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(54) **BOX MANUFACTURING DEVICE**

(57) A box forming apparatus (10) that opens a flattened cardboard box (FB) to form a tubular cardboard box (TB) is equipped with a holding mechanism (40), a moving mechanism (45), and a control device (92), wherein the holding mechanism (40) has holding members (42b, 42a) that hold a first side panel (C11) and a second side panel (C12), the moving mechanism (45) moves front face lower holding members and front face upper holding members, the control device (92) controls the moving mechanism (45) so as to fold at least either one of the first side panel (C11) and the second side panel (C12) along a first fold portion (FP1) to thereby change the angle formed by the first side panel and the second side panel from 0° or 180° to an angle close to 90°, the holding mechanism (40) further has a position adjusting member (50), and when the holding members (42b, 42a) are moved by the moving mechanism (45) to open the flattened cardboard box, the position adjusting member (50), which adjusts the position of a first flap (C31) connected to the first side panel, adjusts the position of the first flap (C31) in such a way that the first flap (C31) connected to the first side panel (C11) is placed in a state in which it extends along the direction in which the first side panel (C11) extends or a state in which it is folded inward in a state the flattened cardboard box being opened.

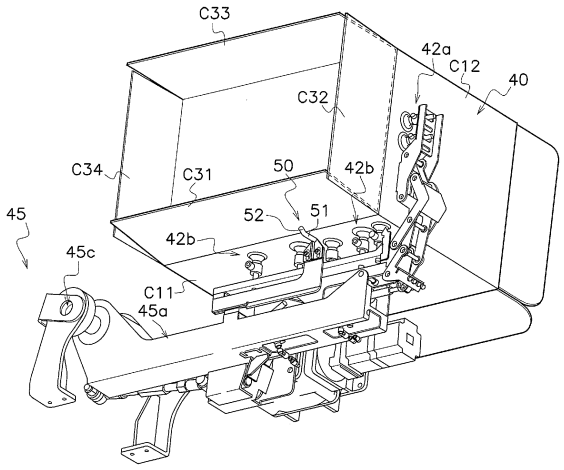

FIG. 10

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Description

TECHNICAL FIELD

[0001] The present invention relates to a box forming apparatus.

BACKGROUND ART

[0002] Cardboard boxes are generally employed as packaging means repeatedly used to transport items. Prior to box forming, the cardboard boxes are in the form of flat-folded flattened cardboard boxes and stacked. The flattened cardboard boxes are transformed by a box forming apparatus into a tubular shape having two open portions, then one of the open portions is closed and items are packed in the box. For example, patent document 1 (WO 2011/119563) proposes a box forming apparatus that takes out one flattened cardboard box from a plurality of flattened cardboard boxes stacked in an upward and downward direction and opens the flattened cardboard box into a tubular cardboard box.

SUMMARY OF INVENTION

<Technical Problem>

[0003] The flattened cardboard box has four side panels and four flaps connected to the respective four side panels. In the box forming apparatus pertaining to above-described patent document 1 (WO 2011/119563), during the operation of opening the flattened cardboard box, the four side panels and the four flaps are each held in such a way that they have predetermined postures. A configuration that holds all of the four side panels and the four flaps during opening the flattened cardboard box is not suited for situations where flattened cardboard boxes of various sizes are handled in the box forming apparatus.

[0004] It is an object of the present invention to provide a box forming apparatus that makes it possible to open flattened cardboard boxes of various sizes to tubular cardboard boxes.

<Solution to Problem>

[0005] A box forming apparatus pertaining to the present invention is a box forming apparatus configured to open a flattened cardboard box to form a tubular cardboard box. The flattened cardboard box is a flat-folded cardboard box. The box forming apparatus is provided with a holding mechanism, a moving mechanism, and a control device. The holding mechanism has a holding member configured to hold a first side panel and a second side panel. The first side panel and the second side panel are two adjacent side panels of four side panels of the flattened cardboard box. The moving mechanism is configured to move the holding members. The control device is configured to control the moving mechanism so as to fold at least either one of the first side panel and the second side panel along a first fold portion to thereby change the angle formed by the first side panel and the second side panel from 0° or 180° to an angle close to 90°. The first fold portion is disposed in the border between the first side panel and the second side panel. The holding mechanism further has a position adjusting member. The position adjusting member is configured to adjust the position of at least one of a first flap and an opposing flap. The first flap is a section of the flattened cardboard box connected to the first side panel. The opposing flap is a section of the flattened cardboard box connected to an opposing side panel opposing the first side panel and opposes the first flap. In a case of adjusting the position of the first flap, when the holding member is moved by the moving mechanism to open the flattened cardboard box, the position adjusting member is configured to adjust the position of the first flap in such a way as to place the first flap in a state in which the first flap extends along a direction in which the first side panel extends or a state in which the first flap is folded inward at the time of the flattened cardboard box being opened. In a case of adjusting the position of the opposing flap, the position adjusting member is configured to adjust the position of the opposing flap in such a way as to place the opposing flap in a state in which the opposing flap extends along a direction in which the opposing side panel extends or a state in which the opposing flap is folded inward at the time of the flattened cardboard box being opened.

[0006] In the box forming apparatus pertaining to the present invention, when the flattened cardboard box is opened, the position adjusting member places the first flap in a state in which it extends along the direction in which the first side panel extends or a state in which it is folded inward at the time of the flattened cardboard box being opened and/or places the opposing flap in a state in which it extends along the direction in which the opposing side panel extends or a state in which it is folded inward at the time of the flattened cardboard box being opened. Because of this, without a configuration that holds all of the flaps, the first flap and/or the opposing flap and the flaps adjacent to the first flap and the opposing flap can be kept in predetermined postures after the operation of opening the flattened cardboard box has been completed. As a result, flattened cardboard boxes of various sizes can be opened to tubular cardboard boxes.

[0007] Furthermore, it is preferred that the holding mechanism has a first holding member and a second holding member. The first holding member is the holding member configured to hold the first side panel. The second holding member is the holding member configured to hold the second side panel. The first holding member is configured to hold the first side panel in such a way that the first side panel has an angle with respect to the horizontal before the operation of opening the flattened cardboard box completes. The second holding member

is configured to hold the second side panel in such a way that the second side panel has an angle with respect to the horizontal before the operation of opening the flattened cardboard box completes. Furthermore, the first holding member is configured to be moved by the moving mechanism in such a way as to hold the first side panel in an inclination parallel or nearly parallel to the horizontal after the operation of opening the flattened cardboard box has completed. Furthermore, the second holding member is configured to be moved by the moving mechanism in such a way as to hold the second side panel in an inclination vertical or nearly vertical to the horizontal after the operation of opening the flattened cardboard box has completed. Because of this, the flattened cardboard box can be opened to the tubular cardboard box at a high speed.

[0008] Furthermore, it is preferred that the position adjusting member is configured to abut the first flap and/or the opposing flap to thereby adjust the position of the first flap and/or the opposing flap the position adjusting member abuts. Because of this, the position of the first flap and/or the opposing flap can be adjusted by a relatively simple configuration.

[0009] Furthermore, it is preferred that the position adjusting member is configured to adjust the position of at least the first flap. Preferably, the first flap has an inclination parallel or nearly parallel to the horizontal after the operation of opening the flattened cardboard box has completed and the position adjusting member is configured to abut the first flap from below. Because of this, when the flattened cardboard box has been opened at a high speed, the first flap can be prevented from being folded in the opposite direction of its folding direction.

[0010] Furthermore, preferably, the flattened cardboard box further has a second flap and a third flap and the second flap and the third flap are in a free state during the operation of opening the flattened cardboard box. The second flap and the third flap are located in positions adjacent to the first flap. Because the position adjusting member does not abut the second flap and the third flap, the place where an abutment mark is left can be minimized.

[0011] Moreover, it is preferred that the holding mechanism further have a support frame that supports the first holding member, the second holding member, and the position adjusting member. Furthermore, it is preferred that a distal end of the position adjusting member configured to abut the first flap is arranged, after the operation of opening the flattened cardboard box has completed, in a position projecting more upward than a height position of a contact plane in which the first holding member contacts the first side panel. Because of this, the second flap and the third flap can be prevented from being folded a large extent in the folding direction.

[0012] Furthermore, it is preferred that the position adjusting member is configured to abut the first flap to thereby tilt the first flap 0° to 30° upward along a second fold portion. The second fold portion is disposed in a border between the first side panel and the first flap. Because of this, the second flap and the third flap can be reliably prevented from being folded a large extent in the folding direction.

[0013] Furthermore, preferably, the second flap and the third flap tilt in the direction of gravity that during the operation of opening the flattened cardboard box and the first flap abutted by the position adjusting member is configured to inhibit the tilting of the second flap or the third flap in the direction of gravity. Because of this, the first flap inhibits the second flap or the third flap to be folded in the folding direction.

[0014] Furthermore, it is preferred that the position adjusting member is configured to blow air against the first flap and/or the opposing flap to thereby adjust the position of the first flap and/or the opposing flap against which the position adjusting member blows air. Because of this, the position of the first flap and/or the opposing flap can be adjusted without causing damage to or depressions in the box.

<Advantageous Effects of Invention>

[0015] The box forming apparatus pertaining to the present invention makes it possible to open flattened cardboard boxes of various sizes to tubular cardboard boxes.

BRIEF DESCRIPTION OF DRAWINGS

[0016]

FIG. 1 is a schematic front view of a box forming and packing system pertaining to an embodiment of the present invention.

FIG. 2 is a schematic perspective view of the box forming apparatus.

FIG. 3 is a schematic plan view of a stacking member.

FIG. 4 is a plan view of a stepped portion.

FIG. 5 is a view showing flattened cardboard boxes stacked on the stepped portion.

FIG. 6 is an enlarged view of region R shown in FIG. 2.

FIG. 7 is a schematic view of the box forming apparatus seen from the upstream side of the conveyance direction.

FIG. 8 is a schematic view of an opening mechanism.

FIG. 9 is a view showing the arrangement of a front face upper holding member and a front face lower holding member when an opening operation starts and ends and the circumstance of the flattened cardboard box being opened.

FIG. 10 is a view showing the front face upper holding member, the front face lower holding member, and an abutting member at the time when the opening operation has completed.

FIG. 11 is a view showing the postures of a first side

panel and a flap held by the front face lower holding member and the abutting member at the time when the opening operation has completed.

FIG. 12 is a schematic configuration view of a bottom forming mechanism.

FIG. 13 is a control block diagram of the box forming and packing system.

FIG. 14A is a perspective view of a cardboard box.

FIG. 14B is a bottom view of the cardboard box.

FIG. 15 is a perspective view of a tubular cardboard box.

FIG. 16A is a front view of a flattened cardboard box.

FIG. 16B is a sectional view, along line I-I, of the flattened cardboard box shown in FIG. 16A.

FIG. 17 is a view showing a state at the end of the opening operation performed by the opening mechanism of the box forming apparatus pertaining to example modification E.

FIG. 18 is a view showing the postures of the first side panel and the flap held by the front face lower holding member and an air blowing member at the end of the opening operation performed by the box forming apparatus pertaining to example modification E.

DESCRIPTION OF EMBODIMENTS

[0017] A box forming apparatus 10 pertaining to an embodiment of the present invention will be described with reference to the drawings. It should be noted that the following embodiment is not intended to limit the technical scope of the present invention.

(1) Overall Configuration

[0018] FIG. 1 is a schematic side view of a box forming and packing system 100 including the box forming apparatus 10 pertaining to the embodiment of the present invention. FIG. 2 is a schematic perspective view of the box forming apparatus 10. In the following description, the upward and downward direction, the right and left direction, and the forward and rearward direction mean the directions shown in FIG. 1 and FIG. 2 unless otherwise indicated. The conveyance direction means the direction in which flattened cardboard boxes FB or boxes B are transferred in the box forming and packing system 100. Upstream/downstream mean upstream/downstream in the conveyance direction.

[0019] The box forming and packing system 100 is a system that forms cardboard boxes B and packs items in the formed cardboard boxes B. As shown in FIG. 1 and FIG. 13, the box forming and packing system 100 mainly includes the box forming apparatus 10, a packing apparatus 90, a conveyance apparatus 91, and a control device 92.

[0020] The box forming apparatus 10 opens flattened cardboard boxes FB (see FIG. 16A and FIG. 16B) to form the cardboard boxes B (see FIG. 14A and FIG. 14B). The box forming apparatus 10 can form cases from both unused flattened cardboard boxes FB and used flattened cardboard boxes FB. The process executed by the box forming apparatus 10 will be called a box forming process. The packing apparatus 90 packs a plurality of items in the cardboard boxes B. The process executed by the packing apparatus 90 will be called a packing process. The conveyance apparatus 91 conveys downstream the cardboard boxes B into which the items have been packed. The control device 92 controls the box forming apparatus 10, the packing apparatus 90, and the conveyance apparatus 91.

[0021] The box forming and packing system 100 executes the box forming process and the packing process while moving the flattened cardboard boxes FB and the cardboard boxes B (see arrows D1 to D6 in FIG. 1). The flattened cardboard boxes FB are transferred through the box forming apparatus 10 and then to the packing apparatus 90. Specifically, the box forming apparatus 10 mainly includes a stacking mechanism 12, a transport mechanism 13, an opening mechanism 14, and a bottom forming mechanism 16. In the box forming and packing system 100, one of the flattened cardboard boxes FB stacked on the stacking mechanism 12 is moved at a time by the transport mechanism 13 to the opening mechanism 14 positioned diagonally above the stacking mechanism 12 (see arrow D1). The flattened cardboard box FB is opened and transformed into a tubular cardboard box TB by the opening mechanism 14. At this time, the flattened cardboard box FB moves to the bottom forming mechanism 16 positioned diagonally below the opening start position (see arrow D2) while the flattened cardboard box FB is being opened. Thereafter, a bottom BC is formed in the tubular cardboard box TB by the bottom forming mechanism 16. The tubular cardboard box TB in which the bottom BC has been formed (the cardboard box B) is thereafter moved in a substantially horizontal direction toward a lowering start position (see arrow D3). Here, the lowering start position is a place where the cardboard box B is conveyed downward. The cardboard box B thereafter drops and moves to the packing apparatus 90 positioned below the lowering start position (see arrow D4). Items are packed in the cardboard box B by the packing apparatus 90, and thereafter the cardboard box B is moved to the conveyance apparatus 91 located in the lowermost position of the box forming and packing system 100 (see arrow D5). Thereafter, the cardboard box B is further moved to a later process by the conveyance apparatus 91 (see arrow D6).

[0022] It should be noted that in the present embodiment the cardboard box B, the tubular cardboard box TB, and the flattened cardboard box FB have the following configurations.

(1-1) Cardboard box

[0023] The cardboard box B has a configuration in which items can be packed. FIG. 14A and FIG. 14B show

the cardboard box B. FIG. 14A is a perspective view of the cardboard box B, and FIG. 14B is a bottom view of the cardboard box B. The cardboard box B includes a tube portion TP, a bottom BC, and flaps C21 to C24.

[0024] The tube portion TP is a section configuring side panels of the cardboard box B. Included in the side panels are a first side panel C11, a second side panel C12, a third side panel C13, and a fourth side panel C14. That is, the tube portion TP is configured by four side panels. The tube portion TP has four fold portions FP1 to FP4. The fold portions FP1 to FP4 are disposed in the borders between two adjacent side panels. Specifically, the fold portion FP1 is disposed in the border between the first side panel C11 and the second side panel C12. The fold portion FP2 is disposed in the border between the second side panel C12 and the third side panel C13. The fold portion FP3 is disposed in the border between the third side panel C13 and the fourth side panel C14. The fold portion FP4 is disposed in the border between the fourth side panel C14 and the first side panel C11. The angles formed by two adjacent side panels on either side of each of the fold portions FP1 to FP4 are 90°.

[0025] The bottom BC is a section serving as a bottom of the cardboard box B. The bottom BC is configured by flaps C31 to C34. The flaps C31 to C34 form the bottom BC of the cardboard box B as a result of being folded and tucked in such a way that they lie on top of their adjacent flaps (see FIG. 14B). The bottom BC has an interleaved shape. The flaps C31 to C34 are positioned lower than the tube portion TP in a direction of a height h (see FIG. 15). Specifically, the flap (first flap) C31 is connected to the lower side of the first side panel C11. The flap (second flap) C32 is connected to the lower side of the second side panel C12. The flap (fourth flap) C33 is connected to the lower side of the third side panel C13. The flap (third flap) C34 is connected to the lower side of the fourth side panel C14. The flap C32 and the flap C34 are located in positions adjacent to the flap C31. The flap C33 is located in a position opposing the flap C31.

[0026] The flaps C21 to C24 are folded and tucked in such a way that they lie on top of their adjacent flaps like the flaps C31 to C34 to form a top of the cardboard box B in a process subsequent to the process of the box forming and packing system 100. The flaps C21 to C24 are positioned upper than the tube portion TP in the direction of the height h (see FIG. 14A and FIG. 15). Specifically, the flaps C21 to C24 are connected to the upper sides of the first side panel C11 to the fourth side panel C14, respectively.

[0027] Fold portions FP11 to FP14 and FP21 to FP24 are also formed in the borders between the side panels C11 to C14 and the flaps C21 to C24 and the borders between the side panels C11 to C14 and the flaps C31 to C34, respectively. Specifically, as shown in FIG. 15, the fold portions FP11 and FP21 are formed in the border between the first side panel C11 and the flap C21 and the border between the first side panel C11 and the flap C31, respectively. The fold portions FP12 and FP22 are formed in the border between the second side panel C12 and the flap C22 and the border between the second side panel C12 and the flap C32, respectively. The fold portions FP13 and FP23 are formed in the border between the third side panel C13 and the flap C23 and the border between the third side panel C13 and the flap C33, respectively. The fold portions FP14 and FP24 are formed in the border between the fourth side panel C14 and the flap C24 and the border between the fourth side panel C14 and the flap C34, respectively.

(1-2) Tubular cardboard box

[0028] The tubular cardboard box TB is the cardboard box B in a state in which the bottom BC is open. In other words, the tubular cardboard box TB is the cardboard box B in a state before the bottom BC is formed in the box forming process. FIG. 15 shows the tubular cardboard box TB. In the present embodiment, the tubular cardboard box TB has the aforementioned tube portion TP, the flaps C21 to C24, and the flaps C31 to C34.

(1-3) Flattened cardboard box

[0029] The flattened cardboard box FB is the tubular cardboard box TB in a flat-folded state. That is, the flattened cardboard box FB is the configuration before the opening operation is performed in the box forming process. FIG. 16A and FIG. 16B show the flattened cardboard box FB. FIG. 16A is a front view of the flattened cardboard box FB. FIG. 16B is a sectional view, along line I-I, of the flattened cardboard box FB shown in FIG. 16A.

[0030] The flattened cardboard box FB indicates a state in which the tube portion TP is folded a large extent along the two opposing fold portions FP2 and FP4. In this configuration, the angles formed by the two adjacent side panels on either side of each of the fold portions FP2 and FP4 are smaller than 90° (see FIG. 16B). Specifically, the second side panel C12 and the third side panel C13 are folded along the fold portion FP2 in such a way that the inner wall of the second side panel C12 and the inner wall of the third side panel C13 come close to each other, and the angle from the inner wall of the second side panel C12 to the inner wall of the third side panel C13 is 0° to 30°. The fourth side panel C14 and the first side panel C11 are also folded along the fold portion FP4 in such a way that the inner wall of the fourth side panel C14 and the inner wall of the first side panel C11 come close to each other, and the angle from the inner wall of the fourth side panel C14 to the inner wall of the first side panel C11 is 0° to 30°.

[0031] In contrast, the angles formed by the two adjacent side panels on either side of each of the remaining fold portions FP1 and FP3 are larger than 90° (see FIG. 16B). Specifically, the first side panel C11 and the second side panel C12 are spread open about the fold portion FP1 in such a way that the inner wall of the first side panel

C11 and the inner wall of the second side panel C12 are separate from each other, and the angle from the inner wall of the first side panel C11 to the inner wall of the second side panel C12 is 150° to 180°. The third side panel C13 and the fourth side panel C14 are also spread open about the fold portion FP3 in such a way that the inner wall of the third side panel C13 and the inner wall of the fourth side panel C14 are separate from each other, and the angle from the inner wall of the third side panel C13 to the inner wall of the fourth side panel C14 is 150° to 180°.

[0032] In the box forming and packing system 100 pertaining to the present embodiment, the flattened cardboard boxes FB are stacked in a posture where the fold portions FP2 and FP4 become the upward and downward direction end portions of the flattened cardboard boxes FB. Specifically, the first side panel C11 and the flaps C21 and C31 connected to the first side panel C11, and the second side panel C12 and the flaps C22 and C32 connected to the second side panel C12, are faced downstream in the conveyance direction (see FIG. 16A and FIG. 16B). Furthermore, the third side panel C13 and the flaps C23 and C33 connected to the third side panel C13, and the fourth side panel C14 and the flaps C24 and C34 connected to the fourth side panel C14, are faced upstream in the conveyance direction. Hereinafter, the face (side panels and flaps) positioned on the downstream side in the conveyance direction will be called a front face FF, and the face (side panels and flaps) positioned on the upstream side in the conveyance direction will be called a rear face RF.

[0033] The configurations of the box forming apparatus 10, the packing apparatus 90, the conveyance apparatus 91, and the control device 92 will be described in detail below.

(2) Box forming Apparatus

[0034] The box forming apparatus 10 opens the flat flattened cardboard boxes FB to form the cardboard boxes B. As shown in FIG. 1, the box forming apparatus 10 is placed most upstream in the conveyance direction. As mentioned above, the box forming apparatus 10 mainly includes the stacking mechanism 12, the transport mechanism 13, the opening mechanism 14, and the bottom forming mechanism 16. The configurations of each will be described in detail below.

(2-1) Stacking Mechanism

[0035] The stacking mechanism 12 allows numerous flattened cardboard boxes FB to be stacked thereon along the conveyance direction (see FIG. 1). Furthermore, the stacking mechanism 12 moves downstream in the conveyance direction the numerous flattened cardboard boxes FB stacked thereon. From the numerous flattened cardboard boxes FB stacked on the stacking mechanism 12, the later-described transport mechanism 13 takes out one flattened cardboard box FB at a time in sequence from downstream side and moves to the opening mechanism 14 disposed in an upper position.

[0036] Specifically, as shown in FIG. 2, the stacking mechanism 12 mainly includes a stacking member 21, front plates 22, a back plate 23, and an insertion mechanism 24.

(2-1-1) Stacking Member

[0037] The stacking member 21 allows numerous flattened cardboard boxes FB to be stacked thereon along the conveyance direction in a state in which the flattened cardboard boxes FB have been positioned in the right and left direction. Furthermore, the stacking member 21 also functions as a conveyor that conveys the numerous flattened cardboard boxes FB downstream in the conveyance direction (forward). As shown in FIG. 3, the stacking member 21 mainly includes a floor portion 211 and a stepped portion 214.

[0038] The floor portion 211 includes a plurality of plate-shaped members. The plurality of plate-shaped members extends in the forward and rearward direction and are spaced apart from each other by a gap having a predetermined width. Rollers 212 are placed on the upstream side and the downstream side of the floor portion 211 in the conveyance direction of the flattened cardboard boxes FB. Endless belts 213 are around the rollers 212. The belts 213 are placed in positions where they cover the gaps of the predetermined width formed in the floor portion 211. The belts 213 contact the lower ends of the flattened cardboard boxes FB loaded on the floor portion 211 and rotate as the rollers 212 are driven to rotate. The flattened cardboard boxes FB are moved forward (downstream in the conveyance direction) by the rotation of the belts 213. The rollers 212 are appropriately driven to rotate by a roller rotating mechanism 212a (see FIG. 13). The roller rotating mechanism 212a drives the rollers 212 to rotate when a sensor not shown in the drawings no longer detects a flattened cardboard box FB on the downstream side end portion of the floor portion 211.

[0039] The stepped portion 214 is a place that receives the plurality of flattened cardboard boxes FB conveyed from the stacking member 21 and supplies one flattened cardboard box FB at a time to the transport mechanism 13. The stepped portion 214 is placed on the downstream side end portion of the stacking member 21 (see FIG. 2 and FIG. 3). The stepped portion 214 includes a plurality of contact surfaces 214a (see FIG. 4 and FIG. 5). The plurality of contact surfaces 214a are placed in different height positions with respect to the horizontal plane. Furthermore, the plurality of contact surfaces 214a are each slightly tilted with respect to the horizontal plane so that the flattened cardboard boxes FB tilt forward with respect to the conveyance direction (see FIG. 5). The plurality of flattened cardboard boxes FB moves from on contact surfaces 214a located in higher positions to on contact surfaces 214a located in lower positions and are con-

veyed downstream in the conveyance direction. As shown in FIG. 4, three cutout portions 214b are formed in the right and left direction in the contact surface 214a configuring the lowermost step of the steps among the plurality of contact surfaces 214a. The cutout portions 214b allow upward and downward movement of claw portions 321 a of a loading member 321 described later.

(2-1-2) Front Plates

[0040] The front plates 22 regulate the forward movement of the flattened cardboard boxes FB stacked on the stepped portion 214. The front plates 22 extend in the upward and downward direction in a forwardly tilted posture. The front plates 22 are disposed on the front end side of the lowermost contact surface 214a (see FIG. 2 and FIG. 6). The front plates 22 extend in the upward and downward direction and contact at two places of the front face FF, in its width direction, of the foremost flattened cardboard box FB among the plurality of flattened cardboard boxes FB stacked on the stepped portion 214.

(2-1-3) Back Plate

[0041] The back plate 23 is a member that holds down, from the rear, the numerous flattened cardboard boxes FB stacked on the stacking member 21. Specifically, the rear plate 23 has a configuration that applies constant force in the conveyance direction to the rear face RF of the flattened cardboard box FB positioned on the tail end of the stacked numerous flattened cardboard boxes FB (see FIG. 2). The back plate 23 moves forward while holding down the rear face RF of the flattened cardboard box FB positioned on the tail end as the flattened cardboard box FB positioned on the tail end moves forward (downstream in the conveyance direction).

(2-1-4) Insertion Mechanism

[0042] The insertion mechanism 24 splits apart, among the plurality of flattened cardboard boxes FB stacked on the stepped portion 214, the foremost flattened cardboard box FB from the plurality of flattened cardboard boxes FB (following flattened cardboard boxes) following the foremost flattened cardboard box FB. As shown in FIG. 2, the insertion mechanism 24 is placed above the stepped portion 214. Furthermore, as shown in FIG. 7, the insertion mechanism 24 mainly includes a fixed plate 241 and a movable member 242.

[0043] The fixed plate 241 contacts the upper ends of the plurality of flattened cardboard boxes FB loaded on the stepped portion 214 and aligns the positions of the upper ends. The fixed plate 241 slopes in conformity with the inclination of the stepped portion 214. By aligning the positions of the upper ends of the flattened cardboard boxes FB, the fixed plate 241 causes the lower ends of the flattened cardboard boxes FB to contact the stepped portion 214. The fixed plate 241 has a shape that allows the movable member 242 to be placed in the width direction center thereof.

[0044] The movable member 242 is movable with respect to the fixed plate 241. The movable member 242 includes a sloping surface having the same inclination as the fixed plate 241 and an insertion portion 242a extending in the upward and downward direction. The movable member 242 rotates using one end on the upstream side as a rotating shaft to thereby move the insertion portion 242a in the upward and downward direction. The movable member 242 is driven by a movable mechanism 243 (see FIG. 13). When the insertion portion 242a moves downward, the insertion portion 242a is temporarily inserted between the foremost flattened cardboard box FB and the adjacent flattened cardboard box FB. At this time, the movable member 242 forcibly holds down from above, with its sloping surface, the upper end of the following flattened cardboard box FB among the plurality of flattened cardboard boxes FB.

(2-2) Feed Mechanism

[0045] The transport mechanism 13 sequentially takes out and conveys to a later process the foremost flattened cardboard box FB from the plurality of flattened cardboard boxes FB stacked on the stepped portion 214. As shown in FIG. 1 and FIG. 2, the transport mechanism 13 is placed downstream of the stacking mechanism 12. As shown in FIG. 7, the transport mechanism 13 mainly has a separating unit 31 and a transfer unit 32.

(2-2-1) Separating Unit

[0046] The separating unit 31 separates the foremost flattened cardboard box FB from the following flattened cardboard box FB among the plurality of flattened cardboard boxes FB stacked on the stepped portion 214. Specifically, the separating unit 31 sucks, by means of a separating sucker 311, the front face FF of the foremost flattened cardboard box FB. The separating sucker 311 is moved toward and away from the front face FF of the foremost flattened cardboard box FB by a separating sucker moving component 312. The separating sucker moving component 312 moves the separating sucker 311 in a direction away from the front face FF of the foremost flattened cardboard box FB in a state in which the separating sucker 311 is sucking the front face FF of the foremost flattened cardboard box FB. As a result, the upper end portion of the foremost flattened cardboard box FB bends. In this way, the separating unit 31 forms a gap between the upper end portion of the foremost flattened cardboard box FB and the upper end portion of the adjacent flattened cardboard box FB.

(2-2-2) Transfer Unit

[0047] The transfer unit 32 conveys upward and transfers to the opening mechanism 14 the foremost flattened

cardboard box FB among the plurality of flattened cardboard boxes FB stacked on the stepped portion 214. The transfer unit 32 mainly includes loading members 321, lifting suckers 322, and a lift mechanism 323 (see FIG. 6 or FIG. 7). The loading members 321 have claw portions 321 a on the distal ends of their lower end portions and extend in the upward and downward direction. The claw portions 321 a are placed in positions corresponding to the cutout portions 214b of the stepped portion 214 mentioned above. The claw portions 321 a contact, from below, the lower end of the foremost flattened cardboard box FB exposed at the positions of the cutout portions 214b and allow the foremost flattened cardboard box FB to be loaded on the upper surfaces of the claw portions 321 a. The lifting suckers 322 suck, from the front face FF side, the flattened cardboard box FB in the neighborhood of its lower end portion. The loading members 321 and the lifting suckers 322 are moved in the upward and downward direction by the lift mechanism 323. The loading members 321 and the lifting suckers 322 transfer, at an upper position, the foremost flattened cardboard box FB to the opening mechanism 14.

(2-3) Opening Mechanism

[0048] The opening mechanism 14 opens the flattened cardboard box FB to form the tubular cardboard box TB. In other words, the opening mechanism 14 transforms, from a flattened shape to a tubular shape, the flattened cardboard box FB delivered thereto from the transport mechanism 13 (see FIG. 9). As shown in FIG. 1 and FIG. 2, the opening mechanism 14 is disposed above the transport mechanism 13. As shown in FIG. 8, the opening mechanism 14 mainly includes a holding mechanism 40 and a plurality of moving mechanisms 43, 44, and 45. The holding mechanism 40 and the plurality of moving mechanisms 43, 44, and 45 will be described in detail below.

(2-3-1) Holding Mechanism

[0049] The holding mechanism 40 is a mechanism that holds the flattened cardboard box FB. The holding mechanism 40 includes a plurality of holding members 41 a, 41 b, 42a, and 42b and an abutting member 50. Using FIG. 8 to FIG. 11 the configuration of each member included in the holding mechanism 40 will be described. It should be noted that in FIG. 8 and FIG. 9 the abutting member 50 is omitted in order to facilitate understanding.

(a) Holding Members

[0050] The plurality of holding members 41 a, 41 b, 42a, and 42b are suction devices. The plurality of holding members 41 a, 41 b, 42a, and 42b include a rear face upper holding member 41 a, a rear face lower holding member 41 b, front face upper holding members (second holding members) 42a, and front face lower holding members (first holding members) 42b. The rear face upper holding member 41 a and the rear face lower holding member 41 b hold the side panels C13 and C14 positioned on the rear face RF side of the flattened cardboard box FB (see FIG. 16B). The front face upper holding members 42a and the front face lower holding members 42b hold the side panels C11 and C12 on the front face FF side. The plurality of holding members 41 a, 41 b, 42a, and 42b start sucking when the opening operation starts and continue sucking until the opening operation completes. Here, "when the opening operation starts" means when the holding members 41 a, 41 b, 42a, and 42b contact, or start moving in order to contact, the flattened cardboard box FB in order to start the opening operation. Furthermore, "when the opening operation completes" means when the transformation from the flattened cardboard box FB to the tubular cardboard box TB is completed.

(a-1) Rear Face Upper Holding Member

[0051] The rear face upper holding member 41 a is placed on the rear face RF side of the flattened cardboard box FB and holds the third side panel C13. The rear face upper holding member 41 a sucks the third side panel C13 in the neighborhood of the fold portion FP3. The rear face upper holding member 41 a is coupled to a first moving mechanism 43. The rear face upper holding member 41 a moves in the forward and rearward direction because of the driving of the first moving mechanism 43.

[0052] Specifically, before the opening operation starts, the rear face upper holding member 41 a is located in a position furthest away from the third side panel C13. When the opening operation starts, the rear face upper holding member 41a is moved to an advanced position in order to receive the flattened cardboard box FB transported by the transport mechanism 13 and contacts and sucks the third side panel C13. Moreover, during the opening operation, the rear face upper holding member 41 a is slightly moved to a retracted position while it sucks the third side panel C13.

(a-2) Rear Face Lower Holding Member

[0053] The rear face lower holding member 41 b is placed on the rear face RF side of the flattened cardboard box FB and holds the fourth side panel C14. The rear face lower holding member 41 b sucks the fourth side panel C14 in the neighborhood of the fold portion FP3. The rear face lower holding member 41 b is coupled to a second moving mechanism 44. The rear face lower holding member 41 b moves in the forward and rearward direction and the upward and downward direction as a result of the second moving mechanism 44 being driven.

[0054] Specifically, before the opening operation starts, the rear face lower holding member 41 b is located in a position furthest away from the fourth side panel C14. When the opening operation starts, the rear face lower

holding member 41 b is moved to an advanced position in order to receive the flattened cardboard box FB transferred by the transport mechanism 13 and contacts and sucks the fourth side panel C14. Moreover, during the opening operation, the rear face lower holding member 41 b is moved to a retracted position while it sucks the fourth side panel C14. When the rear face lower holding member 41 b starts moving, it stops sucking the flattened cardboard box FB and releases the flattened cardboard box FB. The rear face lower holding member 41 b moves following the flattened cardboard box FB with a slight residual suction force after it has stopped sucking, and moves away from the fourth side panel C14 of the flattened cardboard box FB a little above and/or in front of the position where it was arranged before the start of the opening operation.

(a-3) Front Face Upper Holding Members

[0055] The front face upper holding members 42a are placed on the front face FF side of the flattened cardboard box FB and hold the second side panel C12. The front face upper holding members 42a suck the second side panel C12 in the neighborhood of the fold portion FP1. The front face upper holding members 42a are attached to a support frame 45a of a third moving mechanism 45 described later. Specifically, the front face upper holding members 42a are attached to a distal end portion of the support frame 45a. In the present embodiment, there are two front face upper holding members 42a attached along the direction in which the support frame 45a extends (see FIG. 8 to FIG. 10). The front face upper holding members 42a move in the upward and downward direction and the forward and rearward direction because of the driving of the third moving mechanism 45.

(a-4) Front Face Lower Holding Members

[0056] The front face lower holding members 42b are placed on the front face FF side of the flattened cardboard box FB and hold the side panel C11. The front face lower holding members 42b suck the first side panel C11 in the neighborhood of the fold portion FP1. The front face lower holding members 42b are also attached to the support frame 45a of the third moving mechanism 45 described later. Specifically, the front face lower holding members 42b are attached to a main portion of the support frame 45a. In the present embodiment, there are five front face lower holding members 42b attached along the direction in which the support frame 45a extends (see FIG. 8 to FIG. 10). The front face lower holding members 42b move in such a way as to describe a circular arc as a result of the third moving mechanism 45 swinging (see FIG. 9).

(b) Abutting Member

[0057] The abutting member 50 is an example of a position adjusting member. The abutting member 50 adjusts the position of the flap C31 (the first flap) positioned on the front face FF of the flattened cardboard box FB. The abutting member 50 contacts the flap C31 (the first flap) positioned on the front face FF of the flattened cardboard box FB. Specifically, the abutting member 50 abuts the flap C31 (the first flap), which is a section connected to the first side panel C11 of the flattened cardboard box FB. The abutting member 50 abuts the flap C31 (the first flap) to thereby adjust the position of the flap (the first flap) C31 that the abutting member 50 abuts. More specifically, the abutting member 50 holds, among the flaps C31 to C34 to be formed into the bottom BC by the bottom forming mechanism 16 described later, the flap C31 connected to the side panel (the first side panel C11) that comes to a lower position when the opening operation completes. The abutting member 50 applies force to the flap C31 in the opposite direction of the direction of gravity.

[0058] The abutting member 50 is a rod-shaped member (see FIG. 10 and FIG. 11). The abutting member 50 is attached to the support frame 45a of the third moving mechanism 45. Specifically, the abutting member 50 is attached to the main portion of the support frame 45a. More specifically, the abutting member 50 is attached in a position on the distal end portion side of the center position in the lengthwise direction of the main portion.

[0059] As shown in FIG. 10 and FIG. 11, the abutting member 50 includes a first section 51 and a second section 52. The first section 51 is coupled to the support frame 45a. The first section 51 is positioned below the first side panel C11 when the opening operation completes, and extends from the neighborhood of the first side panel C11 toward the flap C31 along the direction in which the first side panel C11 extends (the direction of the height h). The second section 52 configures the distal end portion of the abutting member 50 and extends in a direction intersecting the first section 51. That is, the distal end section (the second section 52) of the abutting member 50 is folded upward. The abutting member 50 contacts the flap C31 at the distal end of the second section 52. The height position of the distal end of the second section 52 is located in a position higher than the height position of the plane in which the front face lower holding members 42b suck the first side panel C11 (see FIG. 11). It is preferred that the distal end of the second section 52 be configured by an elastic member so as to protect the flap C31 from damage.

[0060] The abutting member 50 moves in the upward and downward direction and the forward and rearward direction because of the driving of the third moving mechanism 45. The abutting member 50 continuously abuts the flap C31 from when the operation of opening the flattened cardboard box FB starts to when the opening operation completes. The distal end of the abutting member 50 abuts the flap C31, and thus the abutting member 50 places the flap C31 in a state in which it is slightly folded inward along the fold portion (a second fold portion) FP21 disposed in the border between the first side panel C11

and the flap C31. In other words, the abutting member 50 tilts the flap C31 a predetermined angle θ° inward at the time of the opening operation completes (upward), along the fold portion FP21 (see FIG. 11). That is, the abutting member 50 tilts the flap C31 the predetermined angle θ° in a folding direction along the fold portion FP21. Here, the folding direction is a direction in which the flap C31 becomes folded in order to form the bottom BC. Furthermore, here, the predetermined angle θ° is 0° to 30°, for example, and preferably is 5° to 15°.

(2-3-2) Moving Mechanisms

[0061] The plurality of moving mechanisms 43, 44, and 45 are mechanisms that move the holding mechanism 40. As shown in FIG. 8, the plurality of moving mechanisms 43, 44, and 45 include a first moving mechanism 43, a second moving mechanism 44, and a third moving mechanism 45. The first moving mechanism 43, the second moving mechanism 44, and the third moving mechanism 45 move the rear face upper holding member 41 a, the rear face lower holding member 41 b, and the front face upper holding members 42a and the front face lower holding members 42b, respectively, so that the flattened cardboard box FB is opened to the tubular cardboard box TB (see FIG. 9).

(a) First Moving Mechanism

[0062] The first moving mechanism 43 supports the rear face upper holding member 41 a in such a way that the rear face upper holding member 41 a is movable in the forward and rearward direction. The first moving mechanism 43 mainly has an upper support member 43a and a first drive component 43b (see FIG. 2, FIG. 8, or FIG. 13). The upper support member 43a supports the rear face upper holding member 41 a in such a way that the suction surface of the rear face upper holding member 41 a is parallel to the third side panel C13 of the flattened cardboard box FB transferred from the transport mechanism 13. The upper support member 43a is attached in the highest position of a frame 99 serving as a skeleton of the box forming and packing system 100 (see FIG. 2 and FIG. 8). The upper support member 43a is driven by the first drive component 43b to move the rear face upper holding member 41 a toward and away from the third side panel C13.

(b) Second Moving Mechanism

[0063] The second moving mechanism 44 supports the rear face lower holding member 41 b in such a way that the rear face lower holding member 41 b is movable in the forward and rearward direction and the upward and downward direction. The second moving mechanism 44 mainly has a lower support member 44a and a second drive component 44b (see FIG. 8 or FIG. 13). The lower support member 44a supports the rear face lower holding member 41 b at a position lower than the upper support member 43a. The lower support member 44a supports the rear face upper holding member 41 a in such a way that the suction surface of the rear face lower holding member 41 b is parallel to the fourth side panel C14 of the flattened cardboard box FB transferred from the transport mechanism 13. The lower support member 44a is driven by the second drive component 44b to move the rear face lower holding member 41 b in the forward and rearward direction and the upward and downward direction. Because of this, the lower support member 44a moves the rear face lower holding member 41 b toward and away from the fourth side panel C14.

(c) Third Moving Mechanism

[0064] The third moving mechanism 45 swings the front face upper holding members 42a, the front face lower holding members 42b, and the abutting member 50 to change the height position and planar position of the front face upper holding members 42a, the front face lower holding members 42b, and the abutting member 50.

[0065] The third moving mechanism 45 has the support frame 45a that supports the front face upper holding members 42a, the front face lower holding members 42b, and the abutting member 50 in such a way that they are movable in the upward and downward direction and the forward and rearward direction. The support frame 45a is driven by a third drive component 45b to swing in the upward and downward direction about a swing shaft 45c. As shown in FIG. 8, the swing shaft 45c is disposed in the neighborhood of the end portion on the rear side of the support frame 45a extending in the forward and rearward direction.

[0066] The support frame 45a mainly has a distal end portion and a main portion in its lengthwise direction. When the support frame 45a has a posture where it extends substantially parallel to the horizontal plane, the distal end portion is positioned on the front side. The distal end portion functions as the swinging end. The main portion is the section other than the distal end portion.

[0067] As mentioned above, the front face upper holding members 42a are attached to the distal end portion. The front face lower holding members 42b and the abutting member 50 are attached to the main portion. The distal end portion is connected by a link mechanism to the main portion. The link mechanism is driven by an air cylinder. The inclination of the distal end portion with respect to the main portion is changed by the driving of the link mechanism (see FIG. 8 and FIG. 9). Specifically, while standing by for the opening operation and before the opening operation starts, the distal end portion has an inclination substantially parallel to the horizontal plane (see FIG. 8) the same as the main portion. After the opening operation starts, the link mechanism gradually changes the inclination of the distal end portion with respect to the main portion. Furthermore, the link mechanism changes the inclination of the distal end portion in such

a way that the distal end portion has a 90° inclination with respect to the main portion when the opening operation completes (see FIG. 9 and FIG. 10).

[0068] The support frame 45a swings about the swing shaft 45a to change the height positions and the planar positions of the front face upper holding members 42a, the front face lower holding members 42b, and the abutting member 50. Specifically, because of the swinging of the support frame 45a, the front face upper holding members 45a, the front face lower holding members 42b, and the abutting member 50 move between an opening operation standby position (an opening operation end position) and an opening operation start position so as to describe a circular arc about the swing shaft 45c (see FIG. 8 and FIG. 9). When the support frame 45a swings about the swing shaft 45c and moves the front face upper holding members 42a, the front face lower holding members 42b, and the abutting member 50 from the opening operation start position to the opening operation end position, the flattened cardboard box FB is opened while moving in the direction indicated by arrow AR in FIG. 9 and is transformed into the tubular cardboard box TB.

(2-4) Bottom Forming Mechanism

[0069] The bottom forming mechanism 16 forms the bottom BC in the tubular cardboard box TB. In other words, the bottom forming mechanism 16 shapes the flaps C31 to C34 connected to the lower side of the tube portion TP into the bottom BC. The swastika-shaped bottom BC is formed by the bottom forming mechanism 16 (see FIG. 14B). The bottom forming mechanism 16 forms the bottom BC in the tubular cardboard box TB at the position where the operation of opening the flattened cardboard box FB is completed.

[0070] As shown in FIG. 12, the bottom forming mechanism 16 has flap holding members 61 and flap pushing-and-folding members 62. One flap holding member 61 and one flap pushing-and-folding member 62 are disposed for each of the flaps C31 to C34.

[0071] The flap holding members 61 hold first end portions of the flaps C31 to C34 in the width direction. The flap holding members 61 contact the first end portions of the flaps C31 to C34 from inside so that the flaps C31 to C34 do not fold inward (see FIG. 12).

[0072] Specifically, the flap holding members 61 have holding contact surfaces that contact the flaps C31 to C34. The flap holding members 61 have a configuration where they are movable toward and away from the tubular cardboard box TB. Specifically, the flap holding members 61 are configured in such a way that, the holding contact surfaces are moved to positions opposing the first end portions of the flaps C31 to C34 when the flap holding members 61 advance, and the holding contact surfaces are moved to positions away from the first end portions of the flaps C31 to C34 when the flap holding members 61 retreat. The holding contact surfaces have the same inclinations as each of the side panels configuring the tube portion TP with respect to the horizontal direction or the vertical direction. Furthermore, the holding contact surfaces extend along the direction in which the tube portion TP extends.

[0073] The positions of the flap holding members 61 are adjusted so that, when the flap holding members 61 have moved close to the tubular cardboard box TB, the holding contact surfaces contact the first end portions of the flaps C31 to C34. It should be noted that, at this time, the flaps C31 to C34 have predetermined inclinations or substantially the same inclinations as each of the side panels configuring the tube portion TP with respect to the horizontal direction or the vertical direction. That is, the positions of the flap holding members 61 are adjusted so that, when the flap holding members 61 have moved close to the tubular cardboard box TB, the holding contact surfaces contact the first end portions of the flaps C31 to C34 that have predetermined inclinations with respect to the horizontal plane or the vertical plane.

[0074] The flap pushing-and-folding members 62 push and fold, toward the inside of the tube portion TP, the end portions (second end portions) of the flaps C31 to C34 positioned on the opposite sides of the first end portions. The flap pushing-and-folding members 62 contact the second end portions of the flaps C31 to C34 from outside so as to fold the flaps C31 to C34 inward (see FIG. 12).

[0075] Specifically, the flap pushing-and-folding members 62 have pushing-and-folding contact surfaces that contact the flaps C31 to C34. Furthermore, the flap pushing-and-folding members 62 have a configuration where they can move the pushing-and-folding contact surfaces toward and away from the flaps C31 to C34. Furthermore, the flap pushing-and-folding members 62 have a configuration where they rotate substantially 90° about rotating shafts substantially parallel to the border lines between the side panels C11 to C14 and the flaps C31 to C34. The flap pushing-and-folding members 62 respectively move close to the flaps C31 to C34 and thereafter apply, to the corresponding flaps C31 to C34, force in the directions (arrows D11 to D14 in FIG. 12) in which the flaps C31 to C34 are closed. That is, the flap pushing-and-folding members 62 move close to the flaps C31 to C34 and thereafter fold the corresponding flaps C31 to C34 in the folding directions.

[0076] When the second end portions are folded inward by the flap pushing-and-folding members 62 in a state in which the first end portions of the flaps C31 to C34 are held by the flap holding members 61, the first end portions of the flaps C31 to C34 are folded in such a way as to lie on top of the second end portions of the adjacent flaps C31 to C34, and the bottom BC of the cardboard box B is formed. The flap pushing-and-folding members 62 thereafter move the pushing-and-folding contact surfaces away from the flaps C31 to C34.

[0077] The tubular cardboard box TB in which the bottom BC has been formed (the cardboard box B) by the bottom forming mechanism 16 is thereafter moved in the

horizontal direction as indicated by arrow D3 in FIG. 1 and then travels through a downward leading drop path and moves to the packing apparatus 90.

(3) Packing Apparatus

[0078] The packing apparatus 90 packs a plurality of items in the cardboard box B. The plurality of items is packed in the cardboard box B in a stacked state. After the packing apparatus 90 packs a predetermined numerical quantity of the items in the cardboard box B, the packing apparatus 90 rotates the cardboard box B around a rotational axis disposed at the neighborhood of the long side of the cardboard box B. Because of this, the cardboard box B is transferred to the conveyance apparatus 91 in a state in which the opening faces upward.

(4) Conveyance Apparatus

[0079] The conveyance apparatus 91 is an apparatus that conveys to a later process (a process outside the box forming and packing system 100) the cardboard box B in which the items have been packed. The conveyance apparatus 91 is placed under the packing apparatus 90.

(5) Control Device

[0080] The control device 92 is, as mentioned above, a device that controls the box forming apparatus 10, the packing apparatus 90, and the conveyance apparatus 91.

[0081] FIG. 13 shows a control block diagram relating to the box forming and packing system. As shown in FIG. 13, the control device 92 is connected to each configuration included in the box forming and packing system 100, and transmits signals to and receives signals from each configuration. Specifically, the control device 92 is electrically connected to the box forming apparatus 10, the packing apparatus 90, and the conveyance apparatus 91. Furthermore, the control device 92 is electrically connected to the roller rotating mechanism 212a, the movable mechanism 243, the separating sucker moving component 312, the lift mechanism 323, the first drive component 43b, the second drive component 44b, the third drive component 45b, and the bottom forming mechanism 16, which are included in the box forming apparatus 10.

[0082] The control device 92 mainly includes a CPU 92a, a ROM 92b, a RAM 92c, and a hard disk 92d. Furthermore, the control device 92 is equipped with a touch panel display, a keyboard, and so forth not shown in the drawings.

(6) Opening Operation

[0083] The state of the third moving mechanism 45 pertaining to the operation of opening of the flattened cardboard box FB and the placement and operation of each member moved by the third moving mechanism 45 will be described below. Specifically, the placement and operation of the front face upper holding members 42a, the front face lower holding members 42b, and the abutting member 50, which are moved as the support frame 45a swings, will be described in detail, separately, for a state while standing by for the opening operation, for a state when the opening operation starts, and for a state after the opening operation has completed.

[0084] It should be noted that during the opening operation the flaps C21 to C24 and the flaps C32 to C34 excepting the flap C31 are free. That is, during the opening operation, among the flaps C31 to C34 and C21 to C24, only the flap C31 connected to the first side panel C11 is held by the abutting member 50.

(6-1) While Standing By for the Opening Operation

[0085] The support frame 45a has a posture where it extends substantially parallel to the horizontal plane (see FIG. 8). The front face upper holding members 42a, the front face lower holding members 42b, and the abutting member 50 are attached to the support frame 45a along the direction in which the support frame 45a extends. The front face upper holding members 42a and the front face lower holding members 42b are attached to the support frame 45a in a state in which their suction surfaces face upward. Furthermore, the support frame 45a supports the abutting member 50 in a state in which the second section 52 of the abutting member 50 extends facing upward. As mentioned above, the height position of the distal end of the second section 52 of the abutting member 50 is higher than the height position of the suction surfaces of the front face upper holding members 42a. While standing by for the opening operation, the front face upper holding members 42a, the front face lower holding members 42b, and the abutting member 50 are located in lower positions and more forward positions than they are when the opening operation starts.

(6-2) When the Opening Operation Starts

[0086] The support frame 45a supports the front face upper holding members 42a and the front face lower holding members 42b in such a way that the suction surfaces of the front face upper holding members 42a and the front face lower holding members 42b are substantially parallel to the front face FF of the flattened cardboard box FB transferred to the opening mechanism 14. Furthermore, the support frame 45a supports the abutting member 50 in a state in which the second section 52 of the abutting member 50 extends facing rearward. The front face upper holding members 42a, the front face lower holding members 42b, and the abutting member 50 are located in their highest positions and rearmost positions when the opening operation starts.

[0087] When the opening operation starts (before the opening operation completes), the front face upper hold-

ing members 42a, the front face lower holding members 42b, and the abutting member 50 hold each part of the front face FF of the flattened cardboard box FB in the following state. It should be noted that at this time the rear face RF of the flattened cardboard box FB is held by the rear face upper holding member 41 a and the rear face lower holding member 41 b.

[0088] The front face upper holding members 42a hold the second side panel C12 in such a way that the second side panel C12 has an angle with respect to the horizontal. That is, the front face upper holding members 42a hold the second side panel C12 in such a way that the second side panel C12 intersects the horizontal plane when the opening operation starts (see FIG. 9). As mentioned above, after the opening operation starts, the distal end portion of the support frame 45a gradually rises up with respect to the main portion because of the driving of the link mechanism. As a result, the inclination of the second side panel C12 with respect to the first side panel C11 also changes. That is, the front face upper holding members 42a hold the second side panel C12 while gradually changing the inclination of the second side panel C12 with respect to the first side panel C11.

[0089] The front face lower holding members 42b hold the first side panel C11 in such a way that the first side panel C11 has an angle with respect to the horizontal. That is, the front face lower holding members 42b hold the first side panel C11 in such a way that the first side panel C11 intersects the horizontal plane when the opening operation starts (see FIG. 9).

[0090] The abutting member 50 abuts the flap C31 in such a way that the flap C31 is slightly tilted inward (the folding direction). That is, the abutting member 50 projects from the front side toward the rear side with respect to the flap C31 and contacts the flap C31 when the opening operation starts.

(6-3) When the Opening Operation Completes

[0091] The support frame 45a supports the front face upper holding members 42a and the front face lower holding members 42b in such a way that the suction surfaces of the front face lower holding members 42b face upward and the suction surfaces of the front face upper holding members 42a face rearward. Furthermore, the support frame 45a supports the abutting member 50 in a state in which the second section 52 of the abutting member 50 extends facing upward. The front face lower holding members 42b and the abutting member 50 are located in the same height positions and planar positions as they are while standing by for the opening operation.

[0092] Furthermore, the front face upper holding members 42a, the front face lower holding members 42b, and the abutting member 50 hold each part of the front face FF of the flattened cardboard box FB in the following state when the operation of opening the flattened cardboard box FB completes (after the opening operation has completed).

[0093] The front face upper holding members 42a hold the second side panel C12 in a vertical or nearly vertical inclination with respect to the horizontal plane. In other words, the front face upper holding members 42a support the second side panel C12 in a vertical or nearly vertical inclination with respect to the horizontal plane when the transformation from the flattened cardboard box FB to the tubular cardboard box TB is completed (see FIG. 9). Specifically, the inclination of the distal end portion of the support frame 45a with respect to the main portion is gradually changed after the opening operation starts, and the distal end portion has a 90° angle with respect to the main portion when the opening operation completes. That is, the distal end portion has an upstanding posture with respect to the horizontal plane. The distal end portion tumbles after the bottom BC has been formed in the tubular cardboard box TB by the bottom forming mechanism 16 described later. That is, after the cardboard box B has been formed, the distal end portion changes posture and extends along the direction in which the main portion extends (see FIG. 8).

[0094] The front face lower holding members 42b hold the first side panel C11 in a parallel or nearly parallel inclination with respect to the horizontal plane (see FIG. 9).

[0095] The abutting member 50 abuts the flap C31 in such a way that the flap C31 is placed in a state in which it is slightly folded inward (the folding direction) (see FIG. 10 and FIG. 13). The abutting member 50 abuts the flap C31 of the flattened cardboard box FB (the tubular cardboard box TB) from below. Specifically, the first section 51 of the abutting member 50 extends along the direction in which the first side panel C11 extends. The second section 52 extends along a direction intersecting the direction in which the first side panel C11 extends. In other words, when the operation of opening the flattened cardboard box FB ends, the distal end of the abutting member 50 comes to a position where it projects more upward than the height position of the contact plane in which the front face lower holding members 42b contact the first side panel C11. That is, the height position of the distal end of the second section 52 of the abutting member 50 is higher than the height position of the suction surfaces of the front face upper holding members 42a and the front face lower holding members 42b.

(7) Characteristics

[0096]

(7-1) The box forming apparatus 10 pertaining to the above-described embodiment is provided with the holding mechanism 40, the moving mechanism (the third moving mechanism) 45, and the control device 92. The holding mechanism 40 has the front face lower holding members (the first holding members) 42b and the front face upper holding members (the second holding members) 42a. The front face lower

holding members 42b hold the first side panel C11, and the front face upper holding members 42a hold the second side panel C12. The third moving mechanism 45 moves the front face lower holding members 42b and the front face upper holding members 42a. More specifically, the third moving mechanism 45 moves the front face lower holding members 42b and the front face upper holding members 42a from an upper position to a lower position. The control device 92 controls the third moving mechanism 45 so as to fold at least either one of the first side panel C11 and the second side panel C12 along the fold portion (the first fold portion) FP1 to thereby change the angle formed by the first side panel C11 and the second side panel C12 from 0° or 180° to an angle close to 90°. The holding mechanism 40 further has the abutting member 50 (see FIG. 10). The abutting member 50 adjusts the position of the flap (the first flap) C31, which is a section of the flattened cardboard box FB connected to the first side panel C11. Furthermore, when the front face lower holding members 42b and the front face upper holding members 42a are moved by the third moving mechanism 45 to open the flattened cardboard box, the abutting member 50 adjusts the position of the flap C31 in such a way as to place the flap C31 in a state in which it is folded inward at the time of the flattened cardboard box FB being opened.

The box forming apparatus 10 of the above-described embodiments folds the adjacent flaps C31 to C34 on top of each other to form the interleaved shaped bottom BC after the flattened cardboard box FB has been opened and formed into the tubular cardboard box TB. Furthermore, the bottom BC is formed by the bottom forming mechanism 16 disposed in a predetermined position. In the bottom forming mechanism 16, the first end portions of the flaps C31 to C34 are held by the plurality of flap holding members 61, and the second end portions of the flaps C31 to C34 are pushed and tilted toward the inside of the tube portion TP by the plurality of flap pushing-and-folding members 62. The flap holding members 61 have the contact holding surfaces that contact the flaps C31 to C34. The contact holding surfaces have the same inclinations as each of the side panels configuring the tube portion TP with respect to the horizontal plane or the vertical plane. Therefore, the flaps C31 to C34 of the tubular cardboard box TB fed to the bottom forming mechanism 16 are required to have inclinations in a predetermined range with respect to the horizontal plane or the vertical plane. Specifically, when the tubular cardboard box TB has been fed to the bottom forming mechanism 16, the flaps C31 to C34 are required to have the same inclinations as each of the side panels with respect to the horizontal plane or the vertical plane.

Here, in the box forming apparatus 10 pertaining to the above-described embodiment, during the opening operation, the tubular cardboard box TB is formed while the first side panel C11 and the second side panel C12 of the flattened cardboard box FB are pulled downward. That is, the flattened cardboard box FB is formed into the tubular cardboard box TB while moving from an upper position to a lower position. At this time, a large force is applied in the direction of gravity with respect to each of the flaps C31 to C34. As a result, it is difficult to keep in the predetermined range the inclinations of the flaps C31 to C34 with respect to the horizontal plane or the vertical plane. In particular, it is easy for the flap C31, which comes to a lower position when the opening operation completes, to be folded downward along the fold portion FP21 due to gravity. That is, the flap C31 is folded in the opposite direction of the folding direction. Particularly in a situation where the flattened cardboard box serving as the box forming target is a used flattened cardboard box that has been repeatedly utilized, the extent to which the flap C31 folds downward is marked. In this situation, even if the flap holding members 61 and the flap pushing-and-folding members 62 are moved close to the tubular cardboard box TB, the flap C31 is in a position far from both the holding contact members and the pushing-and-folding contact members, and it may be difficult to suitably fold the flap C31. That is, the bottom BC cannot be formed.

In order to keep the inclinations of the flaps C31 to C34 in the predetermined range, a configuration that continuously holds each of the flaps C31 to C34 during the opening operation is conceivable. However, if holding members that keep holding each of the flaps C31 to C34 during the opening operation are disposed, the configuration of the box forming apparatus becomes complex. Furthermore, as the placement of all of the holding members is required to change each time the size of the cardboard box to be handled changes, and work becomes troublesome.

In the box forming apparatus 10 pertaining to the above-described embodiment, the position of the flap C31 is adjusted by the abutting member 50 in such a way that the flap C31 located in a lower position when the bottom BC is formed is placed in a state in which it is slightly tilted inward at the time of the flattened cardboard box FB being opened. Specifically, the position of the flap C31 is adjusted as a result of the abutting member 50 abutting the flap C31. That is, the abutting member 50 keeps the inclination of the flap C31 with respect to the horizontal plane so that the flap C31 does not fold downward along the fold portion FP21. Because of this configuration, after the opening operation has completed, the inclinations of the flaps C32 and C34 adjacent to the flap C31 can also be maintained in the predetermined range with respect to the vertical plane.

Specifically, the flap C31 folded slightly inward along the fold portion FP21 regulates the folding of the flaps C32 and C34 in the folding direction. As a result, when the flap holding members 61 and the flap pushing-and-folding members 62 have moved close to the tubular cardboard box TB, the flaps C31 to C34 come to positions where they are able to contact the contact holding surfaces and the pushing-and-folding contact surfaces. Because of this, in the bottom forming mechanism 16, the bottom BC can be appropriately formed.

(7-2) In the box forming apparatus 10 pertaining to the above-described embodiment, the holding mechanism 40 has the front face lower holding members (the first holding members) 42b and the front face upper holding members (the second holding members) 42a. The front face lower holding members 42b hold the first side panel C11 in such a way that the first side panel C11 has an angle with respect to the horizontal before the operation of opening the flattened cardboard box FB completes. The front face upper holding members 42a hold the second side panel C12 in such a way that the second side panel C12 has an angle with respect to the horizontal before the operation of opening the flattened cardboard box FB completes. Furthermore, the front face lower holding members 42b are moved by the third moving mechanism (the moving mechanism) 45 in such a way as to hold the first side panel C11 in an inclination parallel or nearly parallel to the horizontal after the operation of opening the flattened cardboard box FB has completed. Furthermore, the front face upper holding members 42a are moved by the third moving mechanism 45 in such a way as to hold the second side panel C12 in an inclination vertical or nearly vertical to the horizontal direction after the operation of opening the flattened cardboard box FB has completed. Because of this, the flattened cardboard box FB can be opened to the tubular cardboard box TB at a high speed.

(7-3) In the box forming apparatus 10 pertaining to the above-described embodiment, the abutting member 50 abuts the flap (the first flap) C31 to thereby adjust the position of the flap C31 the abutting member 50 abuts. Because of this, the position of the flap C31 can be adjusted by a relatively simple configuration in such a way as to place the flap C31 in a state in which it is folded inward at the time of the flattened cardboard box FB being opened.

(7-4) In the box forming apparatus 10 pertaining to the above-described embodiment, the flap (the first flap) C31 has an inclination parallel or nearly parallel to the horizontal plane after the operation of opening the flattened cardboard box FB has completed, and the abutting member 50 abuts the flap C31 from below. Because of this, when the flattened cardboard box FB has been opened at a high speed, the flap C31 can be prevented, by a simple configuration, from being folded toward the outside of the tube portion TP.

(7-5) Furthermore, in the box forming apparatus 10 pertaining to the above-described embodiment, the flattened cardboard box FB has the flap (the second flap) C32, the flap (the third flap) C34, and the flap (the fourth flap) C33. During the operation of opening the flattened cardboard box FB, the flap C32, the flap C33, and the flap C34 are in a free state. The flap C32 and the flap C34 are located in positions adjacent to the flap C31. The flap C33 is in a position opposing the flap C31. The abutting member 50 contacts only part of the flap C31. As a result, the place where an abutment mark is left by the abutting member 50 can be minimized.

(7-6) Moreover, the holding mechanism 40 pertaining to the above-described embodiment has the support frame 45a that supports the front face lower holding members (the first holding members) 42b, the front face upper holding members (the second holding members) 42a, and the abutting member 50. The distal end of the abutting member 50 is arranged, after the operation of opening the flattened cardboard box FB has completed, in a position projecting more upward than the height position of the contact plane in which the front face lower holding members 42b contact the first side panel C11 (see FIG. 11). As a result, the flap C31 becomes slightly folded in the folding direction along the fold portion FP21. The flap C31 prevents folding of the flap C32 and the flap C34 in the folding direction. Because of this, folding of the flap C32 and the flap C34 adjacent to the flap C31 toward the inside of the tube portion TP can be prevented.

(7-7) Furthermore, the abutting member 50 pertaining to the above-described embodiment abuts the flap (the first flap) C31 to thereby tilt the flap C31 by the predetermined angle θ° upward along the fold portion (the second fold portion) FP21 disposed in the border between the first side panel C11 and the flap C31. The predetermined angle is 0° to 30°. Preferably, the predetermined angle is 5° to 15°. Because of this, large folding of the flap C32 and the flap C34 inward can be reliably prevented.

(7-8) Furthermore, in the box forming apparatus 10 pertaining to the above-described embodiment, during the operation of opening the flattened cardboard box FB, the flap (the second flap) C32 and the flap (the third flap) C34 tilt in the direction of gravity. The flap C31 that has been abutted by the abutting member 50 regulates the tilting of the flap C32 or the flap C34 in the direction of gravity. Because of this, the flap C31 regulates folding of the flap C32 and/or the flap C34 inward. As a result, large folding of the flap C33 inward can also be regulated.

(8) Example Modifications

[0097] Example modifications of the above-described embodiment will be described below. It should be noted that the example modifications described below may also be appropriately combined to the extent that they do not contradict each other.

(8-1) Example Modification A

[0098] In the above-described embodiment, the distal end of the abutting member 50 is configured by an elastic member so as to make it difficult for the flap C31 to become damaged.

[0099] Instead of the above-described configuration, the abutting member 50 may also have a configuration where the position of the distal end of the abutting member 50 is adjusted by a spring. Because of this also, the abutting member 50 can be given a configuration that makes it difficult for the flap C31 to become damaged.

[0100] Moreover, in the above-described embodiment, the abutting member 50 is a rod-shaped member, and the surface area of the distal end of the abutting member 50 that contacts the flap C31 is small. Here, the surface area of the distal end of the abutting member 50 may be enlarged. For example, the abutting member 50 may have a distal end that extends in the width direction of the flap C31. Because of this, the force applied to the flap C31 from the abutting member 50 becomes dispersed, so it becomes difficult for the flap C31 to become damaged.

(8-2) Example Modification B

[0101] In the above-described embodiment, an example was shown in FIG. 11 where the abutting member 50 abuts the flap C31 in such a way that the flap C31 becomes slightly folded in the folding direction. As mentioned above, the abutting member 50 contacts the flap C31 in such a way that the flap C31 tilts by the predetermined angle θ° (0° to 30°) in the folding direction along the fold portion FP21. That is, the abutting member 50 may abut the flap C31 in such a way that the flap C31 is placed in a state in which it extends along the direction in which the first side panel C11 extends. That is, the abutting member 50 may abut the flap C31 in such a way that the flap C31 becomes parallel with respect to the horizontal plane.

(8-3) Example Modification C

[0102] In the above-described embodiment, the third moving mechanism 45 moves, from an upper position to a lower position, the holding members (the front face lower holding members 42b serving as the first holding members and the front face upper holding members 42a serving as the second holding members) that hold the first side panel C11 and the second side panel C22, but the third moving mechanism 45 is not limited to this.

[0103] For example, in a situation where the box forming apparatus 10 is configured in such a way that the transport mechanism 13 delivers to the opening mechanism 14 the flattened cardboard box FB in a state in which the first side panel C11 and the second side panel C22 face upward and the opening mechanism 14 opens the flattened cardboard box FB by moving, with the moving mechanism, the holding members that hold the first side panel C11 and the second side panel C22, the moving mechanism may also move the holding members from a lower position to an upper position. In this situation, it is preferred that the abutting member 50 perform the positional adjustment in such a way that, by abutting from above the flap C31 serving as an example of a first flap connected to the first side panel C11 positioned above when the operation of opening the flattened cardboard box FB completes, the flap C31 is placed in a state in which it is folded inward at the time of the flattened cardboard box FB being opened.

(8-4) Example Modification D

[0104] In the above-described embodiment, the abutting member 50 abuts the flap (the first flap) C31 connected to the first side panel C11 held by the front face lower holding members 42b and adjusts the position of the flap C31, but the abutting member 50 is not limited to this.

[0105] For example, instead of adjusting the position of the flap (the first flap) C31 or in addition to adjusting the position of the flap (the first flap) C31, the abutting member may also be configured to adjust the position of the flap (an opposing flap) C33. The flap (the opposing flap) C33 is a section of the flattened cardboard box FB connected to the third side panel (an opposing side panel) C13 opposing the first side panel C11 held by the front face lower holding members 42b and opposes the flap (the first flap) C31. For example, the abutting member is configured to abut the flap (the opposing flap) C33 from above to thereby place the flap C33 in a state in which it extends along the direction in which the third side panel (the opposing side panel) C13 extends or a state in which it is folded inward at the time of the flattened cardboard box FB being opened. When configured in this way, like when the position of the flap C31 is adjusted, folding of the flaps C32 and C34 in the folding direction can be regulated by the flap C33 slightly folded inward along the fold portion FP23.

(8-5) Example Modification E

[0106] In the above-described embodiment, the abutting member 50 serving as an example of the position adjusting member abuts the flap C31 to thereby adjust the position of the flap C31 it abuts, but the position adjusting member is not limited to this kind of configuration.

[0107] For example, the position adjusting member

may also be an air blowing member 150 that jets air (compressed air) (see FIG. 17 and FIG. 18). The air blowing member 150 blows air against the flap C31 (the first flap) to thereby adjust the position of the flap C31 it blows air against. This will be specifically described.

[0108] The air blowing member 150 is attached to the main portion of the support frame 45a (the section of the support frame 45a where the front face lower holding members 42b are attached). The air blowing member 150 is attached to the support frame 45a in such a way that, in a state in which the front face lower holding members 42b attached to the main portion of the support frame 45a are sucking the first side panel C11 of the flattened cardboard box FB, the air outlet of the air blowing member 150 opposes the flap C31 (the first flap) connected to the first side panel C11. The air blowing member 150 is configured to jet air in the opposite direction of the sucking direction in which the front face lower holding members 42b, attached to the main portion of the support frame 45a, suck the first side panel C11 from outside. For that reason, when the air blowing member 150 blows air against the flap C31 (the first flap) connected to the first side panel C11 in a state in which the front face lower holding members 42b are holding (sucking) the first side panel C11, the position of the flap C31 is adjusted to a state in which the flap C31 is folded inward at the time of the flattened cardboard box FB being opened.

[0109] The air blowing member 150 starts jetting air at a predetermined timing after the opening operation starts and before the opening operation completes. For example, the air blowing member 150 starts jetting air when the main portion of the support frame 45a has been rotated 20 degrees about the swing shaft 45c by the third drive component 45b from the opening operation start position, and prevents the flap C31 from being folded outward (tilted downward). In this way, by blowing air against the flap C31 before the opening operation completes, it is easy to reliably prevent a state in which the flap C31 has been folded outward (tilted downward) when the opening operation completes. For that reason, using the air blowing member 150, a state in which the flaps C32 and C34 move inward at the time of the flattened cardboard box FB being opened can be prevented.

REFERENCE SIGNS LIST

[0110]

10	Box forming Apparatus
12	Stacking Mechanism
13	Transport Mechanism
14	Opening Mechanism
16	Bottom Forming Mechanism
40	Holding Mechanism
41a	Rear Face Upper Holding Member
41b	Rear Face Lower Holding Member
42a	Front Face Upper Holding Members (Second Holding Members)
42b	Front Face Lower Holding Members (First Holding Members)
43	First Moving Mechanism
44	Second Moving Mechanism
45	Third Moving Mechanism (Moving Mechanism)
45a	Support Frame
50	Abutting Member (Position Adjusting Member)
90	Packing Apparatus
91	Conveyance Apparatus
92	Control Device
100	Box forming and Packing System
150	Air Blowing Member (Position Adjusting Member)
FB	Flattened Cardboard Box
TB	Tubular Cardboard Box
B	Cardboard Box
C11	First Side Panel
C12	Second Side Panel
C13	Third Side Panel (Opposing Side Panel)
C31	Flap (First Flap)
C32	Flap (Second Flap)
C33	Flap (Fourth Flap, Opposing Flap)
C34	Flap (Third Flap)

CITATION LIST

[0111] <Patent Literature>

Patent Document 1: WO 2011/119563

Claims

1. A box forming apparatus configured to open a flattened cardboard box, which is a flat-folded cardboard box, to form a tubular cardboard box, the box forming apparatus comprising:

a holding mechanism having a holding member configured to hold a first side panel and a second side panel, which are two adjacent side panels of four side panels of the flattened cardboard box;

a moving mechanism configured to move the holding members; and

a control device configured to control the moving mechanism so as to fold at least either one of the first side panel and the second side panel along a first fold portion disposed in the border between the first side panel and the second side panel to thereby change the angle formed by the first side panel and the second side panel from 0° or 180° to an angle close to 90°,

wherein

the holding mechanism further has a position adjusting member configured to adjust a position of at least one of a first flap, which is a section of the flattened cardboard box connected to the first side panel, and

an opposing flap, which is a section of the flattened cardboard box connected to an opposing side panel opposing the first side panel and opposes the first flap,

in a case of adjusting the position of the first flap, when the holding member is moved by the moving mechanism to open the flattened cardboard box, the position adjusting member is configured to adjust the position of the first flap in such a way as to place the first flap in a state in which the first flap extends along a direction in which the first side panel extends or a state in which the first flap is folded inward at the time of the flattened cardboard box being opened, and

in a case of adjusting the position of the opposing flap, when the holding member is moved by the moving mechanism to open the flattened cardboard box, the position adjusting member is configured to adjust the position of the opposing flap in such a way as to place the opposing flap in a state in which the opposing flap extends along a direction in which the opposing side panel extends or a state in which the opposing flap is folded inward at the time of the flattened cardboard box being opened.

2. The box forming apparatus according to claim 1, wherein

the holding mechanism has a first holding member, which is the holding member which is configured to hold the first side panel, and a second holding member, which is the holding member which is configured to hold the second side panel,

the first holding member is configured to hold the first side panel in such a way that the first side panel has an angle with respect to the horizontal before the operation of opening the flattened cardboard box completes,

the second holding member is configured to hold the second side panel in such a way that the second side panel has an angle with respect to the horizontal before the operation of opening the flattened cardboard box completes,

the first holding member is configured to be moved by the moving mechanism in such a way as to hold the first side panel in an inclination parallel or nearly parallel to the horizontal after the operation of opening the flattened cardboard box has completed, and the second holding member is configured to be moved by the moving mechanism in such a way as to hold the second side panel in an inclination vertical or nearly vertical to the horizontal after the operation of opening the flattened cardboard box has completed.

3. The box forming apparatus according to claim 2, wherein the position adjusting member is configured to abut the first flap and/or the opposing flap to thereby adjust the position of the first flap and/or the opposing flap the position adjusting member abuts.

4. The box forming apparatus according to claim 3, wherein

the position adjusting member is configured to adjust at least the position of the first flap,

the first flap has an inclination parallel or nearly parallel to the horizontal after the operation of opening the flattened cardboard box has completed, and

the position adjusting member is configured to abut the first flap from below.

5. The box forming apparatus according to claim 4, wherein

the flattened cardboard box further has a second flap and a third flap located in positions adjacent to the first flap, and

during the operation of opening the flattened cardboard box, the second flap and the third flap are in a free state.

6. The box forming apparatus according to claim 5, wherein

the holding mechanism further has a support frame that supports the first holding member, the second holding member, and the position adjusting member, and

a distal end of the position adjusting member configured to abut the first flap is arranged, after the operation of opening the flattened cardboard box has completed, in a position projecting more upward than a height position of a contact plane in which the first holding member contacts the first side panel.

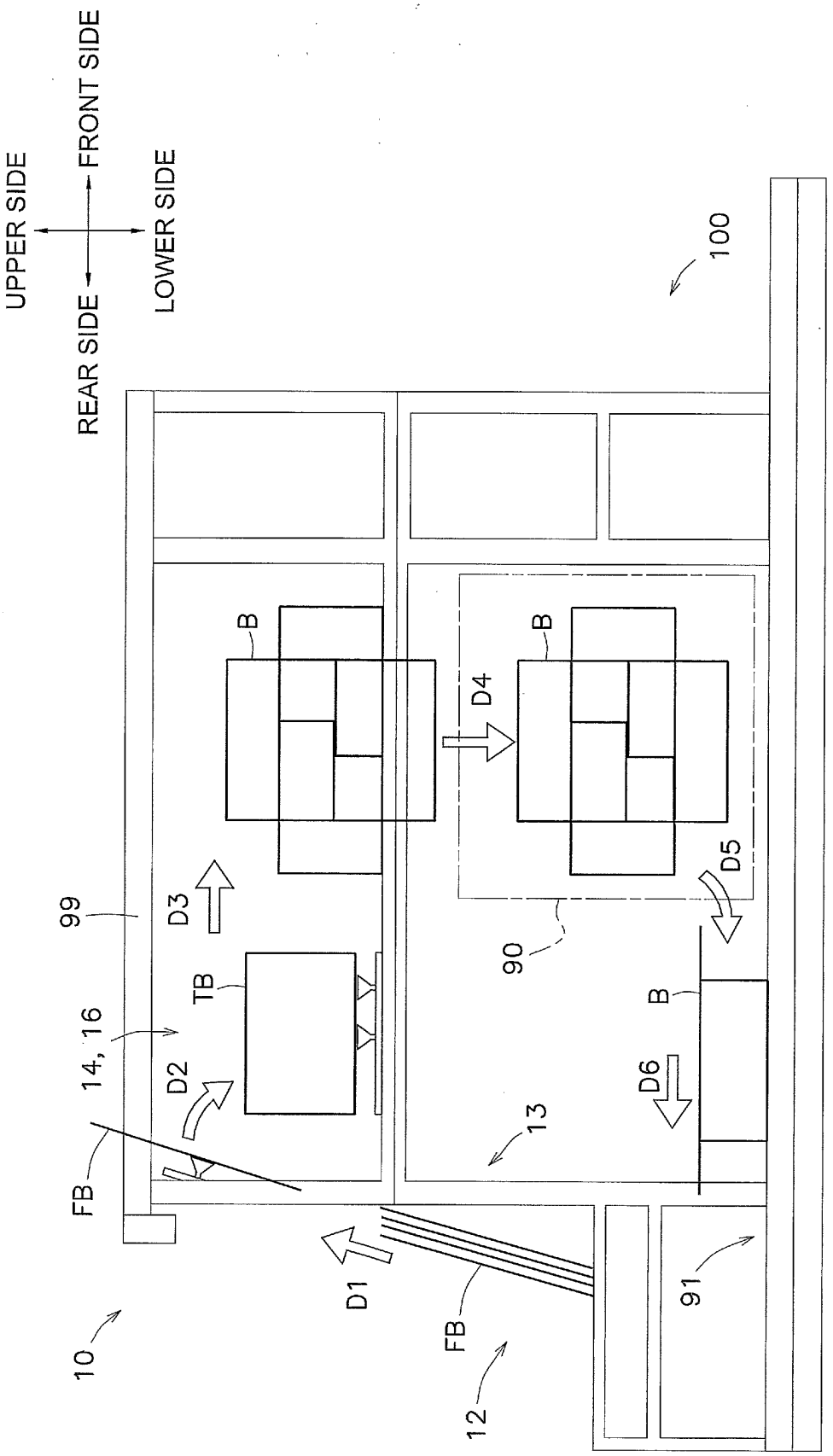
7. The box forming apparatus according to any one of claims 4 to 6, wherein the position adjusting member is configured to abut the first flap to thereby tilt the first flap 0° to 30° upward along a second fold portion disposed in a border between the first side panel and the first flap.

8. The box forming apparatus according to claim 5 or 6, wherein

during the operation of opening the flattened cardboard box, the second flap and the third flap tilt in the direction of gravity, and

the first flap abutted by the position adjusting member is configured to inhibit the tilting of the second flap or the third flap in the direction of gravity.

9. The box forming apparatus according to claim 1 or 2, wherein the position adjusting member is configured to blow air against the first flap and/or the opposing flap to thereby adjust the position of the first flap and/or the opposing flap against which the position adjusting member blows air.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B
D4
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D6
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D1
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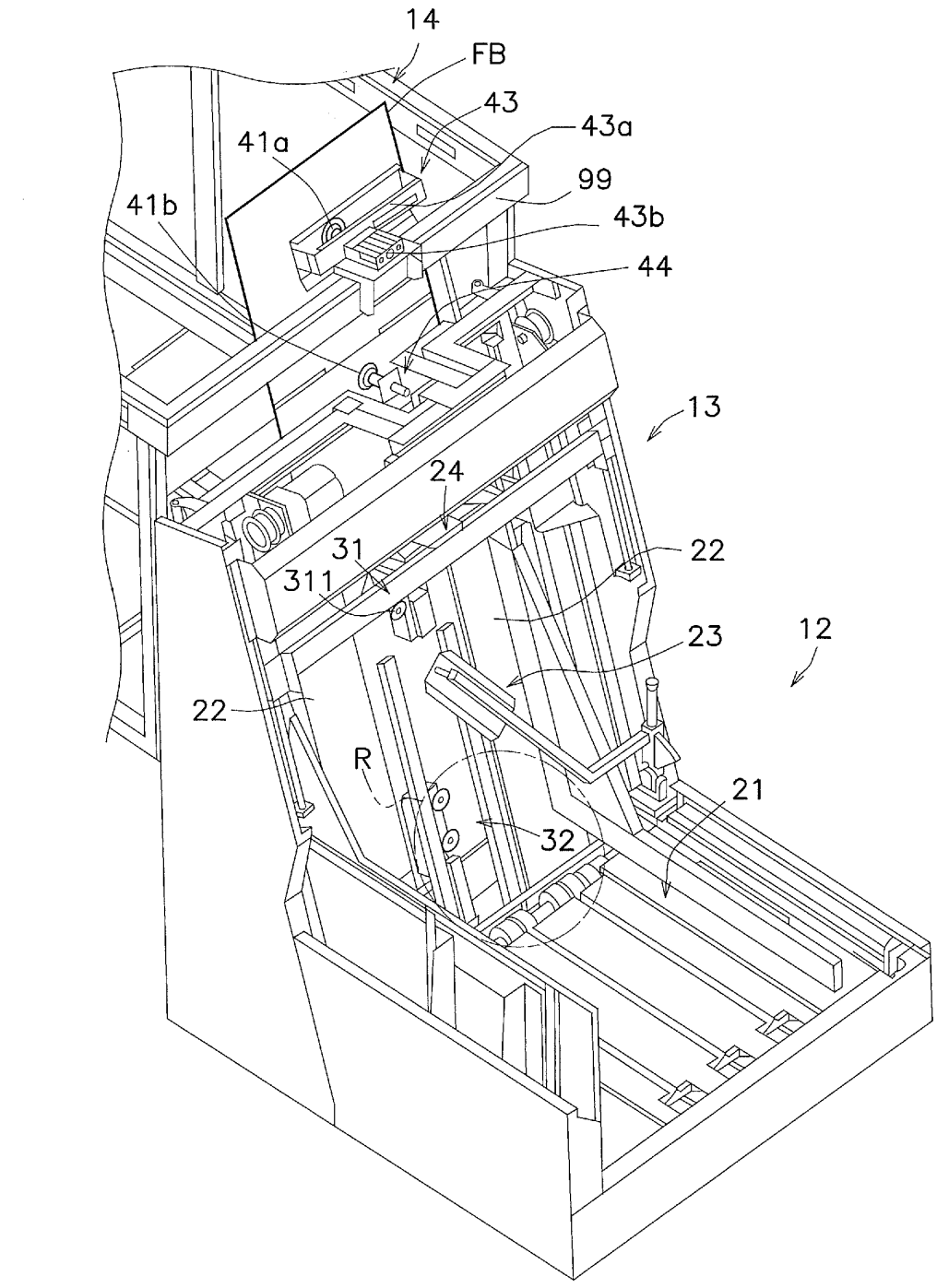
10
12

FIG. 1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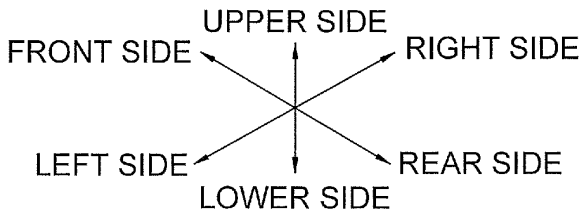
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FIG. 2

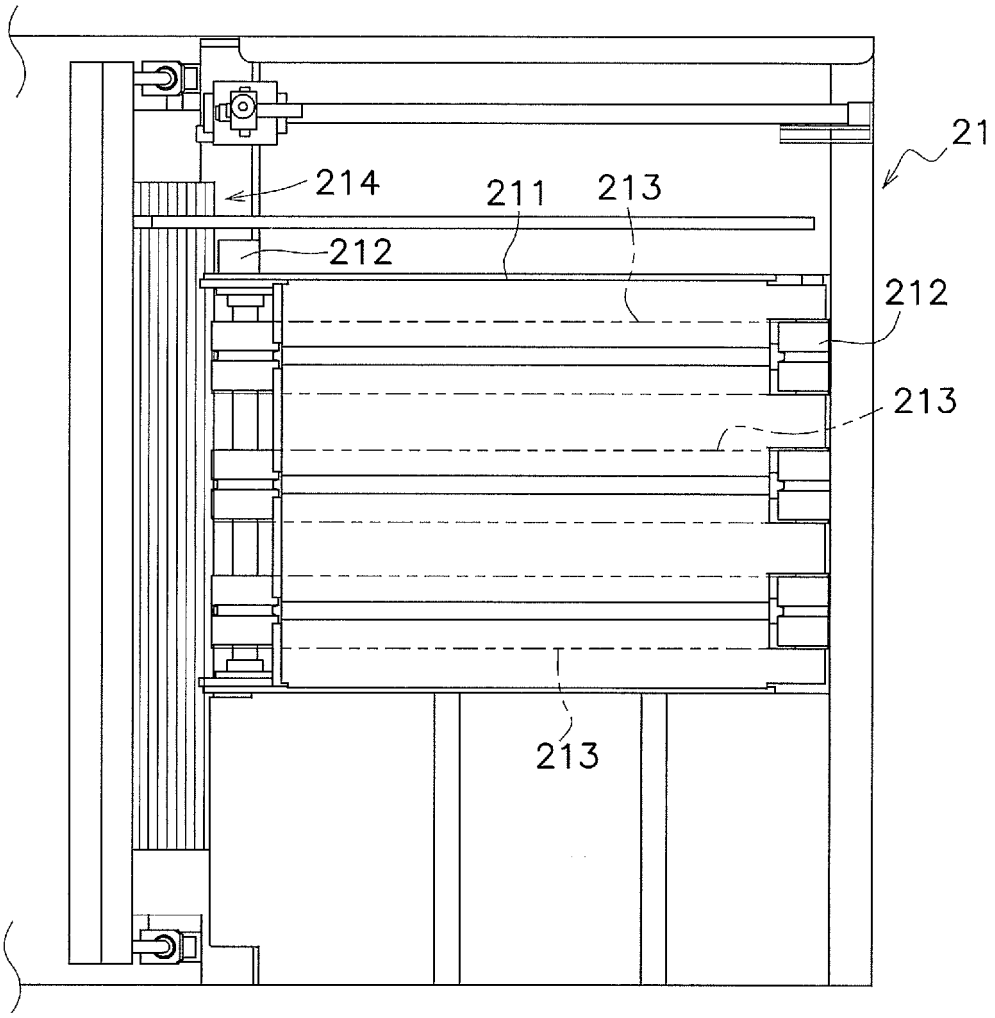

FIG. 3

FIG. 4

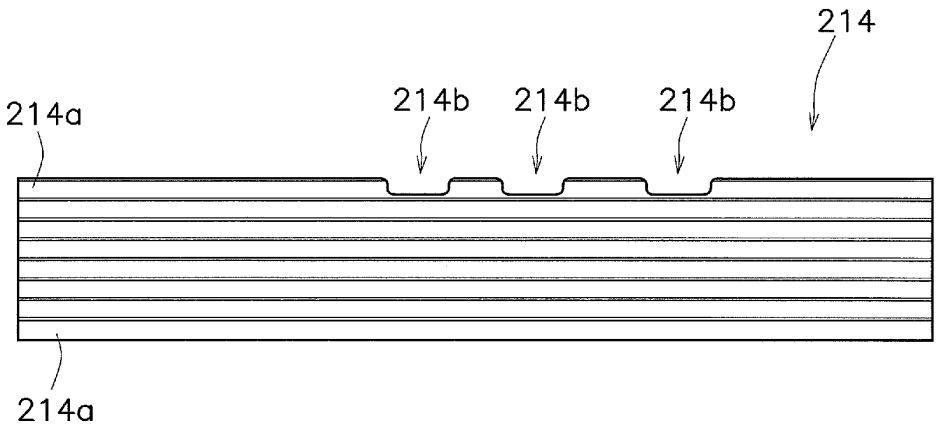
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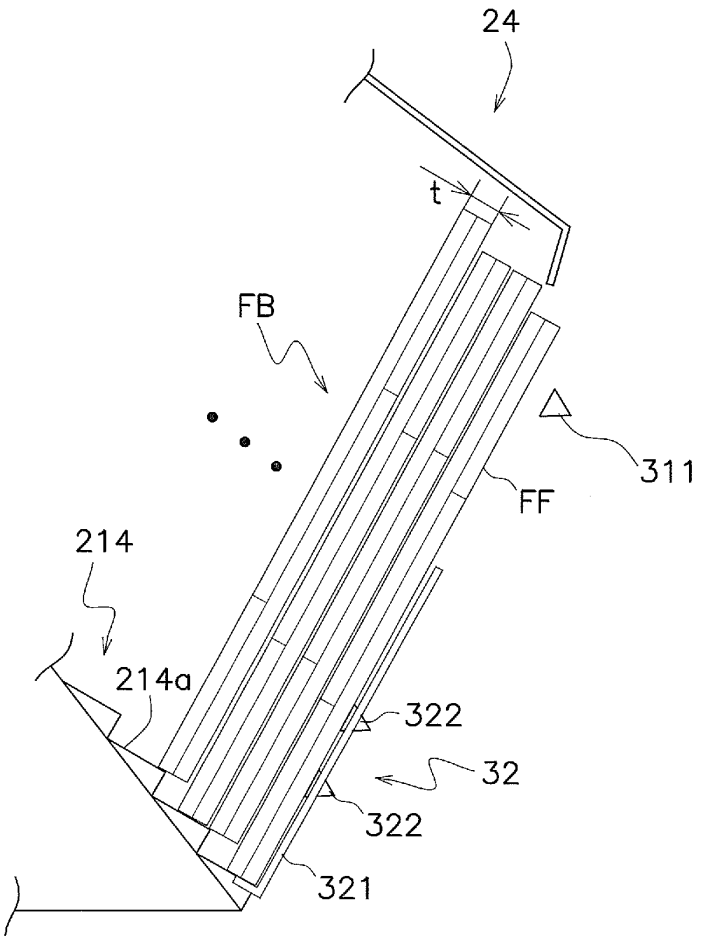
FIG. 5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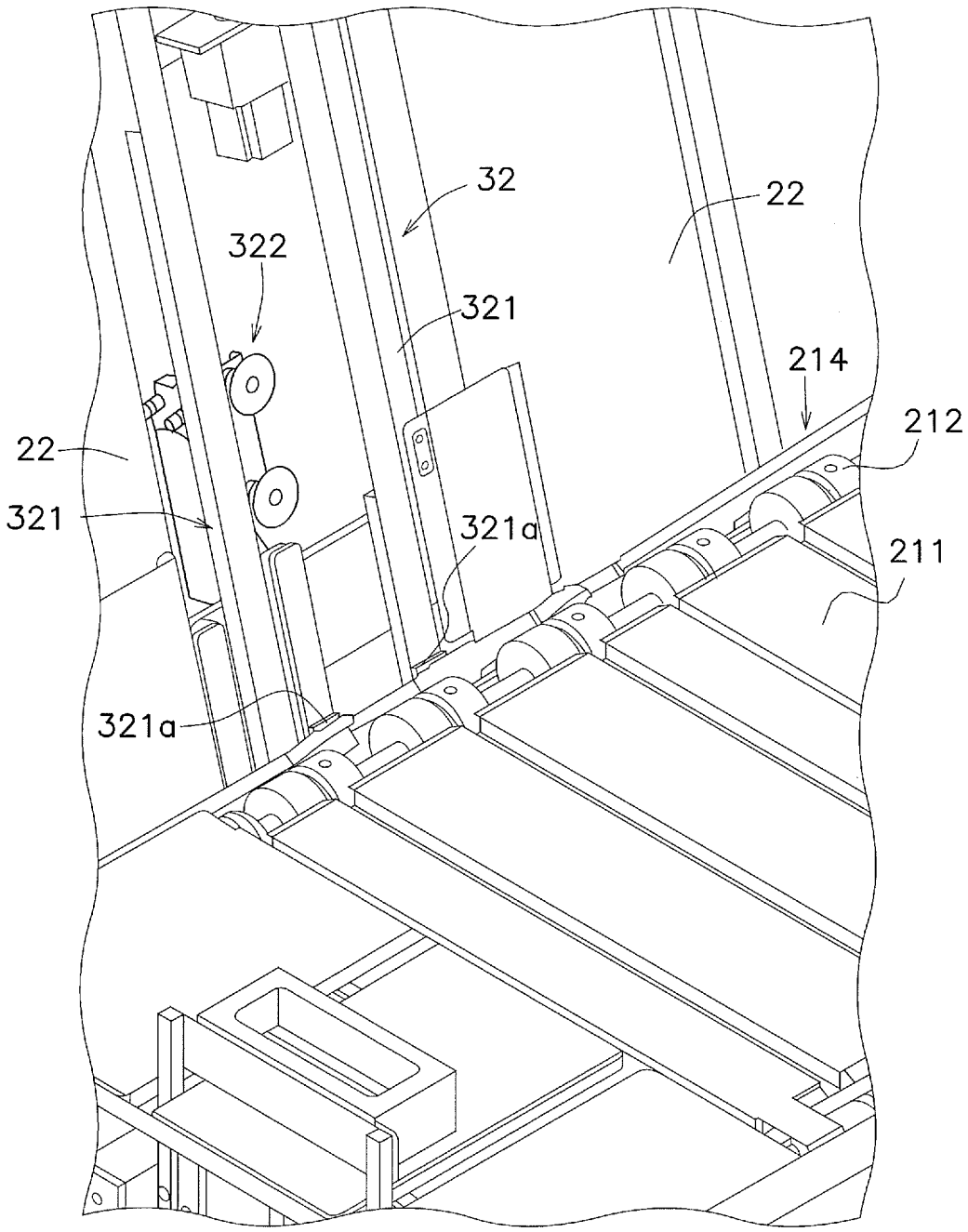
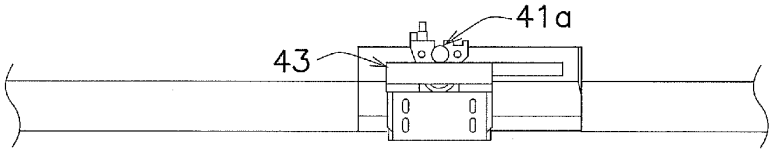


FIG. 6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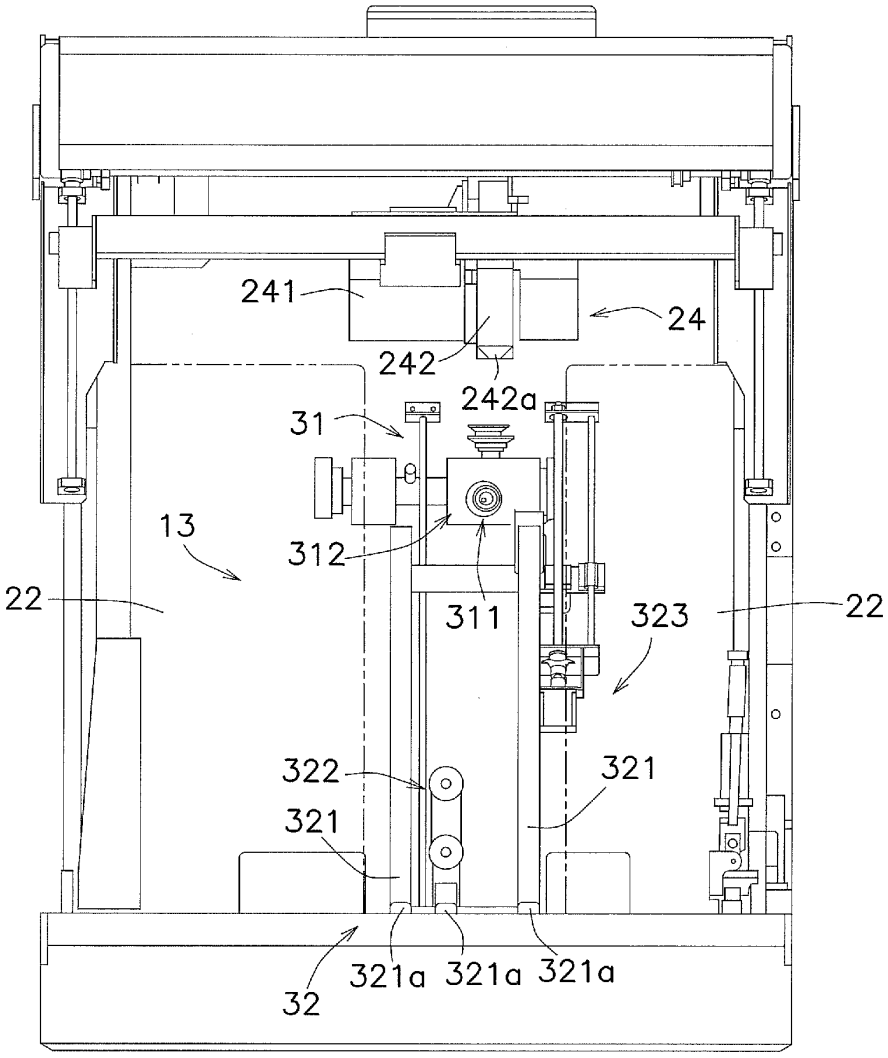
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FIG. 7

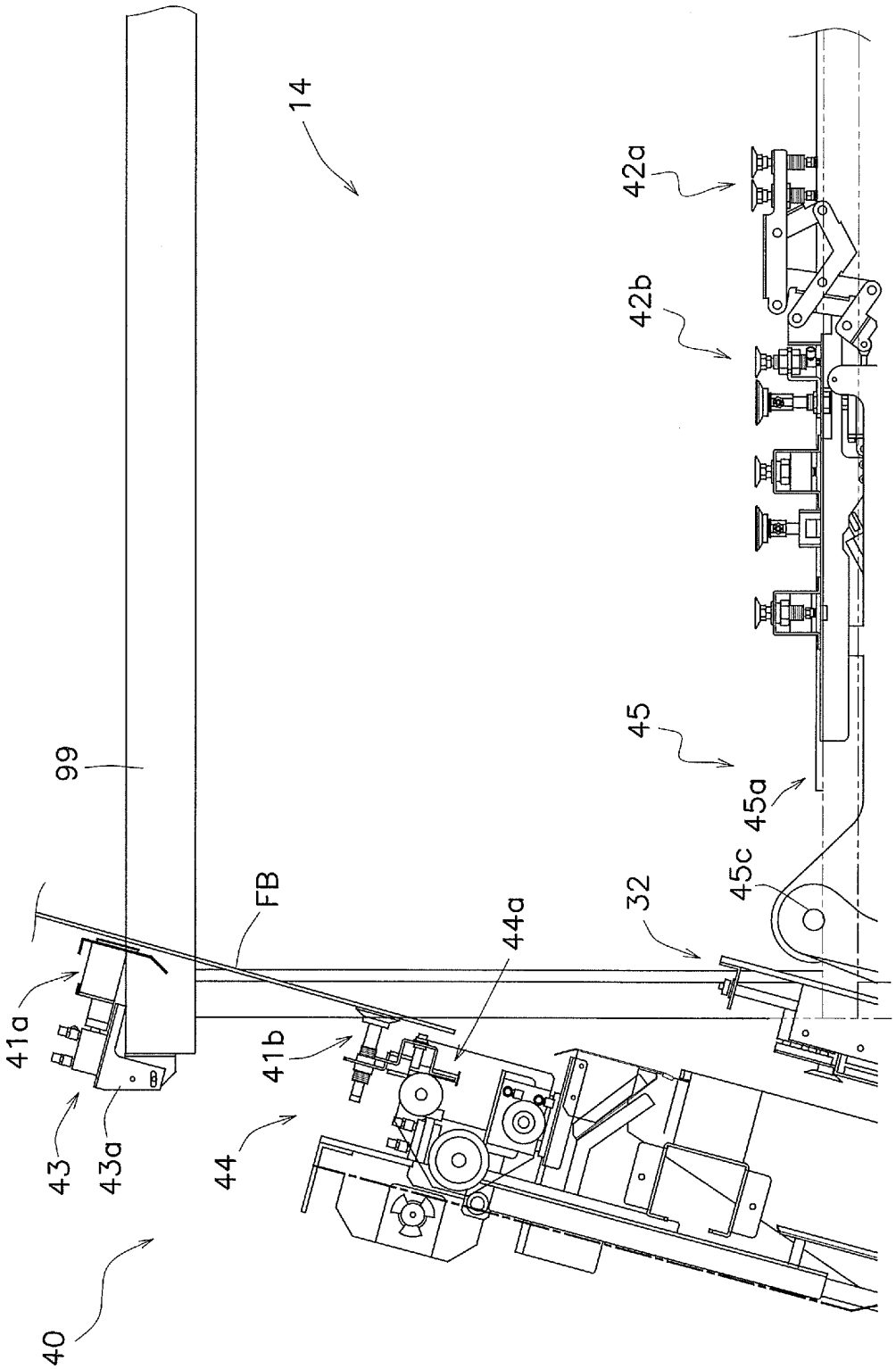


FIG. 8

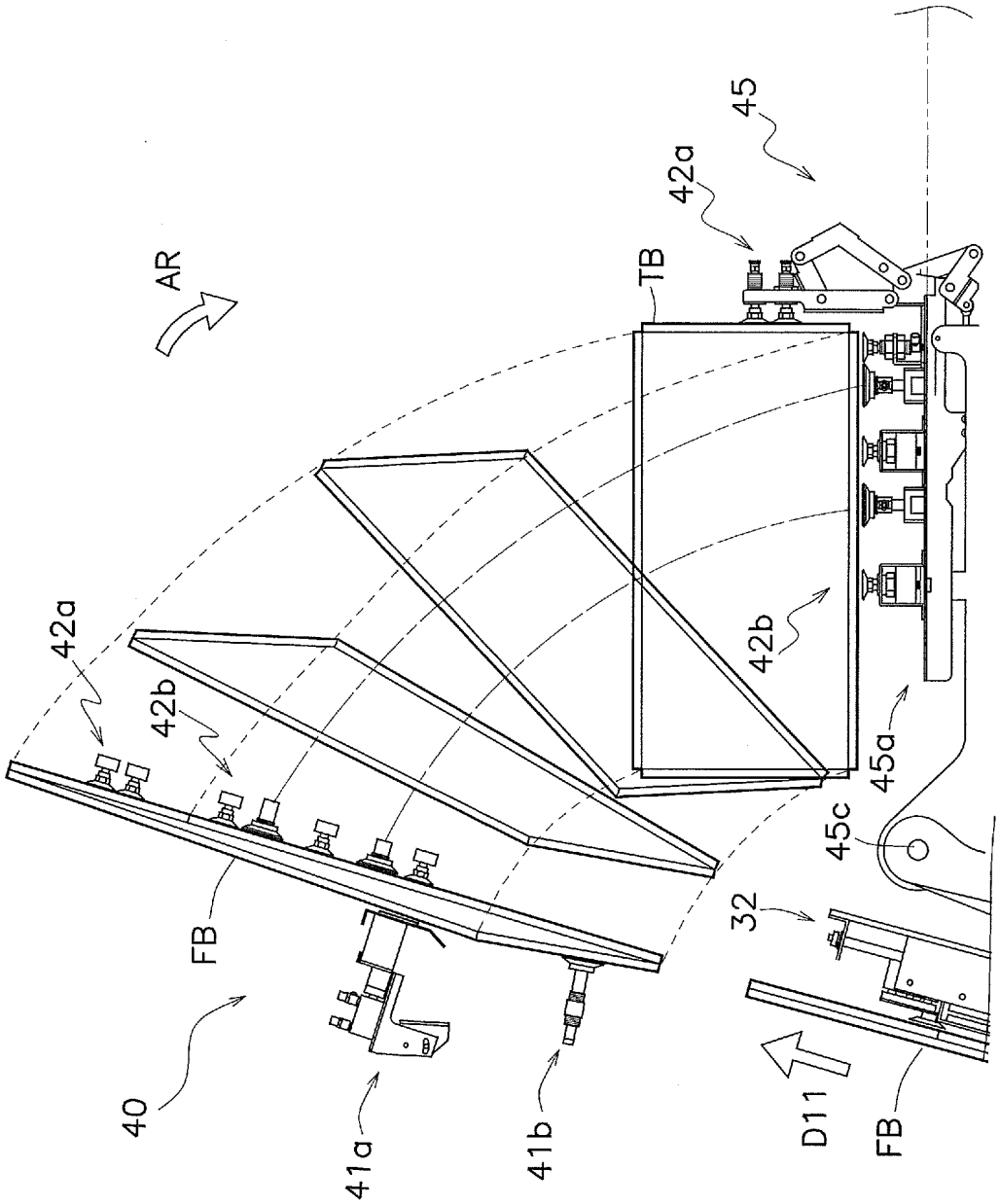


FIG. 9

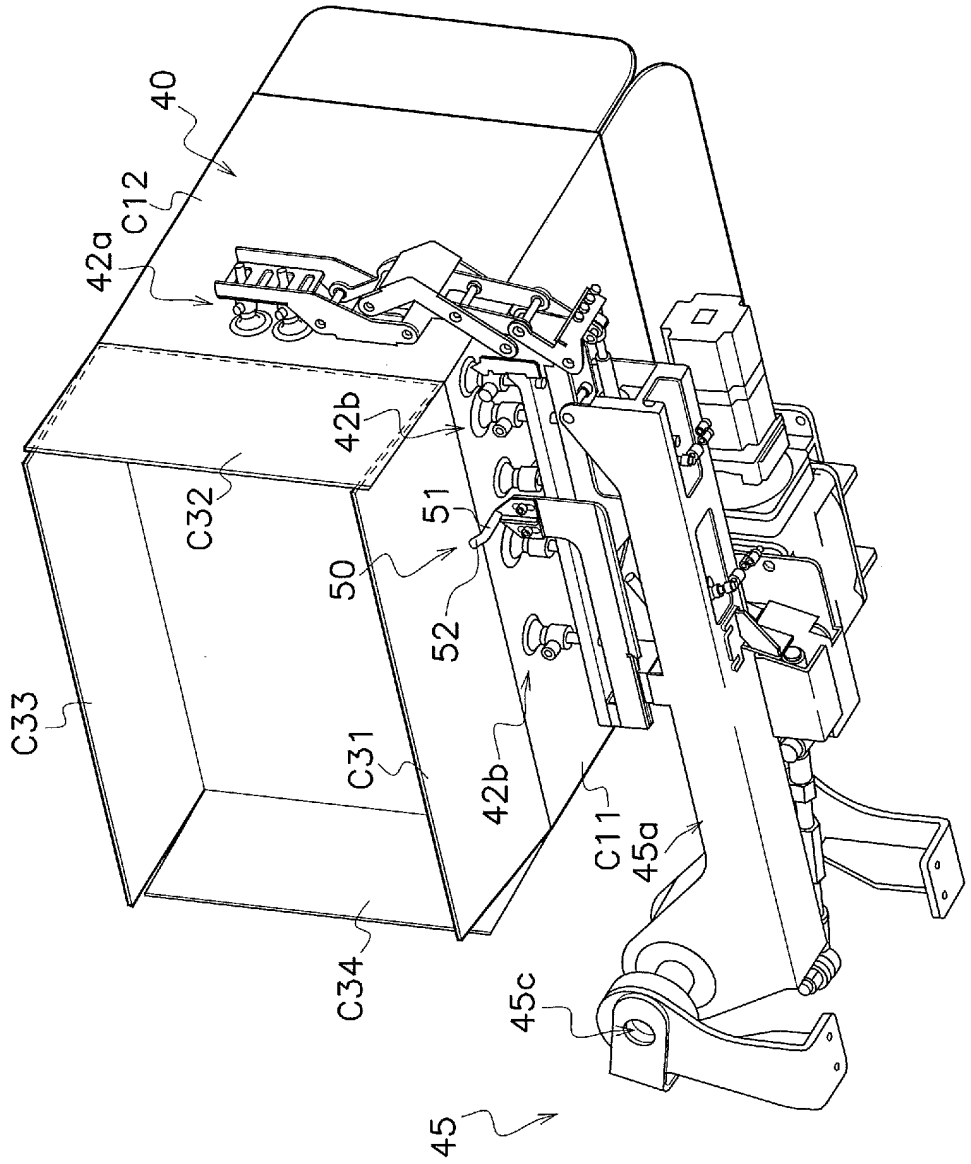


FIG. 10

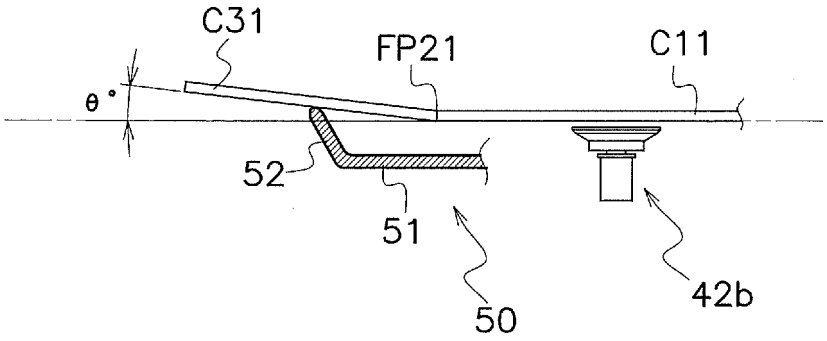
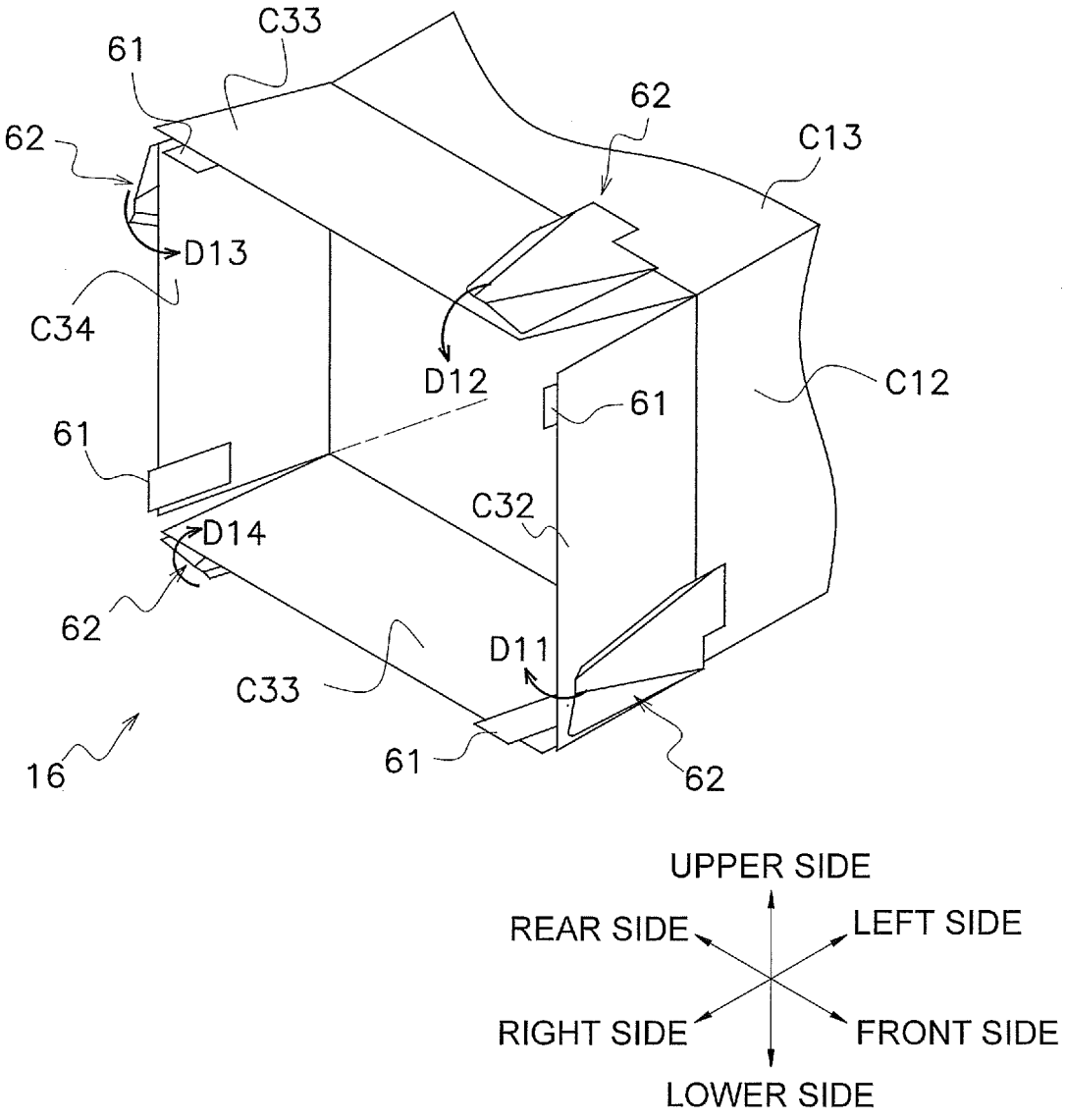


FIG. 11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D14
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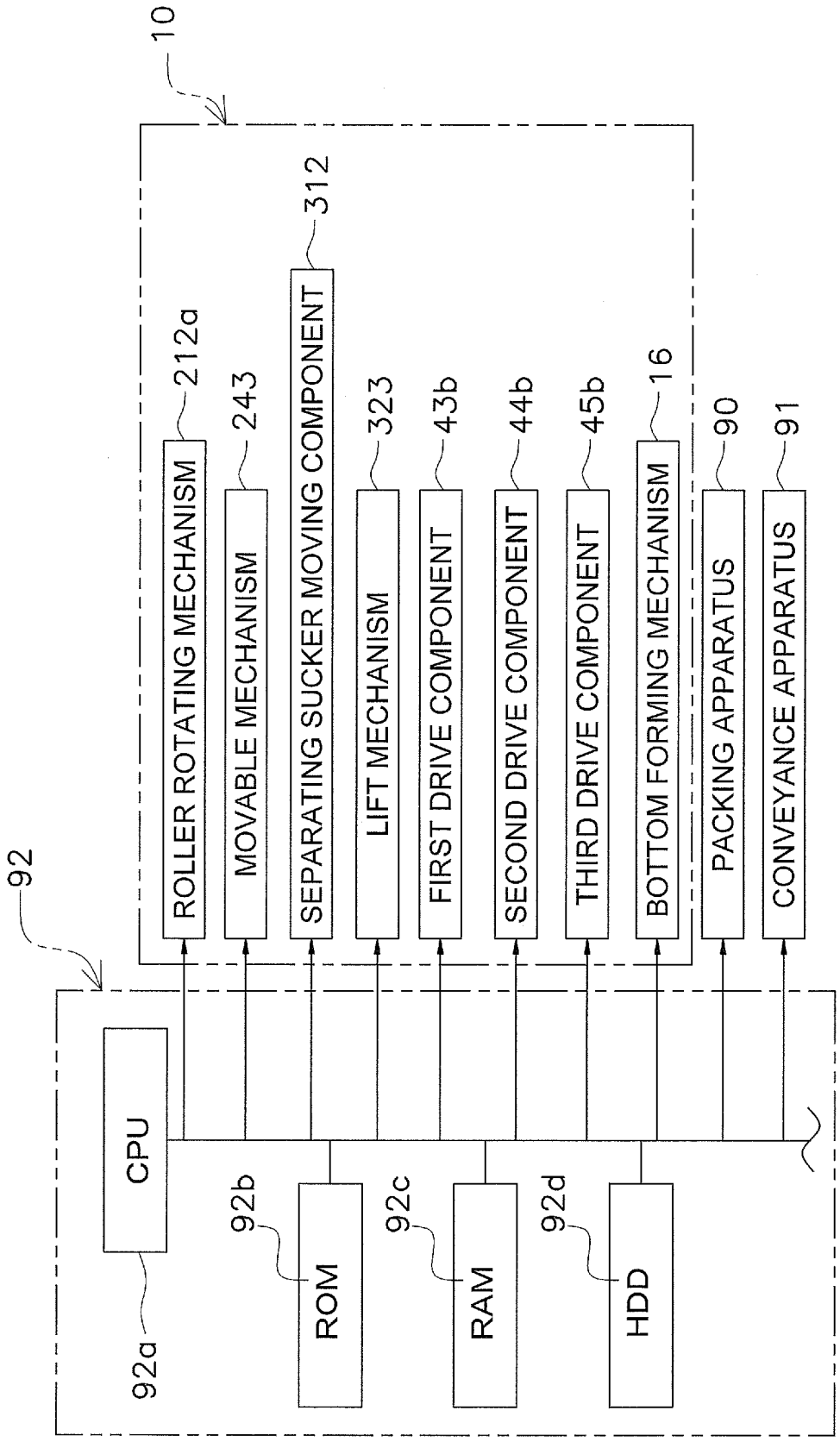
LOWER SIDE

FIG. 12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ROLLER ROTATING MECHANISM
212a
MOVABLE MECHANISM
243
SEPARATING SUCKER MOVING COMPONENT
312
LIFT MECHANISM
323
FIRST DRIVE COMPONENT
43b
SECOND DRIVE COMPONENT
44b
THIRD DRIVE COMPONENT
45b
BOTTOM FORMING MECHANISM
16
PACKING APPARATUS
90
CONVEYANCE APPARATUS
91
CPU
92a
ROM
92b
RAM
92c
HDD
92d

FIG. 13

FIG. 14A

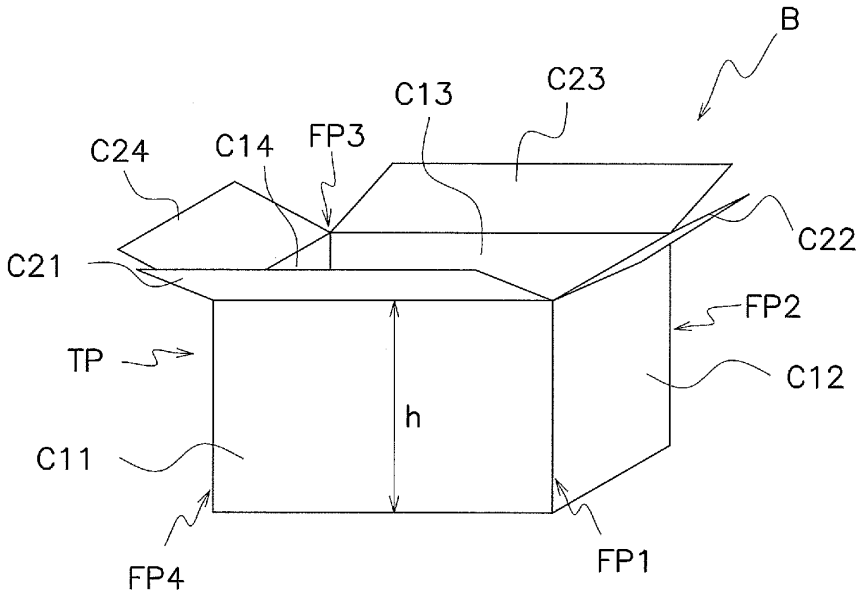
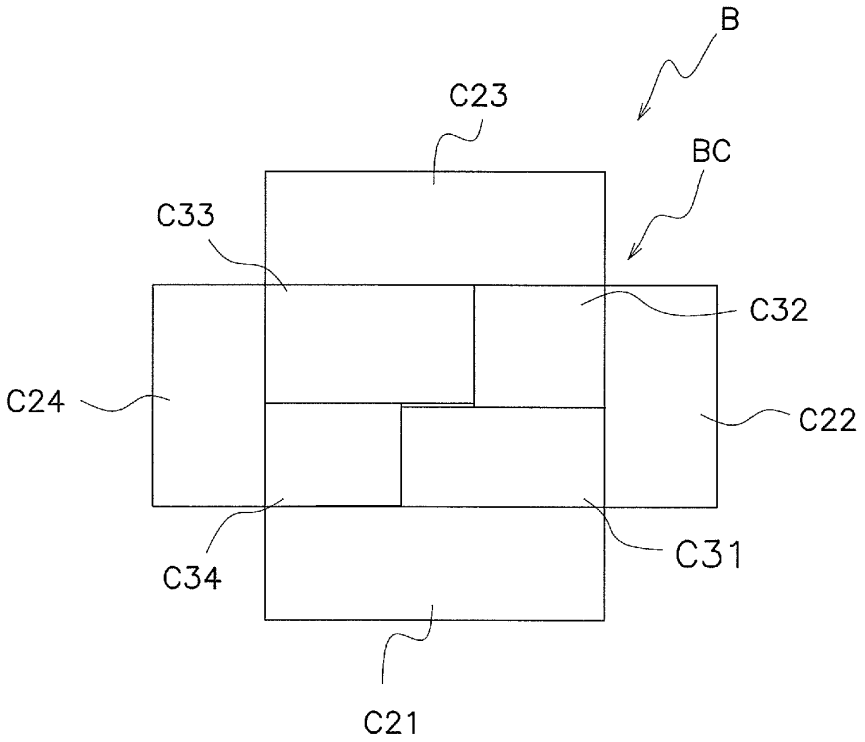


FIG. 14B



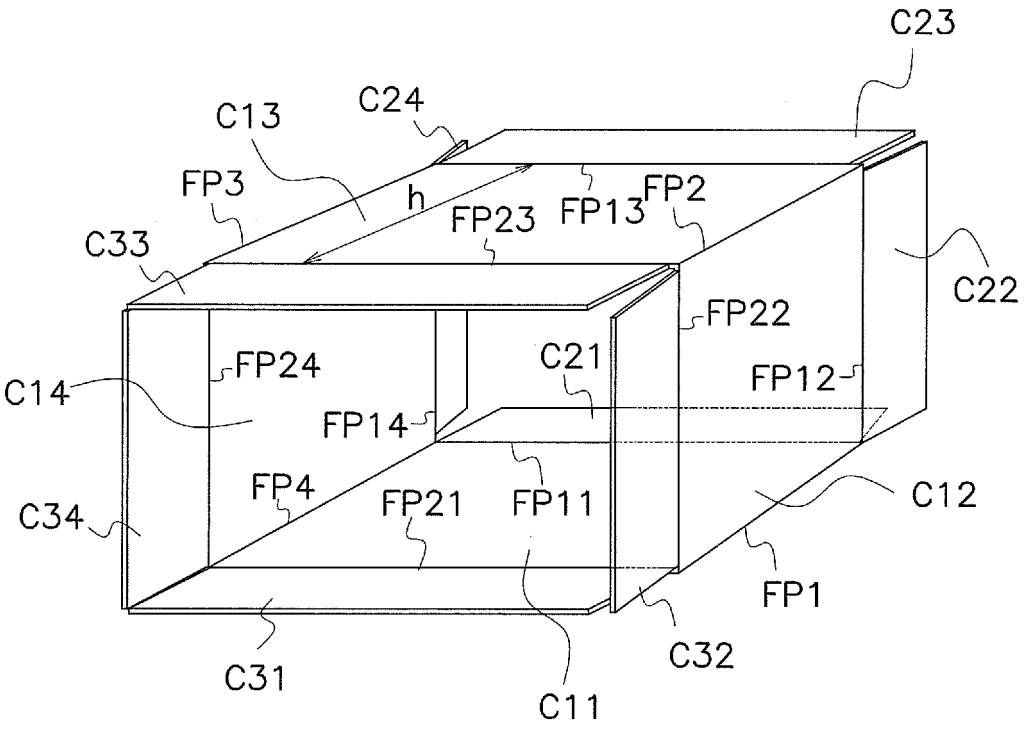

C23
C24
C13
FP3
h
FP23
FP13
FP2
C33
C22
FP22
FP24
C21
FP12
C14
FP14
FP4
FP21
FP11
C12
C34
FP1
C31
C32
C11

FIG. 15

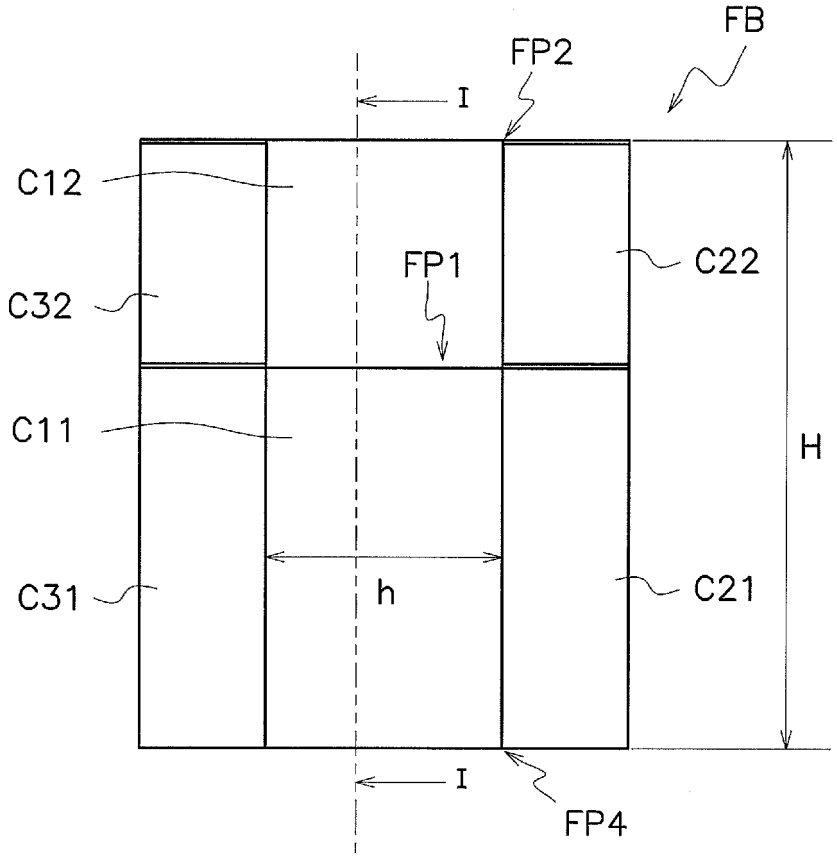


FIG. 16A

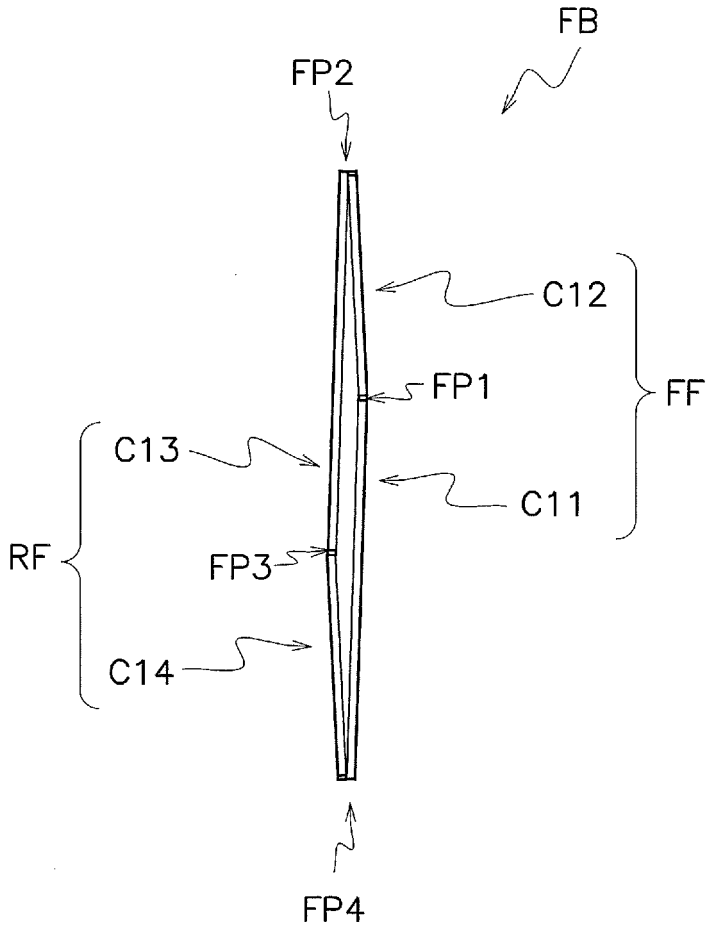


FIG. 16B

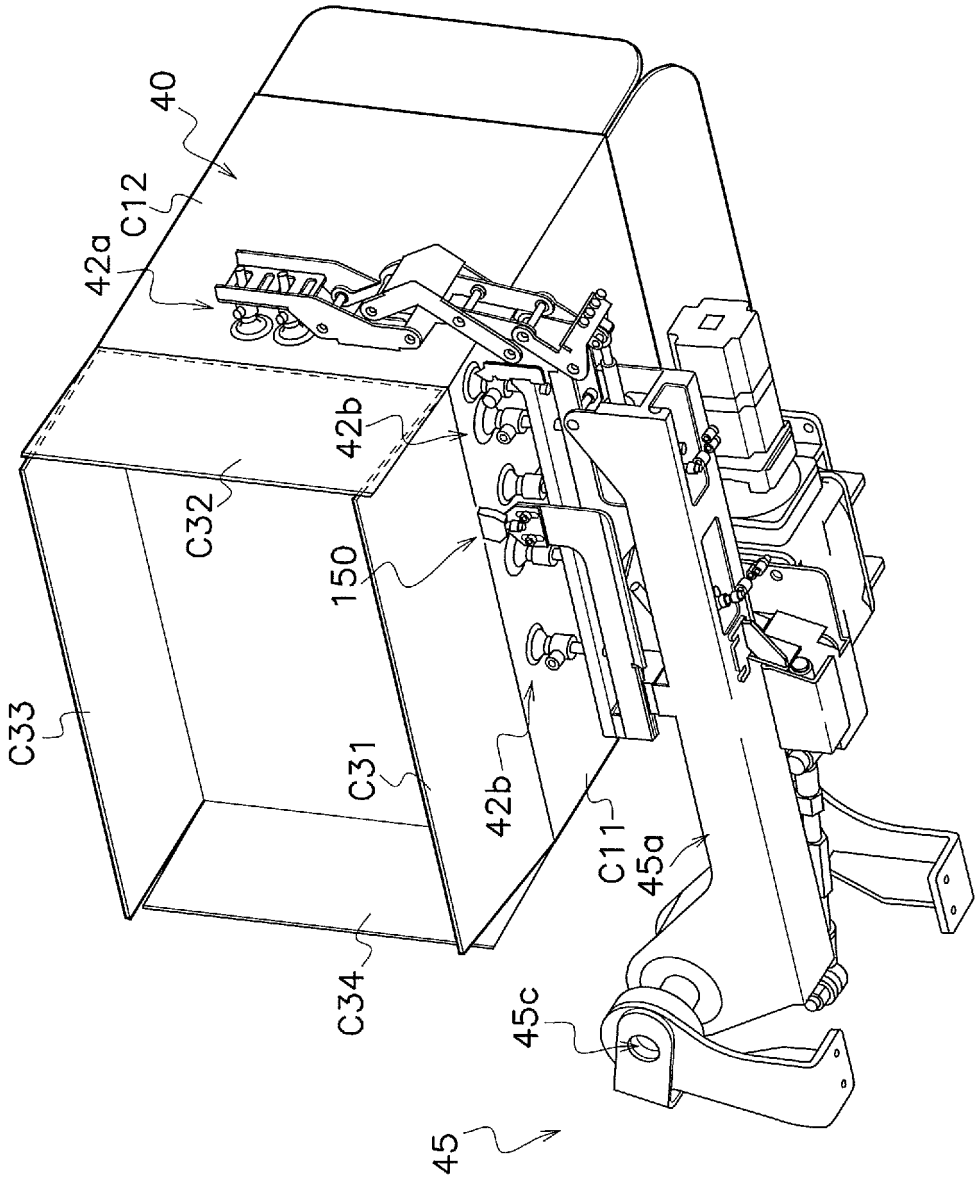


FIG. 17

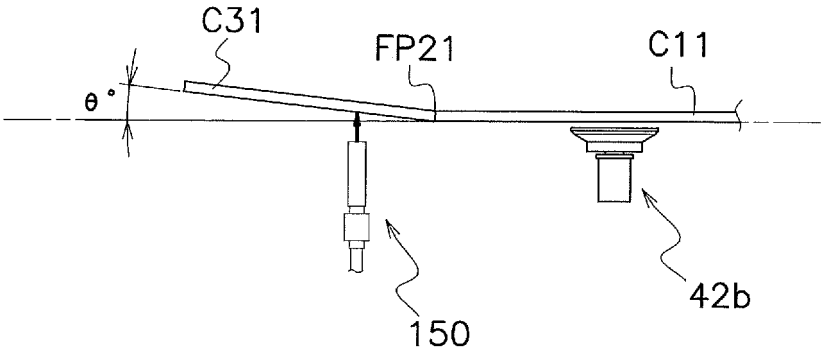


FIG. 18

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2014/082449

A. CLASSIFICATION OF SUBJECT MATTER
B65B43/26(2006.01)i

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)
B65B43/26

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2015
Kokai Jitsuyo Shinan Koho 1971-2015 Toroku Jitsuyo Shinan Koho 1994-2015

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	JP 2005-1304 A (Ushio Lighting, Inc.), 06 January 2005 (06.01.2005), paragraphs [0009] to [0012]; fig. 1 to 3 (Family: none)	1 2-4,7 5-6,8-9
Y A	JP 7-290608 A (Sony Corp.), 07 November 1995 (07.11.1995), paragraphs [0043] to [0057]; fig. 1 to 11 (Family: none)	2-4,7 1,5-6,8-9
A	WO 2011/119563 A2 (DOUGLAS MACHINE INC.), 29 September 2011 (29.09.2011), entire text; all drawings (Family: none)	1-9

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"E" earlier application or patent but published on or after the international filing date
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 February 2015 (24.02.15)	10 March 2015 (10.03.15)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2014/082449

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 8282537 B2 (FRITO-LAY NORTH AMERICA, INC.), 09 October 2012 (09.10.2012), entire text; all drawings & US 2009/0291816 A1 & US 2007/0293383 A1	1-9
A	WO 2009/003032 A2 (DOUGLAS MACHINE INC.), 31 December 2008 (31.12.2008), entire text; all drawings & US 2010/0204030 A1 & RU 2010102234 A	1-9

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2011119563 A **[0002] [0003] [0111]**