming machine 100 automatically prepares one box 11 at a time, starting from a carton 12 selected, on the basis of the volume and shape of the objects 101 of the specific batch to be inserted in the box 11, from a plurality of various cartons 12 that are available.

[0116] In practice, the carton 12 is picked up, the resulting open box 11 of which offers a volume that is not inferior to the volume of the batch to be inserted and which gets closest to the volume of the batch to be inserted.

[0117] The first pick-up device 33 (Fig. 5 and Fig. 6) is moved along the first horizontal guide 35 to bring itself in pick-up position over the compartment 24 from which the carton 12 is to be picked up.

[0118] At this point, the first pick-up device 33 is activated to bring the first gripping element 44 in contact with the flattened-out carton 12. The first gripping suction cups are activated by vacuum in order to stably couple the carton 12 to the first pick-up device 33.

[0119] Advantageously, the first gripping element 44 is associated with the carton 12 (Fig. 13) on both sides of the folding line F facing the first gripping element 44, and eventually in a region comprised between the crease lines M1 and M2, to avoid that the carton 12 can open during the subsequent movement phases.

[0120] In particular, carton 12 is extracted from compartment 24 (Fig. 9), activating the rotating activation component 45 to obtain a movement of the first pick-up device 33 with a vertical component.

[0121] After having engaged the carton 12, the first pick-up device 33 vertically lifts the first gripping element 44 to separate and remove the picked up carton 12 from the remaining cartons present in compartment 24.

[0122] The first pick-up device 33 is then moved on the first horizontal guide 35 along the transfer space 25 up to the release position, where the carton 12 is transferred to the second pick-up device 52.

[0123] During this movement, passing from the pick-up position to the release position, carton 12 is preferably kept in a configuration that is flattened-out along a horizontal surface, remaining in the shared transfer space 25.

[0124] The carton 12 is then moved downward from the second pick-up 52 toward the closing unit 67, activating the second carriage 57 along the second vertical guide 53.

[0125] Before proceeding with the closing of the bottom of carton 12, the flattened-out carton is opened by means of the forming unit 34 to make it take on a tubular shape.

[0126] The opening of the carton 12 takes place after the second pick-up device 52 has made the flattened-out carton 12 rotate from a horizontal position to a vertical position.

[0127] In a favorable manner, thanks to the translation device 58, even the second gripping element 54 can, moreover, alternatingly be translated horizontally from and toward the closing unit 67, as, for example, indicated by the arrow L of Fig. 5, Fig. 6 and Fig. 10, adapting itself to the width of the box 11 for the purpose of correctly centering the box 11 itself with respect to the application of the tape.

[0128] In this manner, the box 11 is produced automatically while a possible operator is free to carry out other actions, for example, packing, at insertion station 105, another batch of objects 101 in another box 11 that was previously formed.

[0129] Moreover, advantageously, the box 11 will neither be oversized or undersized, thus allowing for the optimization of space and costs.

[0130] In a subsequent operational phase, in the insertion station 105 (Fig. 1) the prepared batch of objects 101 is inserted in box 11. Advantageously, with this invention, while the objects 101 of a batch associated with a specific order are inserted in formed box 11, a new carton 12 is picked up from the pertinent compartment 24 in order to form another box 11.

[0131] In practice, the operator need only insert the objects of the batch associated with the specific order in box 11, without worrying about box-forming starting from carton 12, as said forming operations of the box 11 take place automatically and in an overlapping time period.

[0132] In this manner, advantageously, the idle times between the packing of objects 101 pertaining to one purchase order and the subsequent one are reduced, or even eliminated.

[0133] It is clear that modifications and/or additions of parts can be made to the packaging system described

up to here, without going beyond the scope of this invention as defined by the claims. It is also clear that, even though the invention has been described with reference to specific examples, a person skilled in the art can achieve other equivalent packaging systems, having the features stated in the claims and therefore all falling within the scope of protection defined by them.

[0134] In the claims below, references in parentheses are solely for the purpose of facilitating reading and are not to be considered as limiting factors as regards the scope of protection defined by the claims themselves.

Claims

1. Packaging system (10) to pack one or more objects (101) in boxes (11), said packaging system (10) comprising:

   - a supply station (104) to supply one or more objects (101) grouped in respective batches, each batch being associated with a respective purchase order;
   - an insertion station (105) to insert one or more objects (101) of a specific batch picked up from said supply station in a box (11);
   - a closing station (106) to close said box (11);
   - a storage unit (16, 17) defined by a fixed structure having a plurality of compartments (24), each compartment (24) of said plurality of compartments being configured to house a respective group of cartons (12) in a flattened-out state, placed on a corresponding supporting surface (29);
   - a box-forming machine (100) configured to carry out both an automatic pick-up of a corresponding carton (12) in a flattened-out state from said storage unit (16, 17), and a subsequent automatic forming of the box (11) starting from the picked up carton (12), **characterized in that** said box-forming machine (100) comprises a first pick-up device (33) and a second pick-up device (52), respectively slidably mounted on said fixed structure of the storage unit (16, 17) to slide along a respective linear path, wherein the first pick-up device (33) moves between a pick-up position, where it picks up a respective carton (12) in a flattened-out state from one compartment of said plurality of compartments (24), and a release position, where it releases the picked up carton (12) to the second pick-up device (52), said plurality of compartments (24) being in communication with each other through a shared transfer space (25) defined within said fixed structure of said storage unit (16, 17) and **in that** said first pick-up device (33) remains in said shared transfer space (25) when it moves from said pick-up position to said release position.

2. System according to claim 1, wherein said first pick-up device (33) is movable with at least two degrees of freedom, according to a linear movement, along said linear path, and a rotation movement.

3. System according to claim 1 or claim 2, comprising a rotating activation component (45) associated with said first pick-up device (33) and configured to rotate said first pick-up device (33) around an axis of rotation, preferably perpendicular to said linear path of said first pick-up device (33).

4. System according to any one of the preceding claims, wherein said fixed structure of the storage unit (16, 17) comprises a rectilinear first sliding guide (35) on which is slidably associated said first pick-up device (33), which slides on said first sliding guide (35) to move from the pick-up position to the release position,.

5. System according to claim 4, wherein said first pick-up device (33) is mounted on a first carriage (36) which is in turn slidably associated with the rectilinear first sliding guide (35).

6. System according to any one of the preceding claims, wherein said first pick-up device (33) comprises a first gripping element (44) that is extended inside the shared transfer space (25), said first gripping element (44) being provided with one or more first gripping suction cups (48) configured to stably take a carton (12) in a flattened-out state from said group of cartons (12).

7. System according to any one of the preceding claims, wherein said shared transfer space (25) extends, at least partially, in a zone that is placed above said plurality of compartments (24).

8. System according to any one of the preceding claims, wherein said second pick-up device (52) comprises a second gripping element (54) that is extended inside the shared transfer space (25), said second gripping element (54) having one or more second gripping suction cups (56) configured to stably capture the carton (12) in a flattened-out state from the first pick-up device (33).

9. System according to any one of the preceding claims, wherein said storage unit (16, 17) comprises a vertically-placed rectilinear second sliding guide (53) on which said second pick-up device (52) is slidably associated.

10. System according to any one of the preceding claims, wherein said box-forming machine (100)

comprises a forming unit (34) to open the carton (12).

11. System according to claim 10, wherein said forming unit (34) has one or more rotating lever elements (60) having one or more gripping parts (63) configured to couple with the flattened-out carton and form, by rotation, an open tubular carton.

12. System according to claim 10 or claim 11, wherein said forming unit (34) is mounted on said second pick-up device (52).

13. System according to any one of claims 10 - 12, wherein said box-forming machine (100) comprises, moreover, a bottom closing unit (67) configured to form a bottom on the tubular carton after said forming unit (34) has created a tubular carton, in order to obtain a box with only one top opening.

14. System according to any one of the preceding claims, wherein said closing station (106) comprises cutting components (69) configured to reduce the dimension of the box (11) before one of its top parts is closed.

15. System according to any one of the preceding claims, wherein the second pick-up device (52) is mounted on a second carriage (57) activated to horizontally translate by means of a translation device (58), in such a way to translate the carton (12) brought by the second pick-up device (52).

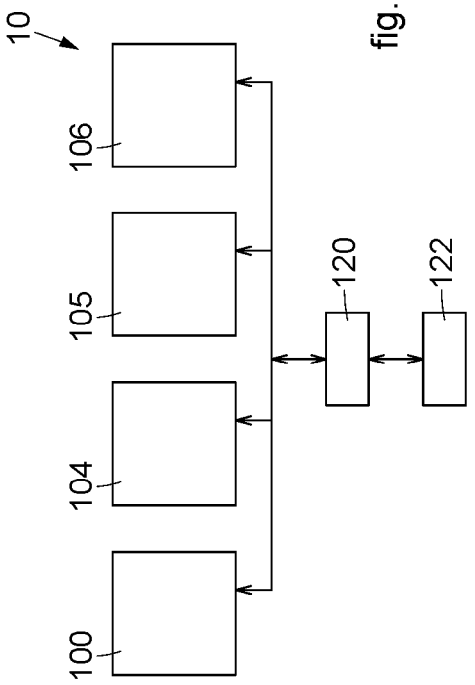


fig.2

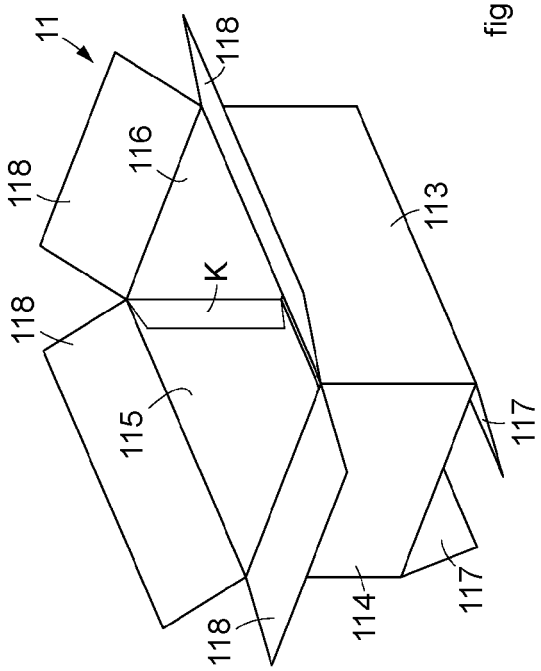


fig. 4

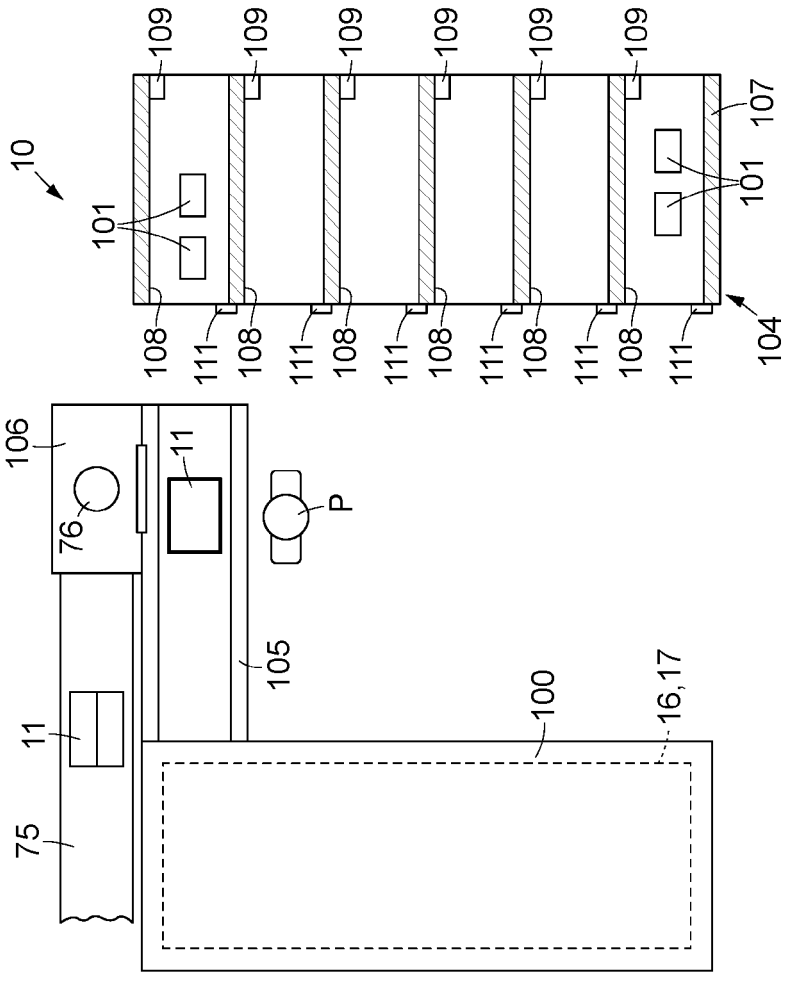
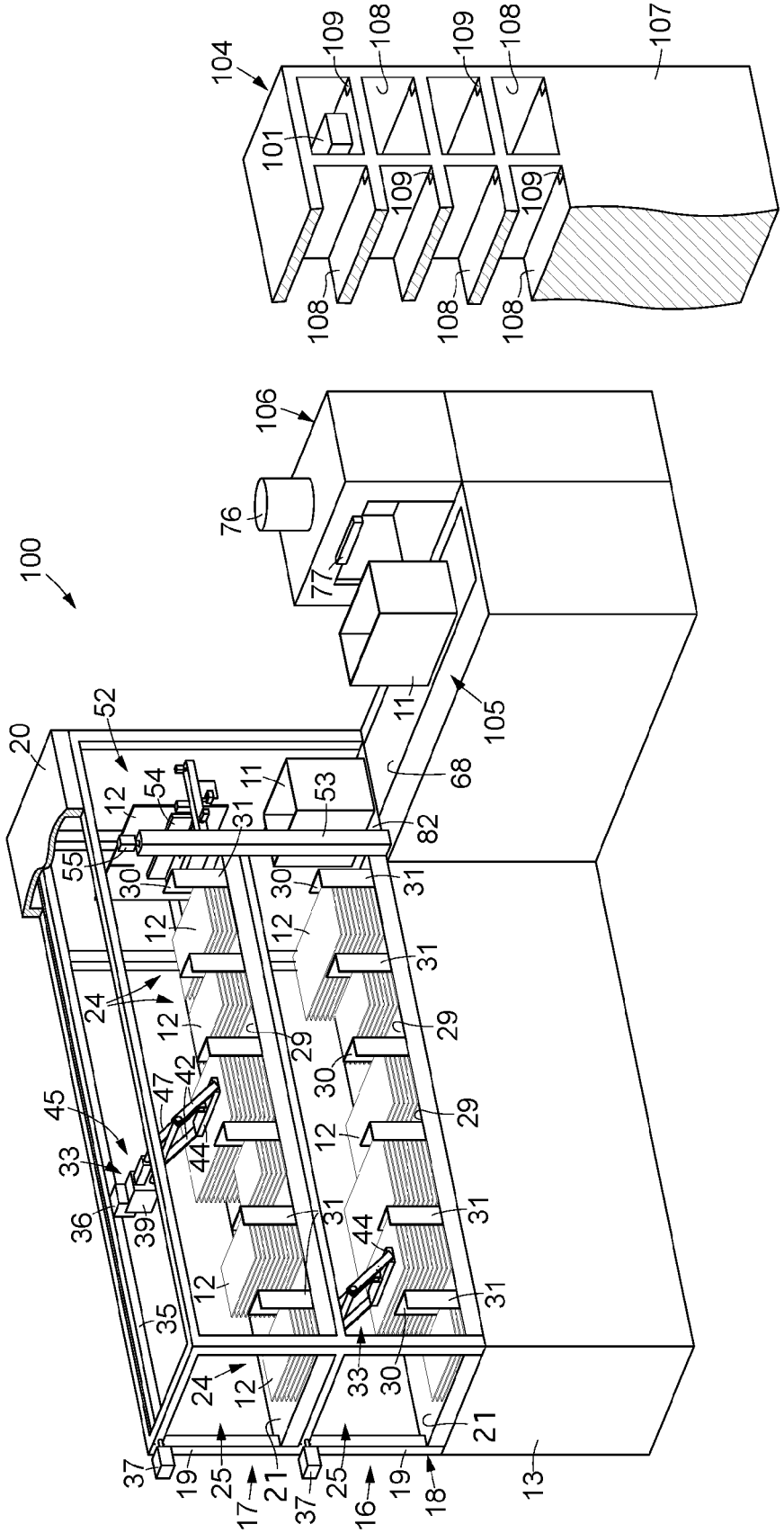


fig. 1


100
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109
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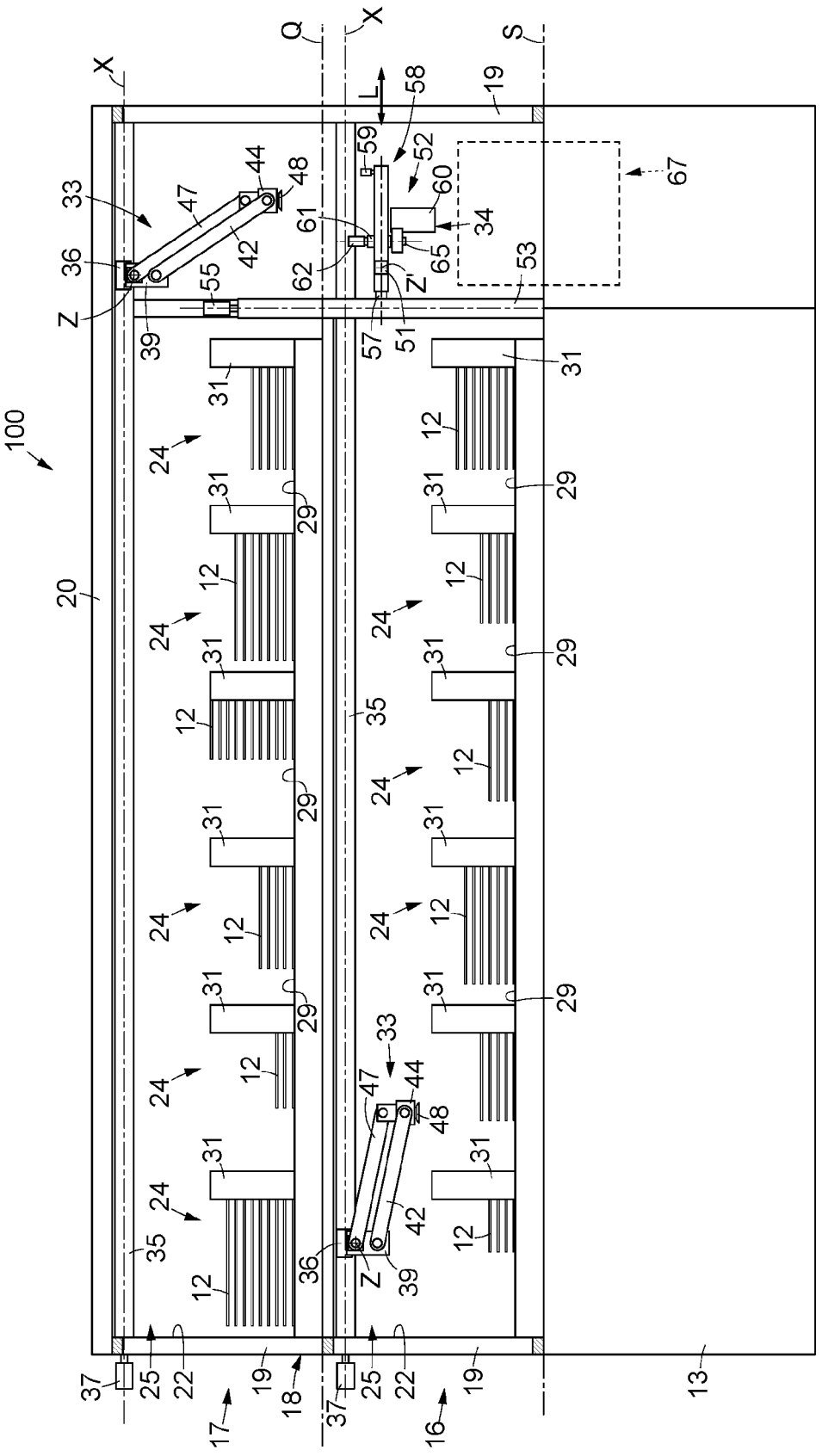
fig. 3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Q
X
S
L
58
19
59
52
67
60
33
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48
61
34
36
42
62
65
53
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Z'
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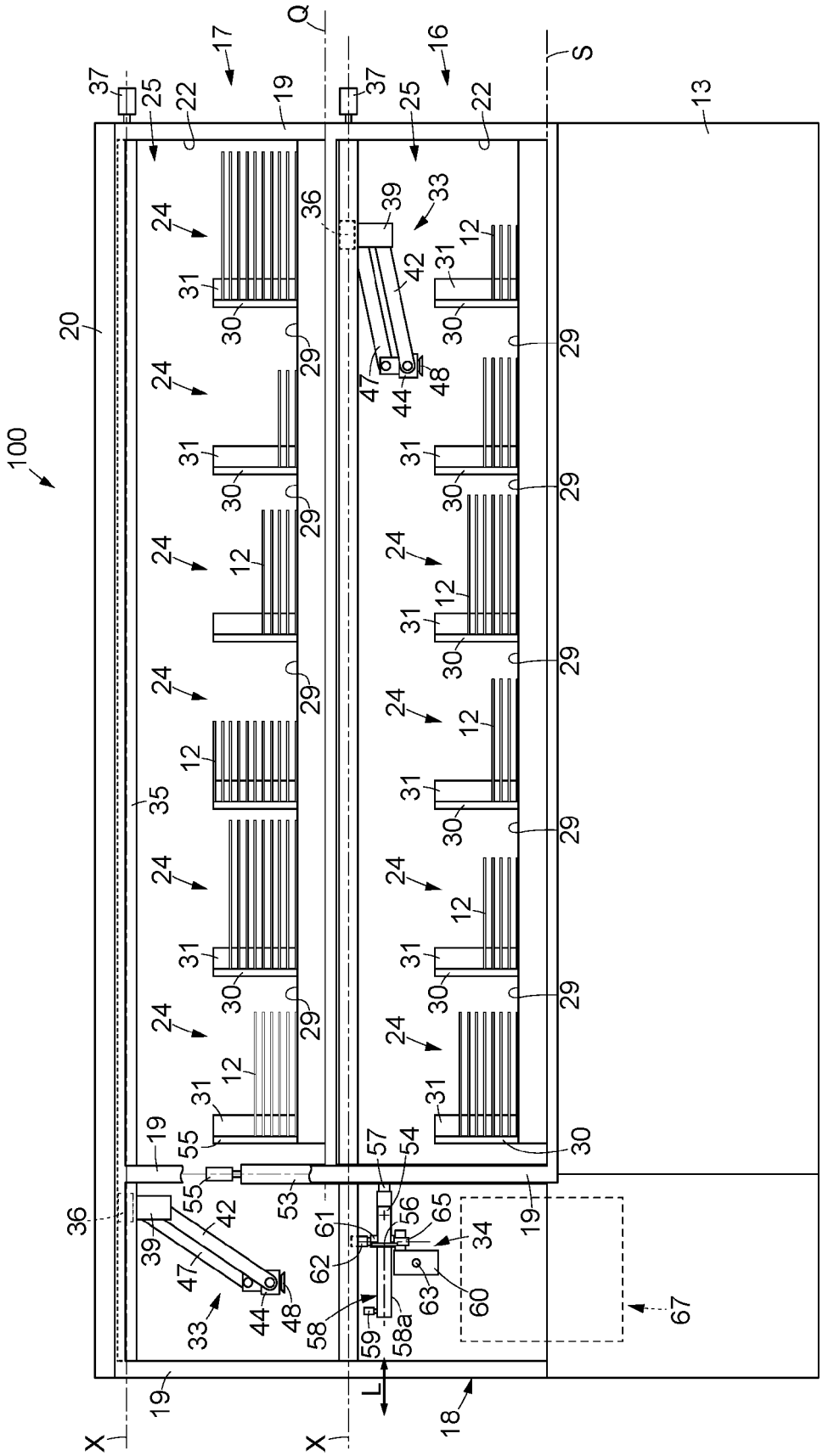
fig. 5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16
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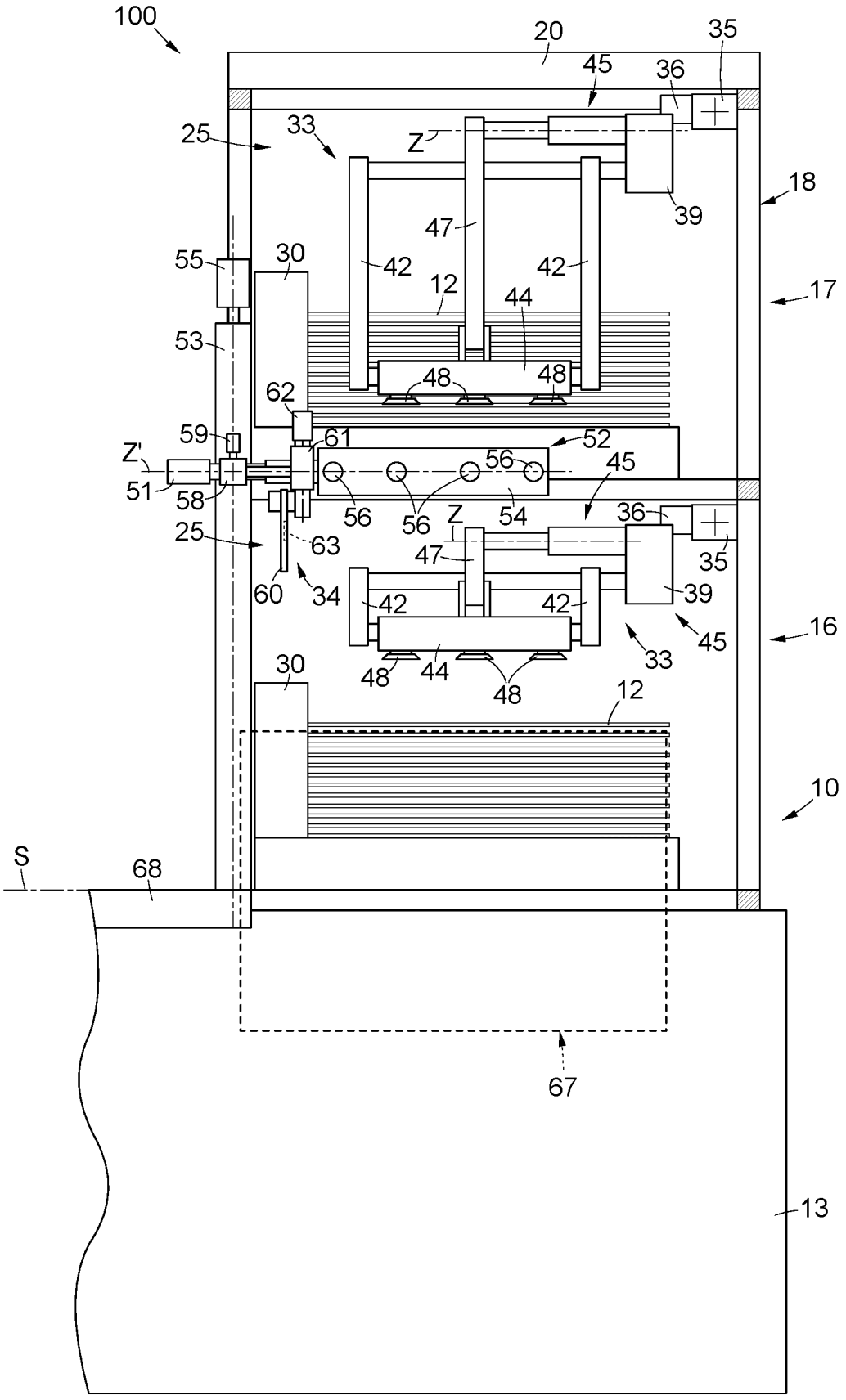
65
34
67

fig. 6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17
53
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48
62
59
61
52
Z'
56
45
51
58
56
56
Z
54
36
25
63
47
35
60
34
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45
16
48
44
48
33
30
12
10
S
68
67
13

fig. 7

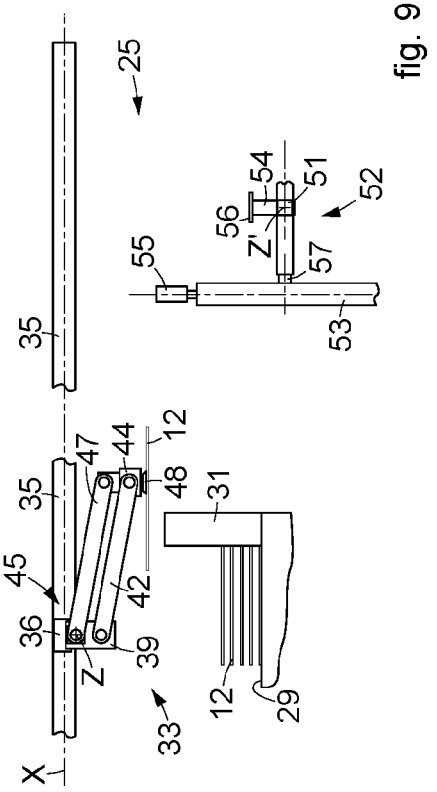


fig. 9

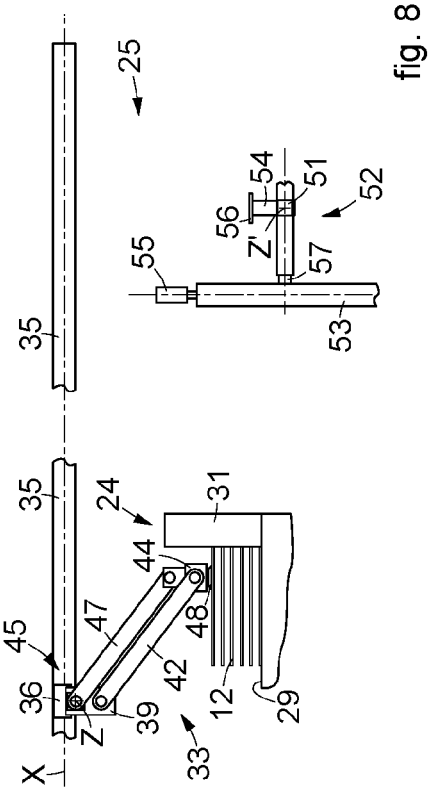


fig. 8

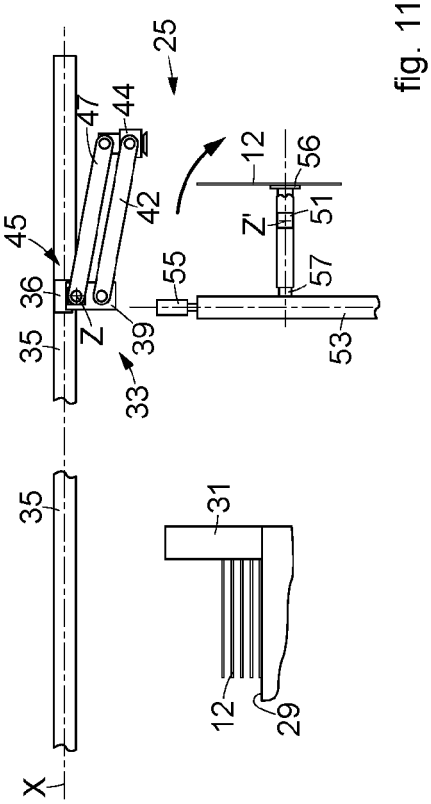


fig. 11

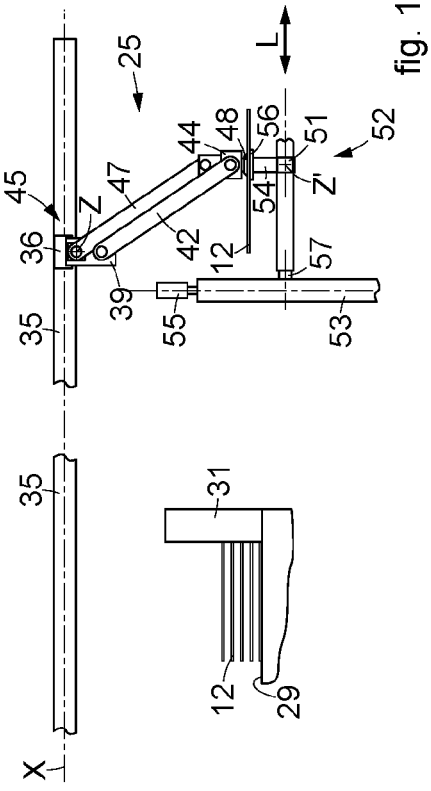
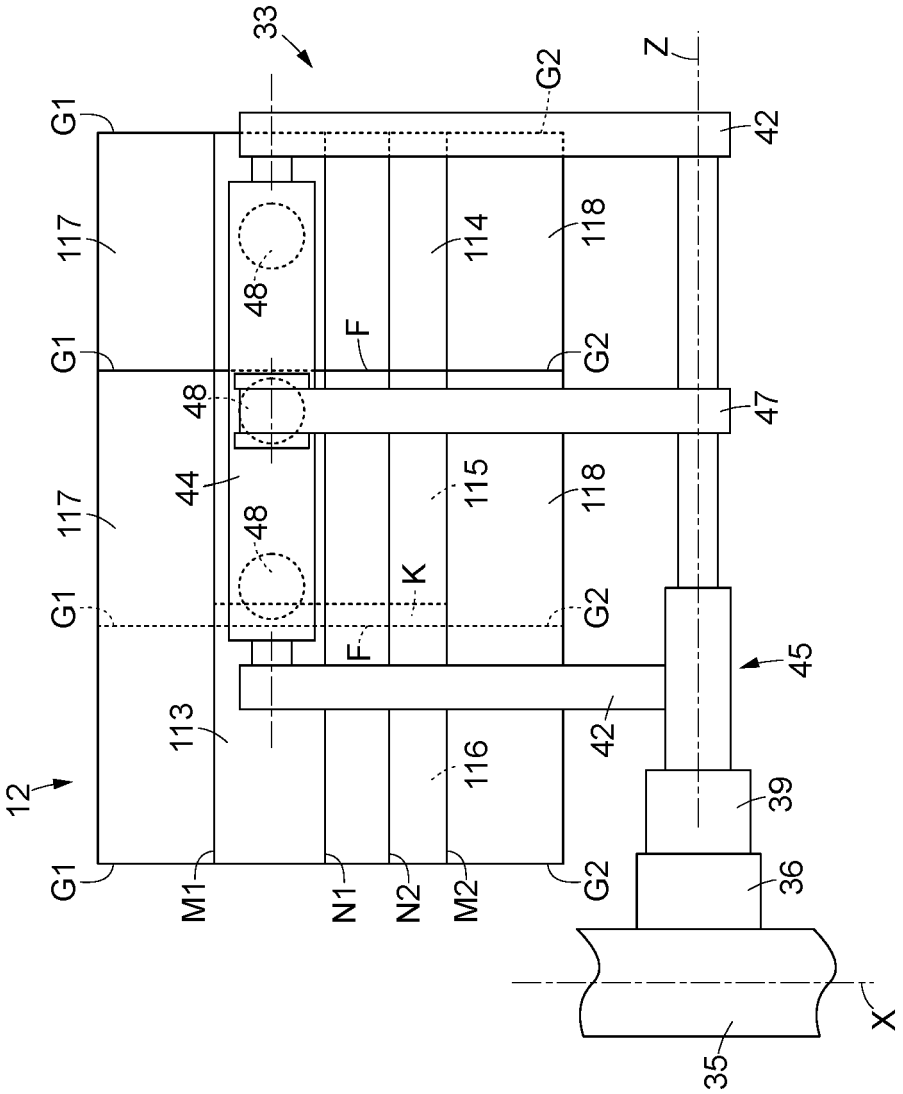


fig. 10


33
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G1
G2
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117
114
118
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F
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44
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K
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113
116
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36
M1
N1
N2
M2
35
X

fig. 12

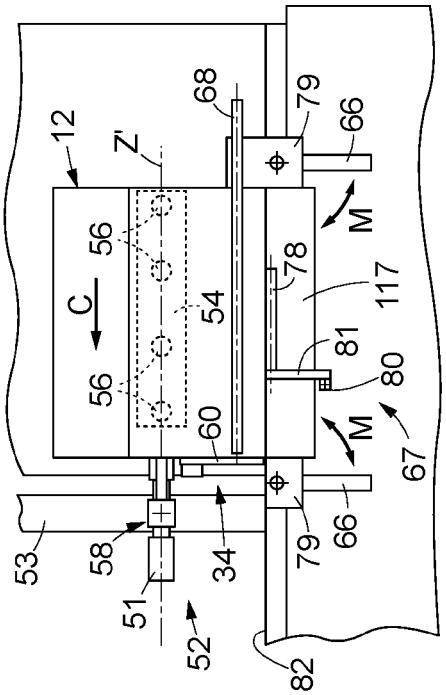


fig. 14a

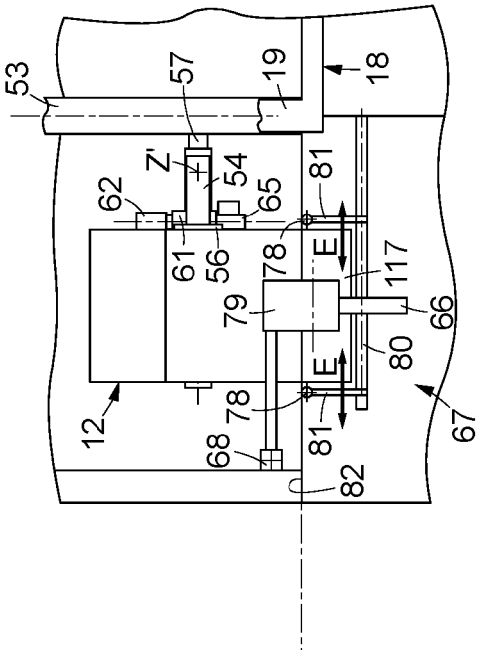


fig. 14b

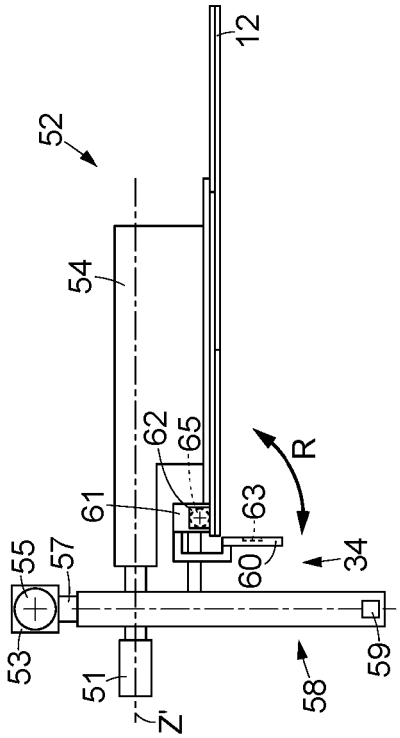


fig. 13a

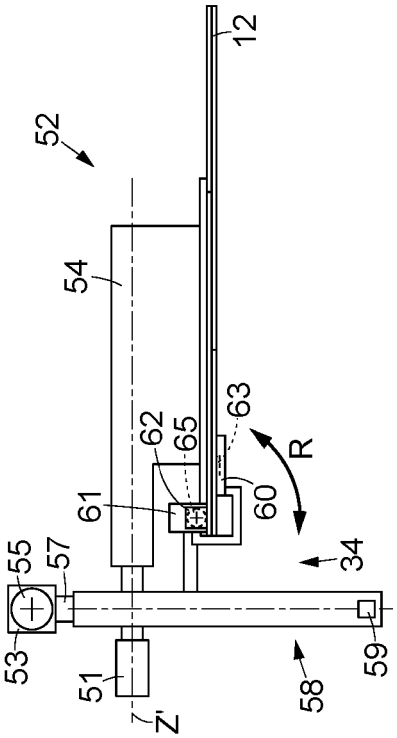


fig. 13b

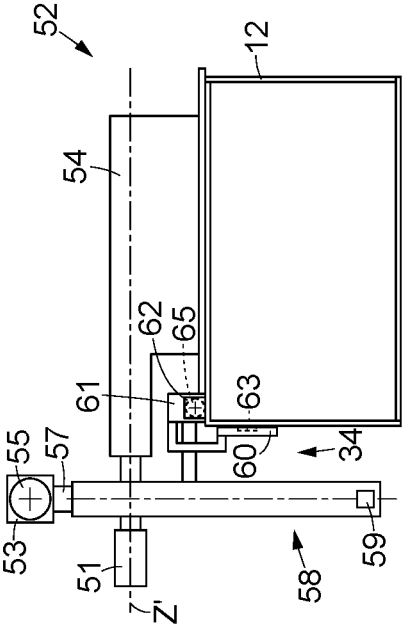
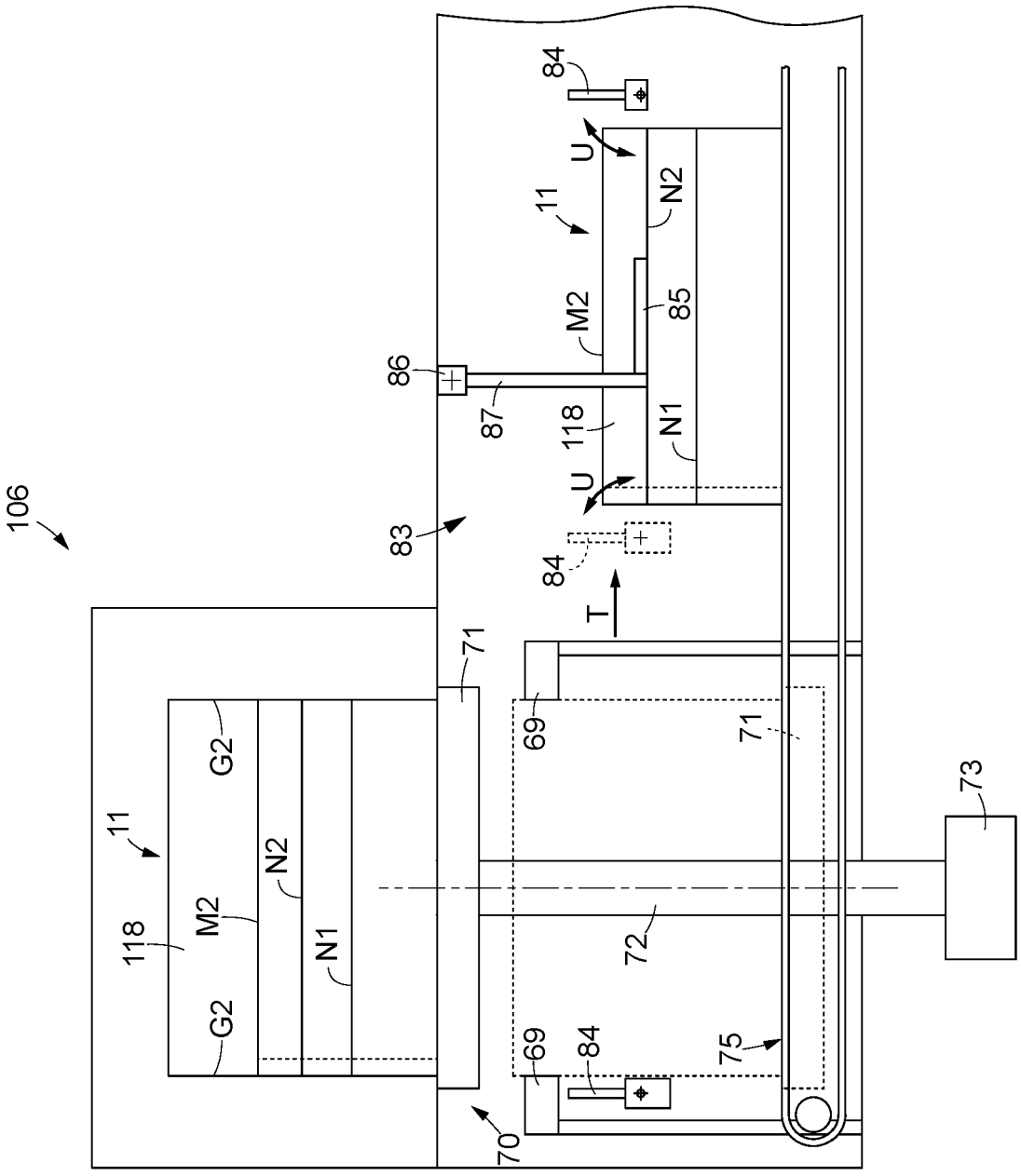


fig. 13c


106
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G2
N2
M2
N1
118
G2
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83
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U
N2
11
M2
85
86
87
118
N1
U
84
T
69
71
73
72
69
84
75
70

fig. 15

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EUROPEAN SEARCH REPORT

Application Number
EP 21 19 6338

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 9 533 785 B2 (BOSCH GMBH ROBERT [DE]) 3 January 2017 (2017-01-03)	1,4-15	INV. B65B5/02
Y	* figure 2 *	2,3	B65B43/18 B65B43/26
A	EP 2 275 350 B1 (KRONES AG [DE]) 11 September 2013 (2013-09-11) * figures 1,2 *	1	
A	US 2008/141632 A1 (MONTI GIUSEPPE [IT]) 19 June 2008 (2008-06-19) * figures 3,4 *	1,4,5	
Y	WO 2017/149872 A1 (ISHIDA SEISAKUSHO [JP]) 8 September 2017 (2017-09-08)	2,3	
A	* figure 7 *	1	

TECHNICAL FIELDS SEARCHED (IPC)
B65B

1 The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	25 February 2022	Dick, Birgit

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

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