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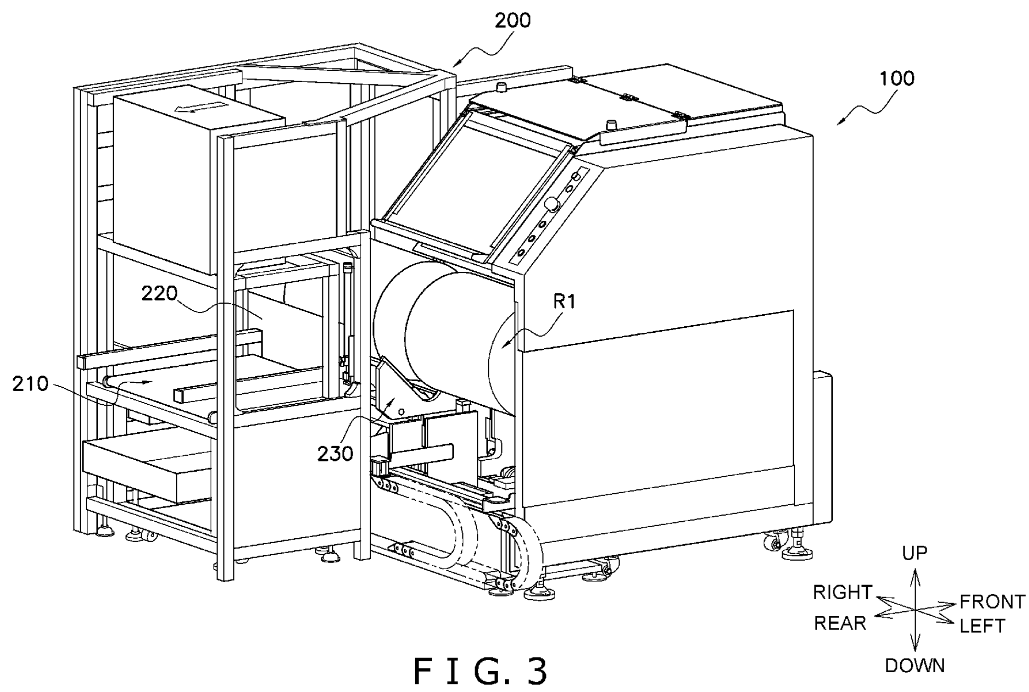
(54) **FILM ROLL SUPPLY DEVICE**

(57) A film-roll supply device improves replacement of a film roll in a bag-making and packaging machine. A film roll replacement device supplies a first film roll to a bag-making and packaging machine. The film roll replacement device is provided with a holding section and a first driving unit. The holding section receives the first film roll to be supplied to the bag-making and packaging machine. The first driving unit changes an orientation of the holding section between a first orientation used when receiving the first film roll and a second orientation used when supplying the first film roll to the bag-making and packaging machine.



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Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is based on and claims the priority benefit of Japanese patent application 2022-143032 filed September 8, 2022, the contents of which are incorporated by reference.

TECHNICAL FIELD

[0002] The present application relates to a film roll supply device to supply a film roll to a bag-making and packaging machine.

BACKGROUND ART

[0003] Bag-making and packaging machines, which package articles using film paying out from a film roll to manufacture bags containing the articles, are known, as in Patent Literature 1 (Japanese Laid-open Patent Publication No. 2002-337817).

[0004] When the film on the film roll is depleted in such bag-making and packaging machines, it is necessary to replace the film roll. Conventionally, attaching a film roll to a bag-making and packaging machine has been done using a manual method such as a method in which a worker lifts the film roll and directly installs the film roll on a supporting shaft of the bag-making and packaging machine, and a method, which is disclosed in Patent Literature 1 (Japanese Laid-open Patent Publication No. 2002-337817), in which the worker lifts the film roll to a predetermined height, loads the film roll onto a cart, and then installs the film roll on the supporting shaft of the bag-making and packaging machine by sliding the film roll on the cart horizontally.

SUMMARY OF THE INVENTION

[0005] However, in the case described above, it is necessary for the worker to stand near the bag-making and packaging machine and perform work to switch out a film roll when the film on the film roll is depleted. Such work not only imposes a burden on the worker but also presents a risk of reducing work efficiency of the worker due to an occurrence of standby time. Additionally, if the film on the film roll is depleted at a time when the worker is performing other work, there is a risk of lengthening a period of time until replacement of the film roll is completed and the bag-making and packaging machine, which will have stopped due to lack of film, is restarted.

[0006] A goal of the claimed invention is to provide a film roll supply device that makes it possible to improve replacement of a film roll in a bag-making and packaging machine.

[0007] A film roll supply device according to a first aspect of the claimed invention supplies a film roll to a bag-making and packaging machine. The film roll supply device comprises a receiver and a first driver. The receiver is configured to receive the film roll to be supplied to the bag-making and packaging machine. The first driver is configured to change an orientation of the receiver between a first orientation used when receiving the film roll and a second orientation used when supplying the film roll to the bag-making and packaging machine.

[0008] When work to replace a film roll using a film roll supply device is automated from the standpoint of, *inter alia*, reducing worker burden, improving work efficiency of the worker, and suppressing downtime of the bag-making and packaging machine, there is a risk that an adverse event such as scratching of a surface of a film on the film roll will occur during transfer of the film roll to the receiver for supplying the film roll to the bag-making and packaging machine.

[0009] However, because the film roll supply device according to the first aspect is configured such that the orientation of the receiver to support the film roll to be supplied to the bag-making and packaging machine is changed from the second orientation used when supplying the film roll to the bag-making and packaging machine to the first orientation used when receiving the film roll, the occurrence of adverse events such as scratching of a surface of the film on the film roll is readily suppressed.

[0010] A film roll supply device according to a second aspect of the claimed invention is the film roll supply device according to the first aspect, wherein the first driver is configured to rotate the receiver about a rotation axis to change the orientation of the receiver. The rotation axis extends in a direction same as an axial direction of the film roll held by the receiver.

[0011] In the film roll supply device according to the second aspect, the orientation of the receiver can be changed using a comparatively simple movement (rotary action).

[0012] A film roll supply device according to a third aspect of the claimed invention is the film roll supply device according to the first or second aspect, further comprises a preliminary placement section on which the film roll being transferred to the receiver is preliminarily placed.

[0013] Because the film roll supply device according to the third aspect has the preliminary placement section, it is possible to set the film roll on the preliminary placement section in advance so that the film roll supply device can execute an action to replace the film roll of the bag-making and packaging machine at a timing when replacement of the film roll is required.

[0014] A film roll supply device according to a fourth aspect of the claimed invention is the film roll supply device according to the third aspect, wherein the receiver is configured to allow the film roll to move from the preliminary placement section to the receiver when the receiver is in the first orientation, and restrict the film roll from moving from the preliminary placement section to the receiver when the receiver is in the second orientation.

[0015] In the film roll supply device according to the fourth aspect, because the film roll is restricted from moving when the receiver is in the second orientation, it is possible to suppress the occurrence of a phenomenon where the film roll moves from the preliminary placement section to the receiver at an unintended timing.

[0016] A film roll supply device according to a fifth aspect of the claimed invention is the film roll supply device according to the third or fourth aspect, wherein the preliminary placement section is configured to support the film roll at a location higher than the film roll transferred to the receiver in the first orientation.

[0017] In the film roll supply device according to the fifth aspect, because the preliminary placement section supports the film roll higher than the film roll supported by the receiver in the first orientation, the film roll can be moved to the receiver without being lifted.

[0018] A film roll supply device according to a sixth aspect of the claimed invention is the film roll supply device according to any of the third to fifth aspects, wherein the receiver has a first surface. The preliminary placement section has a preliminary placement surface on which the film roll is configured to be preliminarily placed. When the film roll is transferred from the preliminary placement section to the receiver in the first orientation, the film roll moves on the preliminary placement surface and the first surface. When the film roll moves on the preliminary placement surface and the first surface, the preliminary placement surface and the first surface are parallel. Alternatively, when the film roll moves on the preliminary placement surface and the first surface, the first surface is downwardly inclined from a proximal side toward a distal side relative to the preliminary placement section.

[0019] In the film roll supply device according to the sixth aspect, due to the preliminary placement surface and the first surface being disposed as described above, the film roll can be smoothly moved from the preliminary placement surface to the first surface of the receiver without being lifted.

[0020] A film roll supply device according to a seventh aspect of the claimed invention is the film roll supply device according to the sixth aspect, wherein the receiver has a second surface. When the receiver is in the first orientation, the second surface is configured to restrict movement of the film roll that moves on the first surface from the proximal side toward the distal side relative to the preliminary placement section.

[0021] Because the film roll supply device according to the seventh aspect has the second surface, it is possible to suppress the occurrence of adverse events, such as the film roll that has moved onto the receiver falling from the receiver or failing to be disposed at a desired position on the receiver.

[0022] A film roll supply device according to an eighth aspect of the claimed invention is the film roll supply device according to the seventh aspect, wherein the receiver includes a first plate-shaped member having the first surface, and a second plate-shaped member having the second surface. When the first plate-shaped member and the second plate-shaped member are viewed from a direction parallel to the first surface and the second surface, the first surface and the second surface are disposed in a V shape.

[0023] In the film roll replacement device according to the eighth aspect, due to the first surface and the second surface being disposed in a V shape, the position of the film roll can be precisely positioned using the first surface of the first plate-shaped member and the second surface of the second plate-shaped member.

[0024] Additionally, due to the first surface and the second surface being disposed in a V shape, it is possible to control only a vertical-direction position of the receiver when supplying the film roll to the bag-making and packaging machine, therefore making it possible to control the position of the film roll during film roll supply using a simple configuration.

[0025] A film roll supply device according to a ninth aspect of the claimed invention is the film roll supply device according to the seventh or eighth aspect, wherein an angle formed by the first surface and the second surface is within a range of $90° \pm 30°$.

[0026] In the film roll supply device according to the ninth aspect, due to the angle formed by the first surface and the second surface being within the aforementioned angular range, the position of the film roll can be precisely controlled using the first surface and the second surface.

[0027] A film roll supply device according to a tenth aspect of the claimed invention is the film roll supply device according to any of the seventh to ninth aspects, wherein when the receiver is in the second orientation, the first surface and the second surface support the film roll on the receiver from below.

[0028] In the film roll supply device according to the tenth aspect, the first surface and the second surface can function as support surfaces for the film roll when the orientation of the receiver is set to the second orientation.

[0029] Because the film roll supply device according to the claimed invention is configured such that the orientation of the receiver to support a film roll to be supplied to the bag-making and packaging machine is changed from the second orientation used when supplying the film roll to the bag-making and packaging machine to the first orientation used when receiving the film roll, the occurrence of adverse events such as scratching of a surface of the film on the film roll is readily suppressed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030]

FIG. 1 is a schematic perspective view of a weighing and packaging system including a bag-making and packaging machine to which a film roll is supplied by a film roll replacement device according to one embodiment of a film roll supply device of the claimed invention;

FIG. 2 is a schematic diagram of the bag-making and packaging machine of FIG. 1;

FIG. 3 is a schematic perspective view of a film supply section of the bag-making and packaging machine of FIG. 1 and the film roll replacement device according to one embodiment of the claimed invention, as seen from the left rear;

FIG. 4 is a schematic perspective view of the film supply section of the bag-making and packaging machine of FIG. 1 and the film roll replacement device according to one embodiment of the claimed invention, as seen from the right rear;

FIG. 5 is a schematic plan view of the film roll replacement device;

FIG. 6 is a schematic left-side view of the film roll replacement device;

FIG. 7 is a control block diagram of the bag-making and packaging machine and the film roll replacement device;

FIG. 8 is a schematic right-side view of a right-side pushing member of the film roll replacement device;

FIG. 9 is a schematic left-side view of a left-side pushing member of the film roll replacement device;

FIG. 10A is a schematic plan view of part of the film roll replacement device and illustrates an action of the film roll replacement device when a film roll is removed from a supporting shaft of the bag-making and packaging machine;

FIG. 10B is a schematic plan view of part of the film roll replacement device and illustrates the action of the film roll replacement device when the film roll is removed from the supporting shaft of the bag-making and packaging machine;

FIG. 10C is a schematic plan view of part of the film roll replacement device and illustrates the action of the film roll replacement device when the film roll is removed from the supporting shaft of the bag-making and packaging machine;

FIG. 10D is a schematic plan view of part of the film roll replacement device and illustrates the action of the film roll replacement device when the film roll is removed from the supporting shaft of the bag-making and packaging machine;

FIG. 11 is a schematic left-side view illustrating the action of the film roll replacement device when a winding core of a depleted film roll is retrieved from a supporting shaft of the bag-making and packaging machine;

FIG. 12A is a schematic left-side view of part of the film roll replacement device and illustrates movement of a film roll to the holding section and adjustment of a height position of the holding section;

FIG. 12B is a schematic left-side view of part of the film roll replacement device and illustrates the movement of the film roll to the holding section and the adjustment of the height position of the holding section;

FIG. 12C is a schematic left-side view of part of the film roll replacement device and illustrates the movement of the film roll to the holding section and the adjustment of the height position of the holding section;

FIG. 12D is a schematic left-side view of part of the film roll replacement device and illustrates the movement of the film roll to the holding section and the adjustment of the height position of the holding section;

FIG. 12E is a schematic left-side view of part of the film roll replacement device and illustrates the movement of the film roll to the holding section and the adjustment of the height position of the holding section;

FIG. 13A is a schematic plan view of part of the film roll replacement device and illustrates mounting of a film roll on a supporting shaft of the bag-making and packaging machine by the film roll replacement device;

FIG. 13B is a schematic plan view of part of the film roll replacement device and illustrates the mounting of the film roll on the supporting shaft of the bag-making and packaging machine by the film roll replacement device;

FIG. 13C is a schematic plan view of part of the film roll replacement device and illustrates the mounting of the film roll on the supporting shaft of the bag-making and packaging machine by the film roll replacement device;

FIG. 13D is a schematic plan view of part of the film roll replacement device and illustrates the mounting of the film roll on the supporting shaft of the bag-making and packaging machine by the film roll replacement device;

FIG. 13E is a schematic plan view of part of the film roll replacement device and illustrates the mounting of the film roll on the supporting shaft of the bag-making and packaging machine by the film roll replacement device;

FIG. 14 is an enlarged view of the holding section of the film roll replacement device, and is a drawing illustrating a method of measuring the height position up to the center of the first film roll;

FIG. 15 is a control block diagram of the film roll replacement device of Modification A; and

FIG. 16 is an enlarged view of the holding section of the film roll replacement device of Modification B, and is a drawing illustrating a method of measuring the height position up to the center of the first film roll.

FIG. 17A illustrates another example of a disposition of a first holding member and a second holding member in the holding section of the film roll replacement device;

FIG. 17B illustrates yet another example of the disposition of the first holding member and the second holding member in the holding section of the film roll replacement device;

FIG. 18A illustrates an example of a disposition of a first holding surface of the holding section and a conveyor surface of a conveyor of the film roll replacement device;

FIG. 18B illustrates an example of the disposition of the first holding surface of the holding section and the conveyor surface of the conveyor of the film roll replacement device;

FIG. 19 illustrates another example of a first orientation of the holding section in the film roll replacement device;

FIG. 20 illustrates another example of the disposition of the conveyor of the film roll replacement device;

FIG. 21A is a schematic left-side view of the film roll replacement device according to modification L, and depicts a state in which an orientation of the holding section is a second orientation;

FIG. 21B is a schematic left-side view of the film roll replacement device according to modification L, and depicts a state in which the orientation of the holding section is a first orientation;

FIG. 22 is a schematic left-side view of the holding section of the film roll replacement device according to modification M;

FIG. 23 is a schematic left-side view of another example of the holding section of the film roll replacement device according to modification N; and

FIG. 24 is a schematic left-side view of yet another example of the holding section of the film roll replacement device according to modification N.

DESCRIPTION OF EMBODIMENTS

[0031] A film roll replacement device 200 according to one embodiment of a film roll supply device of the present disclosure shall now be described with reference to the drawings. The following description is merely a specific example of the claimed invention, and does not limit the technical scope of the claimed invention. It will be understood that various changes in configuration and detail can be made without departing from the spirit and scope of the invention as set forth in the claims.

[0032] In the following description, expressions such as parallel, perpendicular, horizontal, vertical, orthogonal, identical, etc., may be used. Meanings of these expressions are not limited to strictly parallel, perpendicular, horizontal, vertical, orthogonal, identical, etc., may also be substantially parallel, perpendicular, horizontal, vertical, orthogonal, identical, etc.

[0033] For the sake of convenience, expressions such as "front (front surface)," "rear (back surface)," "up," "down," "left," and "right" may be used to indicate directions in the following description. Unless otherwise specified, these directional expressions represent the directions of the arrows added to the drawings.

(1) Bag-making and packaging machine and weighing and packaging system

[0034] First, a bag-making and packaging machine 3, to which the film roll replacement device 200 supplies a film roll, and a weighing and packaging system 1 including the bag-making and packaging machine 3, shall now be described with reference to FIGS. 1, 2, and 7. FIG. 1 is a schematic perspective view of the weighing and packaging system 1. FIG. 2 is a schematic diagram of the bag-making and packaging machine 3. A control block diagram of the bag-making and packaging machine 3 is shown in the lower part of FIG. 7.

[0035] The weighing and packaging system 1 mainly has a combination weighing machine 2 and the bag-making and packaging machine 3 (see FIG. 1).

(1-1) Combination weighing machine

[0036] The combination weighing machine 2 mainly has a plurality of weighing hoppers 2a as in FIG. 1. The combination weighing machine 2 uses the plurality of weighing hoppers 2a to weigh articles P (e.g., potato chips) of a predetermined weight, and supplies the articles to the bag-making and packaging machine 3 positioned thereunder. Specifically, the combination weighing machine 2 conveys and supplies articles P supplied from a supply conveyor (not shown in the figure) or the like to the plurality of weighing hoppers 2a using a conveying means (not shown in the figure). The combination weighing machine 2 measures the weight of the articles P supplied to each of the weighing hoppers 2a using a weighing means (not shown in the figure). The combination weighing machine 2 selects a combination of weighing hoppers 2a so that the total value of weight of the articles P in the selected weighing hoppers 2a will fall within a predetermined weight range. The combination weighing machine 2 supplies articles P of a predetermined weight to the bag-making and packaging machine 3 by downwardly discharging the articles P in weighing hoppers 2a selected in a combination.

(1-2) Bag-making and packaging machine

[0037] The bag-making and packaging machine 3 receives the supply of articles P from the combination weighing machine 2, forms a bag B from a sheet-shaped film F, and manufactures a bag B containing the articles P therein, as shown in FIG. 2. The bag-making and packaging machine 3 mainly includes a bag-making and packaging section 3a, a film supply section 100, and a packaging machine controller 4, as shown in FIGS. 1, 2, and 7.

[0038] The film supply section 100 holds a film roll R1 around which the sheet-shaped film F is wound, and supplies the film F paying out from the film roll R1 to the bag-making and packaging section 3a. The bag-making and packaging section 3a receives the supply of articles P from the combination weighing machine 2 and forms the sheet-shaped film F supplied from the film supply section 100 to manufacture bags B containing the articles P. The packaging machine controller 4 controls actions of various components of the bag-making and packaging machine 3.

(1-2-1) Bag-making and packaging section

[0039] The bag-making and packaging section 3a mainly includes a forming mechanism 10, a film-conveying device 20, a vertical seal mechanism 30, and a lateral seal mechanism 40, as shown in FIG. 2.

[0040] The forming mechanism 10 mainly includes a tube 12 and a former 14, as shown in FIG. 2. The tube 12 is a cylindrical member that is open at upper and lower ends. Articles supplied by the combination weighing machine 2 are dropped into the opening at the upper end of the tube 12 (see FIG. 2). The former 14 is positioned so as to surround the tube 12. The former 14 forms the sheet-shaped film F conveyed by the film supply section 100 into a tube shape, and forms a tubular film Ft having overlapping ends in a direction orthogonal to the conveying direction of the film F.

[0041] The film-conveying device 20 conveys the film F supplied from the film supply section 100. Specifically, the film-conveying device 20 uses suction to hold the tubular film Ft via a pair of belts (not shown in the figure) having a suction function, and conveys the belts downward to convey the tubular film Ft and the sheet-shaped film Ft on the upstream side.

[0042] The vertical seal mechanism 30 seals the tubular film Ft along the vertical direction. The vertical seal mechanism 30 is positioned in front of the tube 12 as in FIG. 2. The overlapping portion of the film F of the tubular film Ft is sandwiched between the vertical seal mechanism 30 and the tube 12, and in this state, the overlapping portion of the film F is heat sealed by a heater (not shown in the figure) of the vertical seal mechanism 30.

[0043] With the articles P having been dropped to a bottom part of the tubular film Ft, the lateral seal mechanism 40 sandwiches the tubular film Ft between a pair of sealing jaws 42 having heaters installed therein, heat-seals the tubular film Ft along a direction orthogonal to the conveying direction, and manufactures a bag B containing the articles P. A cutter (not shown in the figure) is built into one of the pair of sealing jaws 42 to seal the tubular film Ft. When laterally sealing the tubular film Ft, the lateral seal mechanism 40 uses the cutter to cut the tubular film Ft at a heightwise center position of the portion laterally sealed by the sealing jaws 42, and separating the bag containing the articles P from the following tubular film Ft.

(1-2-2) Film supply section

[0044] The film supply section 100 is provided behind and adjacent to the bag-making and packaging section 3a as in FIG. 1, and supplies the sheet-shaped film F to the forming mechanism 10 of the bag-making and packaging section 3a. The film supply section 100 mainly includes a holding mechanism 110, a support frame 120, a frame shaft 130, a joining mechanism 160, a cutting mechanism 162, a plurality of rollers 170, and a tension-adjusting mechanism 180.

[0045] The holding mechanism 110 includes a pair of supporting parts 112 and a support-shaft-driving unit 116. Each of the pair of supporting parts 112 holds a film roll R1 in which a film F is wound around a hollow winding core WC. The film supply section 100 supplies the bag-making and packaging section 3a with film F paying out from the film rolls R1 held by the supporting parts 112.

[0046] Due to the holding mechanism 110 having a plurality (e.g., two in this case) of supporting parts 112, the holding mechanism 110 can simultaneously hold a replacement film roll R1 in addition to the film roll R1 supplying film F to the bag-making and packaging section 3a (the film roll R1 in use). Therefore, when the film F of the film roll R1 in use has been used up, manufacture of bags B can be restarted in a short period of time by using the film F of the replacement film roll R1.

[0047] The supporting parts 112 shall now be described in detail. The supporting parts 112 each have a supporting shaft 114 extending in a left-right direction. Film rolls R1 are mounted on the supporting shafts 114, and the mounted film rolls R1 are supported. Specifically, the film rolls R1 are mounted on the supporting shafts 114 by inserting the supporting shafts 114 through the winding cores WC of the film rolls R1. Air chucks (not shown in the figure) or other fixing mechanisms are provided to the supporting shafts 114. The film rolls R1 are fixed to the supporting shafts 114 by driving the fixing mechanisms in a state in which the supporting shafts 114 have been inserted through the hollow winding cores WC of the film rolls R1. The support-shaft-driving unit 116 of the film supply section 100 may, for example, be a motor provided for both of the supporting shafts 114, and the support-shaft-driving unit 116 causes the supporting shafts 114 to rotate so that the film rolls R1 mounted on the supporting shafts 114 are caused to rotate.

[0048] The support frame 120 is an arm-shaped member that supports the pair of supporting parts 112. The support frame 120 is mounted at the center thereof on the frame shaft 130. The supporting parts 112 are mounted at both ends of the arm-form support frame 120 such that the frame shaft 130 is disposed between the supporting parts 112.

[0049] When the frame shaft 130 is caused to rotate by a motor or another frame-driving unit 132, the support frame 120 rotates together with the frame shaft 130, and the supporting shafts 114 of the pair of supporting parts 112 rotate about a center axis of the frame shaft 130. Due to the support frame 120 rotating about the center axis of the frame shaft 130, the supporting shafts 114 of the pair of supporting parts 112 are moved to respective film roll a replacement position, a film supply position, or other positions. The film roll replacement position is a position at which film roll R1 is supplied by the film roll replacement device 200 to the supporting shafts 114. The film supply position is a position at which the film F is paying out from the film rolls R1 supported by the supporting shafts 114 to the bag-making and packaging section 3a.

[0050] A leading end (the end opposite the side fixed to the winding core WC) of the film F of the replacement film roll R1 mounted on one of the pair of supporting shafts 114 is set in a predetermined position. When the film F of the film roll R1 in use (the film roll R1 mounted on the other supporting shaft 114) is used up (when the remaining amount of the film F becomes equal to or less than a predetermined amount), the joining mechanism 160 controlled by the packaging machine controller 4 joins a vicinity of a trailing end (an end fixed to the winding core WC) of the film F of the film roll R1 in use (in other words, the depleted film roll R1) and a vicinity of the leading end of the film F of the replacement film roll R1. In addition, the cutting mechanism 162 controlled by the packaging machine controller 4 cuts the film F of the depleted film roll R1 on the side toward the depleted film roll R1 from the location where the film is joined to the film F of the replacement film roll R1. As a step of splicing the film F and a step of cutting the film F of the depleted film roll R1 are automatically performed, the burden on the worker when a film roll R1 has been used up can be reduced in the bag-making and packaging machine 3.

[0051] The film F paying out from the film roll R1 supported on the supporting shaft 114 located in the film supply position is guided by a plurality of rollers 170 located along a predetermined film-conveying path of the film supply section 100, and conveyed to the forming mechanism 10 of the bag-making and packaging section 3a.

[0052] The film-conveying path of the film supply section 100 is provided with a tension-adjusting mechanism 180 that adjusts the magnitude of tension applied to the conveyed film F.

[0053] The tension-adjusting mechanism 180 mainly has three fixed rollers 182, a movable roller mechanism 184, a shaft 184a, an air cylinder 187, and an encoder 188 (see FIGS. 2 and 7). The movable roller mechanism 184 includes two movable rollers 185 and a pair of arms 186 that support the movable rollers 185 (see FIG. 2). The pair of arms 186 are located to the left and right of the movable rollers 185 so that the movable rollers 185, extending in the left-right direction, are held between the arms 186, and the arms 186 support ends of the movable rollers 185. The pair of arms 186 are rotatably supported by the shaft 184a extending in the left-right direction. A tip of a rod (not shown in the figure) entering and exiting a cylinder (not shown in the figure) of the air cylinder 187 is linked to an arm (not shown in the figure) extending in a radial direction from the shaft 184a. Driving the air cylinder 187 generates a force that causes the shaft 184a to rotate.

[0054] The fixed rollers 182 are fixed to a frame (not shown in the figure) and do not change positions. The movable rollers 185 change positions in accordance with the movement of the arms 186 between which the movable rollers 185 are mounted. The fixed rollers 182 and the movable rollers 185 are located in the film-conveying path via which the film F paying out from the film rolls R1 supported by the supporting shafts 114 of the supporting parts 112 moves toward the forming mechanism 10 of the bag-making and packaging section 3a. The film F is wound on the fixed rollers 182 and the movable rollers 185, which guide the film F being conveyed along the film-conveying path. The movable rollers 185 move in accordance with the force exerted on the movable rollers 185 by the film F wound on the movable rollers 185.

[0055] One end of the shaft 184a is mounted to the encoder 188, which is for detecting a rotation angle of the shaft 184a. The encoder 188 senses the movements of the movable rollers 185. Detection results of the encoder 188 are used in, *inter alia*, control of the positions of the movable rollers 185 by the packaging machine controller 4.

(1-2-3) Packaging machine controller

[0056] The packaging machine controller 4 is a device that controls the actions of the components of the bag-making and packaging machine 3. The packaging machine controller 4 has, for example, a CPU, storage devices such as a main storage device and an auxiliary storage device, an input/output device, and various electric circuits and electronic circuits. In the packaging machine controller 4, the CPU reads and executes programs stored in memory, whereby the actions of the components of the bag-making and packaging section 3a and the film supply section 100 are controlled.

[0057] Specifically, the packaging machine controller 4 is electrically connected to the film-conveying device 20, the vertical seal mechanism 30, and the lateral seal mechanism 40 of the bag-making and packaging section 3a as shown in FIG. 7, and the packaging machine controller 4 controls the actions of these components. The packaging machine controller 4 is also electrically connected to the support-shaft-driving unit 116, the frame-driving unit 132, the joining mechanism 160, the cutting mechanism 162, and the air cylinder 187 of the film supply section 100, and the packaging machine controller 4 controls the actions of these components. In addition, the packaging machine controller 4 is electrically connected to the encoder 188 and a scanner 190 of the film supply section 100, and the packaging machine controller 4 receives signals transmitted by these instruments. The scanner 190 is a device that reads codes such as bar codes and matrix-type two-dimensional codes added to the film rolls R1.

[0058] During normal operation in which the bag-making and packaging section 3a manufactures bags B, the packaging machine controller 4 controls actions of the support-shaft-driving unit 116, the air cylinder 187, the film-conveying device 20, the vertical seal mechanism 30, and the lateral seal mechanism 40 in the following manner.

[0059] The packaging machine controller 4 controls the film-conveying device 20 so that the sheet-shaped film F paying out from the film rolls R1 is conveyed at a predetermined speed using the support-shaft-driving unit 116. The packaging machine controller 4 controls driving/stopping of the support-shaft-driving unit 116 and the speed at which the film rolls R1 are caused to rotate by the support-shaft-driving unit 116, based on the conveyed state of the film F and the sensing results of the encoder 188. In addition, the packaging machine controller 4 controls the air cylinder 187 so that the movable rollers 185 exert a constant force on the film F being conveyed. Furthermore, the packaging machine controller 4 controls actions of the vertical seal mechanism 30 and the lateral seal mechanism 40 so that the vertical seal mechanism 30 vertically seals the tubular film Ft at a predetermined timing and the lateral seal mechanism 40 laterally seals the tubular film Ft at a predetermined timing.

[0060] Details of the control performed by the packaging machine controller 4 when the film roll replacement device 200 supplies a film roll R1 to the bag-making and packaging machine 3 shall now be described together with a description of the film roll replacement device 200.

(2) Film roll supply device

(2-1) Overall summary

[0061] A summary of the film roll replacement device 200 according to one embodiment of the claimed invention shall now be described with reference to FIGS. 3 to 9.

[0062] FIG. 3 is a schematic perspective view of the film supply section 100 of the bag-making and packaging machine 3 and the film roll replacement device 200 as seen from the left rear. FIG. 4 is a schematic perspective view of the film supply section 100 of the bag-making and packaging machine 3 and the film roll replacement device 200 as seen from the right rear. FIG. 5 is a schematic plan view of the film roll replacement device 200. FIG. 6 is a schematic left-side view of the film roll replacement device 200. A control block diagram of the film roll replacement device 200 is shown in the upper part of FIG. 7. FIG. 8 is a schematic right-side view of a right-side pushing member 240 of the film roll replacement device 200. FIG. 9 is a schematic left-side view of a left-side pushing member 250 of the film roll replacement device 200.

[0063] The film roll replacement device 200 supplies film rolls R1 to the bag-making and packaging machine 3. For the sake of clarity in the description below, a film roll R1 supplied by the film roll replacement device 200 to the bag-making and packaging machine 3 may be referred to as a first film roll R1a.

[0064] In the present disclosure, the film roll replacement device 200 removes a depleted film roll R1 or a partially used film roll R1 from a supporting shaft 114 of the bag-making and packaging machine 3. The term "depleted film roll R1" means a film roll R1 in which the film F wound around the winding core WC has been used up (the remaining amount of the film F has become equal to or less than a predetermined amount). The term "partially used film roll R1" means a film roll R1 that is no longer used in the bag-making and packaging machine 3 at least temporarily even though the film F has not been used up. For the sake of clarity in explanation below, a film roll R1 removed from the supporting shaft 114 of the bag-making and packaging machine 3 may be referred to as a second film roll R1b.

[0065] The film roll replacement device 200 may be a device that has only the function of supplying film rolls R1 to the bag-making and packaging machine 3. In this case, the second film roll R1b may be manually removed from the supporting shaft 114 by a worker.

[0066] The film roll replacement device 200 is placed, for example, on the right side of the film supply section 100 of the bag-making and packaging machine 3, as in FIGS. 3 and 4. The placement of the film roll replacement device 200 depicted in FIGS. 3 and 4 is merely one example, and may be changed as appropriate in accordance with the specifications of the bag-making and packaging machine 3 and the film roll replacement device 200.

[0067] The film roll replacement device 200 has a conveyor 210, a gate 220, a holding section 230, a right-side pushing member 240, a left-side pushing member 250, a stopper 260, a winding-core-retrieving mechanism 270, and a first member 280, as shown in FIGS. 5 and 6. In addition, the film roll replacement device 200 has a gate-driving unit 222, a first driving unit 235, a second driving unit 236, a third driving unit 237, a right-side pushing-member-driving unit 242, a left-side pushing-member-driving unit 252, a stopper-driving unit 262, a first-member-driving unit 282, an encoder 284, a distance sensor 286, and a controller 290 as shown in FIG.7. The driving units 222, 235, 236, 237, 242, 252, 262, 282 are motors, air cylinders, and other machines for actuating objects to be driven. The types of machines to use for the driving units 222, 235, 236, 237, 242, 252, 262, 282 may be selected as appropriate.

[0068] Details of the various components of the film roll replacement device 200 are described below.

(2-2) Details

(2-2-1) Conveyor

[0069] The conveyor 210 forwardly conveys the first film roll R1a, which is to be supplied to the bag-making and packaging machine 3, to the holding section 230. A worker may supply the first film roll R1a to the conveyor 210, or an automatic guided vehicle (AGV) for conveying the film roll R1a may supply the first film roll R1a to the conveyor 210.

[0070] In the present embodiment, the conveyor 210 is a belt conveyor that drives a conveyor belt by a motor (not shown in the figure) to convey the film rolls R1. However, the type of conveyor 210 is not limited to a belt conveyor; the conveyor 210 may be a roller conveyor that does not have a drive source. Even in this case, for example, if an end portion of the conveyor 210 on the holding section 230 side is lower than an end portion of the conveyor 210 on the side opposite to the holding section 230, the film rolls R1 can be conveyed to the holding section 230 even without a person moving the film rolls R1.

[0071] The conveyor 210 may be omitted from the film roll replacement device 200. If there is no conveyor 210, the AGV may directly convey and supply the first film roll R1a to the holding section 230. Alternatively, a worker may directly supply the first film roll R1a to the holding section 230.

(2-2-2) Gate

[0072] The gate 220 is placed in front of the conveyor 210 and to the rear of the holding section 230 as shown in FIG. 5. In other words, the gate 220 is placed between the conveyor 210 and the holding section 230 in a plan view as shown in FIG. 5.

[0073] The gate 220 is a member that restricts the movement of the first film roll R1a on the conveyor 210, and prevents the first film roll R1a from moving to the holding section 230 at unintended timings. The gate 220 is driven by the gate-driving unit 222 to move between a position (restricting position) of restricting the movement of the first film roll R1a toward the holding section 230 and a position (non-restricting position) of not restricting the movement of the first film roll R1a toward the holding section 230.

[0074] Matters such as the timing at which the gate-driving unit 222 moves the gate 220 shall now be described hereinafter.

(2-2-3) Holding section

[0075] The holding section 230 is one example of a receiver to receive the first film roll R1a to be supplied to the bag-making and packaging machine 3.

[0076] The holding section 230 is, at least temporarily, placed adjacent to a supporting shaft 114 supporting a film roll R1 in the bag-making and packaging machine 3, as shown in FIG. 5. Specifically, the holding section 230 is placed in a position adjacent to the previously described supporting shaft 114 caused to move to the film roll replacement device.

[0077] The holding section 230 holds the first film roll R1a supplied to the bag-making and packaging machine 3. The holding section 230 also holds the second film roll R1b removed from the supporting shaft 114.

[0078] The holding section 230 has a first end portion 231a placed, in the left-right direction, on a far side of the supporting shaft 114 placed in the film roll replacement position, and a second end portion 231b placed on the side opposite to the first end portion 231a, on a side near the supporting shaft 114 placed in the film roll replacement position, as shown in FIG. 5. The holding section 230 holds the first film roll R1a supplied by the conveyor 210 and the second film roll R1b removed from the supporting shaft 114 between the first end portion 231a and the second end portion 231b, in an orientation such that the winding core WC extends in the left-right direction.

[0079] The holding section 230 has a first holding member 232 and a second holding member 234 as shown in FIGS. 5 and 6. The first holding member 232 and the second holding member 234 are arranged side by side in the front-rear direction. Specifically, the first holding member 232 is located behind the second holding member 234 (on the conveyor 210 side) as shown in FIGS. 5 and 6. The first holding member 232 and the second holding member 234 are flat members. However, the first holding member 232 and the second holding member 234 are not limited to being flat as long as the holding section 230 can function as described below. The first holding member 232 has a first holding surface 232a that supports the first film roll R1a, and the second holding member 234 has a second holding surface 234a that supports the first film roll R1a.

The first holding member 232 and second holding member 234 having flat-plate-shape are arranged so as to form a V shape in a right-side view, as in FIG. 6. In other words, the first holding member 232 and the second holding member 234 are arranged such that, in a right-side view and a left-side view, the first holding surface 232a and the second holding surface 234a form a V shape. In other words, the first holding member 232 and the second holding member 234 are arranged such that in a view along the axial directions of the supporting shafts 114 of the bag-making and packaging machine 3, the first holding surface 232a and the second holding surface 234a form a V shape. In other words, when the first holding member 232 and the second holding member 234 are viewed from a direction parallel to the first holding surface 232a and the second holding surface 234a, the first holding surface 232a and the second holding surface 234a are disposed in a V shape. In particular, a line perpendicular to the first holding surface 232a and a line perpendicular to the second holding surface 234a are orthogonal in this embodiment. However, the angle formed by a normal to the first holding surface 232a and a normal to the first holding surface 232a (i.e., an angle formed by the first holding surface 232a and the first holding surface 232a) may be different than 90°. For example, the angle formed by the first holding surface 232a and the first holding surface 232a may be less than 90°, as shown in FIG. 17A, or may be greater than 90°, as shown in FIG. 17B. An angle α formed by the first holding surface 232a and the second holding surface 234a (see FIGS. 17A and 17B) is preferably within a range of $90° \pm 30°$.

[0080] The first holding member 232 and the second holding member 234 arranged so as to form a V shape are spaced apart such that a gap 230a is formed between the first holding member 232 and the second holding member 234 in the trough of the V shape. In other words, the gap 230a is formed in a lower part of the holding section 230. A front-rear-directional width of the gap 230a is greater than an outer diameter of the winding cores WC of the film rolls R1. The gap 230a in the holding section 230 is used to allow passage of the winding core WC of the second film roll R1b, particularly the depleted film roll R1, which has been removed from the supporting shaft 114 and moved to the holding section 230, and to drop and discharge the winding core WC of the depleted film roll R1 into the winding-core-retrieving mechanism 270.

[0081] The holding section 230 is driven by the first driving unit 235, the second driving unit 236, and the third driving unit 237.

[0082] The first driving unit 235 rotates the holding section 230 about a rotation axis O that extends in a left-right direction, which is one example of a first direction, and is disposed at a predetermined position (see FIG. 14). For example, in a left-side view, the first driving unit 235 causes the holding section 230 to rotate about an intersection point X between a straight line imagined as an extension of the first holding surface 232a and a straight line imagined as an extension of the second holding surface 234a (see FIG. 14). Specifically, the first driving unit 235 rotates the holding section 230 about the rotation axis O, thereby changing an orientation of the holding section 230 between a first orientation and a second orientation (see FIG. 14). The first orientation is used when receiving the first film roll R1a. The second orientation is used when supplying the first film roll R1a to the bag-making and packaging machine 3. The first film roll R1a is supported in an orientation such that an axial direction of the first film roll R1a matches the left-right direction (first direction identical to a direction in which the rotation axis O extends) both when the holding section 230 is in the first orientation and when the holding section 230 is in the second orientation. When the holding section 230 is in the first orientation, the perpendicular line of the first holding surface 232a extends vertically and the perpendicular line of the second holding surface 234a extends horizontally. The first orientation of the holding section 230 shown here is merely one example. The orientation of the holding section 230 when inclined slightly such that the first holding surface 232a lowers from the rear toward the front may be the first orientation of the holding section 230. When the holding section 230 is in the second orientation, the line perpendicular to the first holding surface 232a is tilted 45° in relation to a horizontal plane, and the line perpendicular to the second holding surface 234a is also tilted 45° in relation to a horizontal plane. When the holding section 230 in the second orientation is viewed from the left, the first holding surface 232a is inclined 45° in relation to a vertical plane, and the second holding surface 234a is inclined 45° in relation to a vertical plane. In other words, when the holding section 230 in the second orientation is viewed from the left, the first holding surface 232a and the second holding surface 234a are arranged symmetrically with respect to a vertical plane V spreading in the up-down direction and the left-right direction (see FIG. 6). When the holding section 230 in the second orientation is viewed from the left, the first holding surface 232a and the second holding surface 234a form an upward-opening V shape. When the holding section 230 is in the second orientation, the first holding surface 232a and the second holding surface 234a support the film roll R1 on the holding section 230 from below.

[0083] The second driving unit 236 moves the holding section 230 in the up-down direction.

[0084] The third driving unit 237 moves the holding section 230 in the left-right direction. In other words, the third driving unit 237 moves the holding section 230 in the second orientation to the left so as to approach the supporting shaft 114 located in the film roll replacement position, and to the right so as to move away from the supporting shaft 114 located in the film roll replacement position.

[0085] The third driving unit 237 of the present embodiment moves the holding section 230, the right-side pushing member 240, and the left-side pushing member 250 simultaneously to the left and right. In other words, the third driving unit 237 moves the holding section 230 integrally with the right-side pushing member 240 and the left-side pushing member 250 to the left and right.

[0086] Further details regarding, *inter alia*, the timing at which the first driving unit 235, the second driving unit 236, and the third driving unit 237 move the holding section 230 and the transfer of the first film roll R1a from the conveyor 210 to the holding section 230 are described below.

(2-2-4) Right-side pushing member

[0087] The right-side pushing member 240 is a member placed adjacent to the first end portion 231a of the holding section 230, as shown in FIG. 5. The right-side pushing member 240 is a member that pushes a right end surface of the first film roll R1a held by the holding section 230.

[0088] The right-side pushing member 240 is driven in the up-down direction by the right-side pushing-member-driving unit 242. By driving the right-side pushing member 240 in the up-down direction, the right-side pushing-member-driving unit 242 moves the right-side pushing member 240 to a position (referred to as a contact position) where said member can come into contact with an end surface of the first film roll R1a. In addition, by driving the right-side pushing member 240 in the up-down direction, the right-side pushing-member-driving unit 242 moves the right-side pushing member 240 to a position (referred to as a non-contact position) where said member does not come into contact with the film rolls R1 mounted on the supporting shafts 114 of the bag-making and packaging machine 3.

[0089] Furthermore, the right-side pushing member 240 is driven in the left-right direction by the third driving unit 237. In particular, while the right-side pushing member 240 being in the contact position, the third driving unit 237 moves the right-side pushing member 240 to the left so that the right end surface of the first film roll R1a held by the holding section 230 is pushed by the right-side pushing member 240, and the first film roll R1a is moved leftward toward the supporting shaft 114 located in the film roll replacement position.

[0090] There are no particular limitations as to the shape of the right-side pushing member 240; said member has a substantially rectangular shape in a right-side view as in FIG. 8. In an upper part of the right-side pushing member 240 there is preferably formed a recess 240a that conforms to a shape of an outer diameter of the supporting shafts 114 of the bag-making and packaging machine 3. There are no particular limitations as to the shape; the recess 240a is, for example, U-shaped or V-shaped. For example, if the recess 240a is U-shaped, the recess 240a is substantial rectangular and a lower end part thereof is formed in a semicircular shape in a right-side view. Moreover, if the recess 240a is U-shaped, the recess 240a may be a semicircular recess in a right-side view as shown in FIG. 8. In the present disclosure, a semicircular recess 240a is formed in an upper part of the right-side pushing member 240. Preferably, a diameter A of the semicircle of the recess 240a is greater than a diameter D1 of the supporting shaft 114 on which the first film roll R1a is mounted, and is less than a diameter D2 of an outer circumference of the winding core WC of the first film roll R1a.

[0091] Reasoning for providing a recess 240a of these dimensions in the upper part of the right-side pushing member 240 shall now be described.

[0092] Normally in the first film roll R1a, an end surface of the winding core WC of the first film roll R1a is located farther to the outside in an axial direction of the winding core WC than the film F wound around the winding core WC. Should a recess 240a of the above mentioned dimensions be formed in the upper part of the right-side pushing member 240, the right-side pushing member 240 driven by the third driving unit 237 is able to push only the winding core WC of the first film roll R1a if the right-side pushing-member-driving unit 242 moves the right-side pushing member 240 in the up-down direction such that a bottom part of the recess 240a in the right-side pushing member 240 comes to be located in a vicinity below a lowest point of the supporting shaft 114 on which the first film roll R1a is to be mounted.

[0093] Should the film F be wound comparatively loosely around the winding core WC of the first film roll R1a, and the right-side pushing member 240 pushes only the portion of the F at the end surface of the first film roll R1a, there is a risk that part of the film F will be misaligned in the left-right direction and the film supply section 100 will not be able to convey the film F to an appropriate position in the bag-making and packaging section 3a. By contrast, if the right-side pushing member 240 pushes only the end surface of the winding core WC, the left-right-directional misalignment of part of the film F wound around the first film roll R1a can be suppressed even if the right-side pushing member 240 pushes the end surface of the first film roll R1a.

[0094] Even in cases in which the right-side pushing member 240 pushes the portion of the film F at the end surface of the first film roll R1a in addition to the end surface of the winding core WC, the left-right-directional misalignment of the film F in the first film roll R1a is suppressed by pushing at least the end surface of the winding core WC.

[0095] The shape of the right-side pushing member 240 is not limited to the U shape described here. For example, the right-side pushing member 240 may have a shape other than a U shape that can at least push the right end surface of the winding core WC without coming into contact with the supporting shaft 114.

[0096] If there are no disadvantages in particular, the right-side pushing member 240 may push only the portion of the film F on the right end surface of the first film roll R1a.

[0097] The manner in which the right-side pushing-member-driving unit 242 and the third driving unit 237 move the right-side pushing member 240 shall now be described hereinafter.

(2-2-5) Left-side pushing member

[0098] The left-side pushing member 250 is a member located adjacent to the second end portion 231b of the holding section 230 as shown in FIG. 5. The left-side pushing member 250 is a member that pushes the right end surface of the first film roll R1a mounted on a supporting shaft 114 of the bag-making and packaging machine 3. In addition, the left-side pushing member 250 is a member that pushes a left end surface of the second film roll R1b removed from a supporting shaft 114 of the bag-making and packaging machine 3.

[0099] The left-side pushing member 250 is driven in the up-down direction by the left-side pushing-member-driving unit 252. By driving the left-side pushing member 250 in the up-down direction, the left-side pushing-member-driving unit 252 moves the left-side pushing member 250 to a position (referred to as a contact position) where said member can come into contact with the end surface of the first film roll R1a and the end surface of the second film roll R1b. In addition, by driving the left-side pushing member 250 in the up-down direction, the left-side pushing-member-driving unit 252 moves the left-side pushing member 250 to a position (referred to as a non-contact position) where said member does not come into contact with the film rolls R1 mounted on the supporting shafts 114 of the bag-making and packaging machine 3.

[0100] Furthermore, the left-side pushing member 250 is driven in the left-right direction by the third driving unit 237.

[0101] With the left-side pushing member 250 in the contact position and the left-side pushing member 250 located on the right side of the first film roll R1a, the third driving unit 237 moves the left-side pushing member 250 to the left. At this time, the left-side pushing member 250 pushes the right end surface of the first film roll R1a in which the supporting shaft 114 is inserted into part of a hollow part of the winding core WC, and moves the first film roll R1a leftward to a predetermined position on the supporting shaft 114.

[0102] In addition, with the left-side pushing member 250 in the contact position and the left-side pushing member 250 located on the left side of the second film roll R1b, the third driving unit 237 moves the left-side pushing member 250 to the right. At this time, the left-side pushing member 250 pushes the left end surface of the second film roll R1b in which the supporting shaft 114 is supported, and moves the second film roll R1b to the holding section 230.

[0103] There are no particular limitations as to the shape of the left-side pushing member 250; said member is substantially rectangular in a left-side view as in FIG. 9. In an upper part of the left-side pushing member 250 is formed a recess 250a having the same shape as the recess 240a of the right-side pushing member 240. Because the shape of the recess 250a is the same as the shape of the recess 240a, details of the shape of the recess 250a shall not be described. Due to the recess 250a being formed in the upper part of the left-side pushing member 250, the left-side pushing member 250 can push the winding core WC of the first film roll R1a and the winding core WC of the second film roll R1b.

[0104] The shape of the left-side pushing member 250 is not limited to a U shape. For example, the left-side pushing member 250 may have a shape other than a U shape that can at least push the right end surface of the winding core WC of the first film roll R1a or the left end surface of the winding core WC of the second film roll R1b without coming into contact with the supporting shaft 114.

[0105] If there are no disadvantages in particular, the left-side pushing member 250 may push only the portion of the film F on the right end surface of the first film roll R1a.

[0106] There are some cases in which almost no film F remains on the second film roll R1b when the second film roll R1b is removed from the supporting shaft 114. Therefore, the left-side pushing member 250 preferably pushes at least the left end surface of the winding core WC when the second film roll R1b is removed from the supporting shaft 114.

[0107] The manner in which the left-side pushing-member-driving unit 252 and the third driving unit 237 move the left-side pushing member 250 shall now be described hereinafter.

(2-2-6) Stopper

[0108] The stopper 260 is a member for closing the gap 230a in the holding section 230 in the second orientation (see FIG. 6) and preventing the second film roll R1b removed from the supporting shaft 114 from falling from the gap 230a into the winding-core-retrieving mechanism 270 below.

[0109] The stopper 260 is driven by the stopper-driving unit 262 to move between a closed position at which the gap 230a is closed and an open position at which the gap 230a is not closed. When the stopper 260 is placed in the closed position, the stopper 260 prevents the winding core WC of the second film roll R1b from falling into the winding-core-retrieving mechanism 270. When the stopper 260 is placed in the open position, the stopper 260 allows the winding core WC of the second film roll R1b to fall into the winding-core-retrieving mechanism 270.

[0110] The timings at which the stopper-driving unit 262 moves the stopper 260 shall now be described hereinafter.

(2-2-7) Winding-core-retrieving mechanism

[0111] The winding-core-retrieving mechanism 270 is a mechanism that retrieves the second film roll R1b removed from the supporting shaft 114 and fallen from the gap 230a in the holding section 230 in the second orientation. Particularly, the winding-core-retrieving mechanism 270 is a mechanism for retrieving the winding core WC of a depleted film roll R1 serving as the second film roll R1b falling from the gap 230a in the holding section 230 in the second orientation.

[0112] The second film roll R1b fallen from the gap 230a in the holding section 230 slides down an inclined surface 272 of the winding-core-retrieving mechanism 270 and is retrieved in a retrieval area 274 directly below the conveyor 210 (see FIG. 6). The manner of retrieving the second film roll R1b fallen from the gap 230a in the holding section 230 may be designed as appropriate.

(2-2-8) First member and encoder

[0113] The first member 280 and the encoder 284 are components used to measure a diameter of the first film roll R1a supplied to the bag-making and packaging machine 3.

[0114] The first member 280 is located above the conveyor 210.

[0115] The first member 280 is located in a predetermined first position (standby position) when not being used to measure the diameter of the first film roll R1a. The first position is a position at which the first member 280 does not come into contact with the first film roll R1a conveyed along the conveyor 210, even if the first member 280 had been present in the first position. When the first member 280 is used to measure the diameter of the first film roll R1a, the first-member-driving unit 282 downwardly moves the first member 280 to a second position where contact is made with an outer peripheral surface (upper end) of the first film roll R1a carried on the conveyor 210.

[0116] The first-member-driving unit 282 in this embodiment is a motor to which the encoder 284 is attached. The encoder 284 measures an amount of rotational displacement of the motor when the first-member-driving unit 282 moves the first member 280 from the first position to the second position, and transmits to the controller 290 (described hereinafter) a signal corresponding to the measured amount of rotational displacement.

[0117] The controller 290, serving as a first measuring unit, calculates a distance the first member 280 moves from the first position to the second position based on the signal of the encoder 284. Furthermore, the controller 290 measures the diameter of the first film roll R1a on the conveyor 210 based on the calculated distance that the first member 280 moves.

(2-2-9) Distance sensor

[0118] The distance sensor 286 is a sensor that contactlessly measures a distance from a predetermined reference position to the outer peripheral surface of the film roll R1. For example, the distance sensor 286 is located directly below the gap 230a in the holding section 230. There are no limitations as to the type of the distance sensor 286; for example, the distance sensor 286 is a laser distance sensor. The distance sensor 286 can measure a distance from a reference position where the distance sensor 286 is located to the outer peripheral surface of the film roll R1 carried on the holding section 230, or to the outer peripheral surface of the film roll R1 mounted on the supporting shaft 114.

[0119] The application of the distance sensor 286 shall now be described hereinafter.

(2-2-10) Controller

[0120] The controller 290 is a device that controls the actions of the components of the film roll replacement device 200. The controller 290 has, for example, a CPU, storage devices such as a main storage device and an auxiliary storage device, an input/output device, and various electric circuits and electronic circuits.

[0121] The controller 290 is electrically connected to the conveyor 210, the gate-driving unit 222, the first driving unit 235, the second driving unit 236, the third driving unit 237, the right-side pushing-member-driving unit 242, the left-side pushing-member-driving unit 252, the stopper-driving unit 262, the first-member-driving unit 282, and the encoder 284, as shown in FIG. 7. The controller 290 controls actions of the conveyor 210, the gate-driving unit 222, the first driving unit 235, the second driving unit 236, the third driving unit 237, the right-side pushing-member-driving unit 242, the left-side pushing-member-driving unit 252, the stopper-driving unit 262, and the first-member-driving unit 282. In addition, the controller 290 receives signals output by the encoder 284 and the distance sensor 286. In addition, the controller 290 is communicably connected to the packaging machine controller 4 of the bag-making and packaging machine 3.

[0122] The controller 290 controls the actions of the components of the film roll replacement device 200 and causes the film roll replacement device 200 to execute actions such as the following due to the CPU executing programs stored in the storage devices.

[0123] The controller 290 removes a film roll R1 (the second film roll R1b) that has been used or has experienced interrupted use from the supporting shaft 114. The controller 290 also moves the holding section 230 to align a height position of a center of a replacement film roll R1 (the first film roll R1a) held by the holding section 230 and a height position of a center of the supporting shaft 114 on which the first film roll R1a is to be mounted. The controller 290 also moves the holding section 230 to the left to move the first film roll R1a held by the holding section 230 to a supporting part 112 of the bag-making and packaging machine 3 (to the supporting shaft 114 of the supporting part 112).

[0124] Below is a description, made with reference to FIGS. 10 to 13, of the manner in which the film roll replacement device 200 removes the second film roll R1b from the supporting shaft 114 and mounts the replacement first film roll R1a on the supporting shaft 114. FIGS. 10A to 10E are schematic plan views of part of the film roll replacement device 200, and are intended to illustrate the actions of the film roll replacement device 200 when the second film roll R1b is removed from the supporting shaft 114 of the bag-making and packaging machine 3. FIG. 11 is a schematic left-side view for illustrating the actions of the film roll replacement device 200 when the second film roll R1b is removed from the supporting shaft 114 of the bag-making and packaging machine 3. FIGS. 12A to 12E are schematic left-side views of part of the film roll replacement device 200 and are intended to illustrate movement of the first film roll R1a to the holding section 230 and adjustment of a height position of the holding section 230. FIGS. 13A to 13E are schematic plan views of part of the film roll replacement device 200 and are intended to illustrate the mounting of the first film roll R1a on the supporting shaft 114 of the bag-making and packaging machine 3 by the film roll replacement device 200.

(A) Removal of second film roll from supporting shaft of bag-making and packaging machine

[0125] When a request to replace a film roll R1 is transmitted from the packaging machine controller 4, the controller 290 first removes the film roll R1 (second film roll R1b) from the supporting shaft 114 of the bag-making and packaging machine 3.

[0126] Though not an action of the film roll replacement device 200, the action of the bag-making and packaging machine 3 when the packaging machine controller 4 transmits a request to replace a film roll R1 shall first be described. Particularly, the action of the bag-making and packaging machine 3 shall now be described regarding when the film F is used up from the film roll R1 that had so far been used in the bag-making and packaging machine 3.

[0127] The packaging machine controller 4 senses that the film F of the film roll R1 used so far has been used up based on, for example, movement of the movable rollers 185 detected based on a signal output by the encoder 188. Upon sensing that the film F of the film roll R1 has been used up, the packaging machine controller 4 controls the joining mechanism 160 to join the vicinity of the trailing end of the film F of the depleted film roll R1 and the vicinity of the leading end of the film F of the replacement film roll R1. The packaging machine controller 4 also controls the cutting mechanism 162 to cut the film F of the depleted film roll R1 at a predetermined position.

[0128] The packaging machine controller 4 then drives the frame-driving unit 132 to move the supporting shaft 114 supporting the replaced film roll R1 (the film roll R1 to be used for packaging from this point onward) to the film supply position and move the supporting shaft 114 supporting the depleted film roll R1 to the film roll replacement position.

[0129] At this time, if the frame-driving unit 132 happens to be driven without the film F of the depleted film roll R1 having been cut, there is a risk of an adverse event such as the film F becoming entangled in the rollers 170 of the bag-making and packaging machine 3.

[0130] Before driving the frame-driving unit 132, the packaging machine controller 4 preferably controls the support-shaft-driving unit 116 to cause the supporting shaft 114 supporting the depleted film roll R1 to rotate in a direction of winding the film F. At this time, if the film F of the depleted film roll R1 and the film F extending toward the bag-making and packaging machine 3 remain connected, the movable rollers 185 are moved upward. Therefore, the packaging machine controller 4 can sense based on the sensing result from the encoder 188 that the depleted film roll R1 and the bag-making and packaging section 3a are connected by the film F pulled out from the depleted film roll R1. When the depleted film roll R1 and the bag-making and packaging section 3a remain connected by the film F, the packaging machine controller 4 does not perform control to drive the frame-driving unit 132, and, for example, causes the bag-making and packaging machine 3 and the film roll replacement device 200 to stop due to an error.

[0131] After having moved the supporting shaft 114 supporting the second film roll R1b to the film roll replacement position and before transferring the second film roll R1b to the holding section 230, the packaging machine controller 4 preferably controls the action of the support-shaft-driving unit 116 to cause the supporting shaft 114 supporting the second film roll R1b to rotate and to wind the film F of the second film roll R1b on the winding core WC. Due to this configuration, it is possible to suppress adverse events such as when the film F remaining on the second film roll R1b is entangled with the various components of the film roll replacement device 200, and the winding core WC of the second film roll R1b to be discharged to the winding-core-retrieving mechanism 270 is not discharged to the winding-core-retrieving mechanism 270.

[0132] An amount of winding of the film F of the second film roll R1b (an amount of rotation of the supporting shaft 114 on which the second film roll R1b is mounted) is preferably determined based on a film roll diameter of the second film roll R1b so that the film F does not hang down from the second film roll R1b.

[0133] To realize this objective, for example, the film roll replacement device 200 moves the holding section 230 to be directly below the supporting shaft 114 placed in the film supply position before the packaging machine controller 4 actuates the support-shaft-driving unit 116 in order to wind the film F. The film roll replacement device 200 then causes the distance sensor 286 to measure the distance from the distance sensor 286 to the outer peripheral surface (lowest part) of the second film roll R1b. The controller 290 of the film roll replacement device 200 then measures (calculates) the film roll diameter of the second film roll R1b based on a value measured by the distance sensor 286 and a positional relationship between the distance sensor 286 and the supporting shaft 114 disposed in the film supply position stored in advance in a storage device. The controller 290 then transmits the measured film roll diameter of the second film roll R1b to the packaging machine controller 4. The packaging machine controller 4 determines the winding amount of the film F of the second film roll R1b (the rotation amount of the supporting shaft 114) based on the received film roll diameter of the second film roll R1b so that the film F does not hang down from the second film roll R1b.

[0134] In this embodiment, the controller 290 of the film roll replacement device 200 measures the film roll diameter of the second film roll R1b, but as an alternative, the packaging machine controller 4 may measure (calculate) the film roll diameter of the second film roll R1b based on the value measured by the distance sensor 286. In this embodiment, the value measured by the distance sensor 286 is used to measure the film roll diameter of the second film roll R1b, but this feature is not provided by way of limitation; for example, the film roll diameter of the second film roll R1b may be measured based on a value measured by a distance sensor (not shown in the figure) provided to the bag-making and packaging machine 3.

[0135] The packaging machine controller 4, for example, transmits a request to replace a film roll R1 to the controller 290 of the film roll replacement device 200 immediately before the action of winding the film F onto the winding core WC of the second film roll R1b. The timing at which the packaging machine controller 4 transmits the request to replace a film roll R1 to the controller 290 may be determined as appropriate unless there is no contradiction. For example, if the film roll diameter of the second film roll R1b is not measured using the value measured by the distance sensor 286 when the film F is wound onto the winding core WC of the second film roll R1b, the timing at which the packaging machine controller 4 transmits a request to replace a film roll R1 to the controller 290 may occur after the action of winding the film F onto the winding core WC of the second film roll R1b.

[0136] Now, description of the removal of the second film roll R1b from the supporting shaft 114 disposed in the film roll replacement position performed by the film roll replacement device 200 is made, with reference to FIGS. 10A to 10D and FIG. 11. The following description is merely one example of the action of removing the second film roll R1b performed by the film roll replacement device 200, and may be changed as appropriate.

[0137] It is presumed in the description below that at the point in time depicted in FIG. 10A, there is no film roll R1 on the holding section 230, the holding section 230 is disposed in a position adjacent to the front of the gate 220, and the right-side pushing member 240 and the left-side pushing member 250 are disposed in the non-contact position previously described. Also at the point in time depicted in FIG. 10A, the gap 230a in the holding section 230 is closed by the stopper 260.

[0138] When the controller 290 receives a request to replace the film roll R1 from the packaging machine controller 4, the controller 290 controls the action of the third driving unit 237 to move the holding section 230 from the position depicted in FIG. 10A, which is adjacent to the gate 220, leftward to a position directly below the supporting shaft 114 disposed in the film roll replacement position of FIG. 10B. At this time, the controller 290 controls the second driving unit 236 to move the holding section 230 to the lowest position in the vertical movable range so that the holding section 230 does not come into contact with the supporting shaft 114 or the second film roll R1b mounted on the supporting shaft 114.

[0139] When the holding section 230 is located directly below the supporting shaft 114 as in FIG. 10B, the distance sensor 286 measures the distance from the distance sensor 286 to the outer peripheral surface (the lowest part) of the second film roll R1b.

[0140] Preferably, the packaging machine controller 4, based on the value measured by the distance sensor 286, causes the supporting shaft 114 supporting the second film roll R1b to rotate to wind the film F of the second film roll R1b onto the winding core WC before the second film roll R1b is transferred to the holding section 230, as previously described. The packaging machine controller 4 then causes the fixing mechanism to cease fixing the supporting shaft 114 and the second film roll R1b together.

[0141] Based on the positional relationship between the distance sensor 286 and the holding section 230 stored in advance in a storage device, and the distance from the distance sensor 286 to the outer peripheral surface of the second film roll R1b, the controller 290 measures the distance in the up-down direction between the holding section 230 (a predetermined representative location on the holding section 230) and the outer peripheral surface of the second film roll R1b supported by the supporting shaft 114.

[0142] Next, the controller 290 controls the second driving unit 236 and adjusts the height position of the holding section 230 based on the distance in the up-down direction between the holding section 230 and the outer peripheral surface of the second film roll R1b supported by the supporting shaft 114. Specifically, the controller 290 controls the second driving unit 236 and moves the holding section 230 near to the second film roll R1b.

[0143] The controller 290 also controls the action of the left-side pushing-member-driving unit 252 and raises the left-side pushing member 250 to a position (the previously-described contact position) where the left-side pushing member 250 does not come into contact with the supporting shaft 114 and the left-side pushing member 250 comes into contact with the winding core WC of the second film roll R1b.

[0144] Next, the controller 290 controls the action of the third driving unit 237 and moves the holding section 230 rightward from the position depicted in FIG. 10B to the position in FIG. 10C (the position where the holding section 230 is located at the point in time of FIG. 10A). Through this process, the second film roll R1b is pushed and moved by the left-side pushing member 250 onto the holding section 230 as is depicted in FIG. 10C.

[0145] Upon moving the holding section 230 to the position depicted in FIG. 10C, the controller 290 controls the action of the left-side pushing-member-driving unit 252 and moves the left-side pushing member 250 to the previously-described non-contact position.

[0146] Next, the controller 290 causes the stopper 260 to be moved to the open position by the stopper-driving unit 262. As a result, the second film roll R1b (the winding core WC of the second film roll R1b) falls from the gap 230a in the holding section 230. The detection result from the distance sensor 286 can be used to determine whether or not the second film roll R1b has fallen safely.

[0147] In this embodiment, it is assumed that the second film roll R1b is the depleted film roll R1, but it is acceptable if the controller 290 does not cause the stopper-driving unit 262 to drive the stopper when the second film roll R1b is a film roll R1 with film F still remaining (a film roll R1 of which use has been interrupted in the bag-making and packaging machine 3). For example, in this case, the controller 290 may, using an output device (a display, a speaker, or the like) (not shown in the figure), issue a notification that the film roll R1 with remaining film F is present in the holding section 230. Based on this notification, a worker takes out the film roll R1 with remaining film present in the holding section 230.

[0148] When the controller 290 has caused the stopper 260 to be moved by the stopper-driving unit 262 to the open position, the second film roll R1b, after falling from the gap 230a in the holding section 230, slides down the inclined surface 272 of the winding-core-retrieving mechanism 270 to be retrieved in the retrieval area 274 located directly below the conveyor 210, as shown in FIG. 11.

(B) Mounting of first film roll on supporting shaft of bag-making and packaging machine

[0149] When removal of the second film roll R1b from the supporting shaft 114 of the bag-making and packaging machine 3 is complete, the controller 290 supplies the first film roll R1a to the bag-making and packaging machine 3 and mounts the first film roll R1a on the supporting shaft 114.

[0150] The movement of the first film roll R1a to the holding section 230 and the adjustment of the height position of the holding section 230 shall first be described with reference to FIGS. 12A to 12E. The mounting of the first film roll R1a onto the supporting shaft 114 of the bag-making and packaging machine 3, performed by the film roll replacement device 200, shall then be described with reference to FIGS. 13A to 13E.

(B-1) Movement of first film roll to holding section and adjustment of height position of holding section

[0151] It is presumed in the description below that at the point in time depicted in FIG. 12A, a film roll R1 is not present on the holding section 230, and the holding section 230, which is in the second orientation previously described, is located in a position (initial position) adjacent to the front of the gate 220. In addition, at the point in time depicted in FIG. 12A, the gate 220 is in a position where the first film roll R1a is restricted from moving toward the holding section 230, and the first film roll R1a is being carried on the conveyor 210 in a position adjacent to the gate 220. A configuration is preferably adopted such that when the holding section 230 is in the second orientation, the first film roll R1a is restricted from moving from the conveyor 210 to the holding section 230 by the first holding member 232 so that the first film roll R1a cannot move onto the holding section 230 (see FIG. 12A). Adopting this configuration makes it possible to suppress the situation where the first film roll R1a moves from the conveyor 210 to the holding section 230 at an unintended timing even when the gate 220 is omitted. The first member 280 is located in the above-described first position where the first member 280 is apart from the first film roll R1a and above the first film roll R1a.

[0152] In this state, the controller 290 causes the first-member-driving unit 282 to move the first member 280 to a second position where contact is made with the outer peripheral surface (upper end) of the first film roll R1a carried on the conveyor 210 (see FIG. 12B).

[0153] When the first-member-driving unit 282 has moved the first member 280 from the first position to the second position, the controller 290 receives a signal, sent by the encoder 284, corresponding to an amount of rotational displacement of a motor (the first-member-driving unit 282). The controller 290 calculates the distance the first member 280 moves from the first position to the second position based on the signal of the encoder 284. Furthermore, the controller 290, serving as a first measuring unit, measures (calculates) the diameter of the first film roll R1a on the conveyor 210 based on the calculated movement distance of the first member 280. For example, a distance from the first position to a conveying surface (the surface on which the first film roll R1a is carried) of the conveyor 210 is stored in advance in a storage device of the controller 290. The controller 290 calculates the diameter of the first film roll R1a by subtracting the distance the first member 280 moves from the first position to the second position, from the distance from the first position to the conveying surface of the conveyor 210.

[0154] Next, the controller 290 causes the first-member-driving unit 282 to move the first member 280 to the first position where contact is not made with the outer peripheral surface of the first film roll R1a.

[0155] Next, the controller 290 controls the action of the first driving unit 235 to cause the holding section 230 to rotate and change the orientation of the holding section 230 from the second orientation to the first orientation. The holding section 230 in the first orientation allows the first film roll R1a to move from the conveyor 210 to the holding section 230. Particularly, in the present embodiment, when the holding section 230 is in the first orientation, the first holding surface 232a is horizontal. The controller 290 controls the action of the first driving unit 235 to cause the holding section 230 to rotate 45° counterclockwise in a left-side view, and changes the orientation of the holding section 230 from the second orientation to the first orientation (see FIG. 12C). For example, if the holding section 230 on the first holding surface 232a slightly inclined so as to lower from rear to front is defined as the holding section 230 in the first orientation, the angle at which the controller 290 causes the holding section 230 to rotate may be determined, as appropriate, to be a predetermined angle other than 45°.

[0156] The controller 290 also controls the action of the gate-driving unit 222 to move the gate 220 to a position where the first film roll R1a is not restricted from moving toward the holding section 230 (see FIG. 12C). The controller 290 also controls the action of the conveyor 210 to move the first film roll R1a to the holding section 230 (see FIG. 12C).

[0157] A conveyor surface 210a of the conveyor 210 on which the first film roll R1a is placed preferably supports the first film roll R1a at the same height as that of the first film roll R1a transferred to the holding section 230 in the first orientation 230, as shown in FIG. 18A. However, the conveyor surface 210a of the conveyor 210 may instead support the first film roll R1a at a location higher than the height at which the first film roll R1a is transferred to the holding section 230 in the first orientation, as shown in FIG. 18B. Adopting this configuration makes it possible for the first film roll R1a to be moved to the holding section 230 without being lifted on the conveyor 210.

[0158] In the present embodiment, when the first film roll R1a is transferred from the conveyor 210 to the holding section 230 in the first orientation, the first film roll R1a moves on the conveyor surface 210a of the conveyor 210, which is one example of a preliminary placement surface, and on the first holding surface 232a of the first holding member 232 of the holding section 230. In order to facilitate movement of the first film roll R1a, the conveyor surface 210a and the first holding surface 232a are parallel as shown in FIG. 18A when, for example, the first film roll R1a is moving on the conveyor surface 210a and the first holding surface 232a. The first holding surface 232a more preferably is downwardly inclined from a proximal side toward a distal side relative to the conveyor 210, as shown in FIG. 19, when the first film roll R1a is moving on the conveyor surface 210a and the first holding surface 232a. Adopting this configuration makes it possible for the first film roll R1a on the conveyor 210 to be moved onto the holding section 230 without being lifted.

[0159] Additionally, at least when the first film roll R1a moves on the conveyor surface 210a and the first holding surface 230a, the conveyor surface 210a may be configured to be downwardly inclined toward the holding section 230 as shown in FIG. 20. Adopting this configuration makes it possible for the first film roll R1a to be moved to the holding section 230 even if the conveyor 210 is not operated or if the conveyor 210 does not have a drive source. The conveyor 210 may be attached to the film roll replacement device 200 such that the conveyor surface 210a is downwardly inclined toward the holding section 230. Alternatively, the conveyor 210 may have a driving unit (not shown) for changing an inclination of the conveyor 210, and the controller 290 may change an orientation of the conveyor 210 such that the conveyor surface 210a is downwardly inclined toward the holding section 230 at a necessary timing.

[0160] When the holding section 230 is in the first orientation, the second holding surface 234a of the second holding member 234 of the holding section 230 restricts movement of the first film roll R1a that moves on the first holding surface 232a from the proximal side toward the distal side relative to the conveyor 210. Thus, due to the holding section 230 having the second holding surface 234a to restrict movement of the first film roll R1a that moves on the first holding surface 232a from the proximal side toward the distal side relative to the conveyor 210, it is possible to suppress adverse events, such as the first film roll R1a that has moved onto the holding section 230 falling from the holding section 230 or failing to be disposed at a desired position on the holding section 230.

[0161] When the first film roll R1a has moved onto the holding section 230, the controller 290 then controls the action of the first driving unit 235 to cause the holding section 230 to rotate, and changes the orientation of the holding section 230 from the first orientation to the second orientation. Particularly, in the present embodiment, because the holding section 230 with the horizontal first holding surface 232a is the holding section 230 in the first orientation, the controller 290 controls the action of the first driving unit 235 to cause the holding section 230 to rotate 45° clockwise in a left-side view, and changes the orientation of the holding section 230 from the first orientation to the second orientation (see FIG. 12C). For example, if the holding section 230 on the first holding surface 232a slightly inclined so as to lower from rear to front is defined as the holding section 230 in the first orientation, the angle at which the controller 290 causes the holding section 230 to rotate may be determined, as appropriate, to be a predetermined angle other than 45°.

[0162] The controller 290 also controls the action of the gate-driving unit 222 to move the gate 220 to a position where the first film roll R1a is restricted from moving toward the holding section 230 (see FIG. 12D). The controller 290 also stops the action of the conveyor 210.

[0163] Next, based on the measured diameter of the first film roll R1a, the controller 290 controls the action of the second driving unit 236 to move the holding section 230 to a position where the height position of the center of the first film roll R1a held in the holding section 230 is aligned with the height of the center of the supporting shaft 114 disposed in the film roll replacement position.

[0164] For example, specifically, the controller 290 changes the height position of the holding section 230 in the following manner. The description shall be made with reference to FIG. 14. FIG. 14 is an enlarged view of the holding section 230 of the film roll replacement device 200, and is a drawing for describing a method of measuring the height position to the center of the first film roll R1a.

[0165] It is presumed in the description below that the storage device of the controller 290 has stored therein information on the height position of the center of the supporting shaft 114 disposed in the film roll replacement position (e.g., a height H1 from a floor surface to the center of the supporting shaft 114). It is also presumed in the description below that the controller 290 ascertains, for example, a height position that is the current location of the intersection point X between a straight line imagined as an extension of the first holding surface 232a and a straight line imagined as an extension of the second holding surface 234a in a left-side view (e.g., a height h1 from the floor surface to the intersection point X).

[0166] Under such conditions, the controller 290 calculates in the following manner the height position of the center of the first film roll R1a currently held by the holding section 230. Because the height h1 from the floor surface to the intersection point X is known at present, the height from the floor surface to the center (represented by symbol C) of the first film roll R1a can be determined when the value of h2 is determined in FIG. 14. The controller

290 has calculated the diameter D of the first film roll R1a as previously described. In addition, in a left-side view, an angle θ formed between a straight line connecting the intersection point X and the center C and a line perpendicular to the first holding surface 232a is determined according to the design of the holding section 230 and is therefore known. Therefore, using a trigonometric function, h2 can be calculated by the formula $D/2\cos\theta$. The controller 290 calculates the height position of the center of the first film roll R1a currently held by the holding section 230 by adding the value h1 and the value h2 together. When the height position of the center of the first film roll R1a currently held by the holding section 230 is calculated and the holding section 230 is moved upward by a distance of $\Delta h = H1-(h1+h2)$, the height position of the center of the first film roll R1a held by the holding section 230 will be aligned with the height position of the center of the supporting shaft 114 disposed in the film roll replacement position.

[0167] The controller 290 then controls the action of the second driving unit 236 to move the holding section 230 upward by a distance of Δh from the position drawn in double-dash lines to the position drawn in solid lines, as in FIG. 12E. As a result, the height position of the center of the first film roll R1a held by the holding section 230 is aligned with the height position of the center of the supporting shaft 114 disposed in the film roll replacement position. If the value of Δh is negative, the holding section 230 is caused to move downward.

[0168] Due to the structure of the holding section 230, the center C of the first film roll R1 held in the holding section 230 is disposed in the same position as the intersection point X previously described in the front-rear direction. In other words, in a left-side view, the center of the first film roll R1 held in the holding section 230 is disposed on a straight line extending in the vertical direction through the intersection point X. Therefore, if the film roll replacement device 200 is designed such that the front-rear-directional position of the intersection point X does not change, there is no need, in the front-rear direction, to adjust the position of the center of the first film roll R1a held in the holding section 230 and the position of the center of the supporting shaft 114 disposed in the film roll replacement position.

[0169] The film roll replacement device 200 preferably has, for example, both an electric cylinder and an air cylinder as the second driving unit 236. The reason therefor shall now be described.

[0170] Even, for example, using only an electric cylinder as the second driving unit 236, the film roll replacement device 200 can move the holding section 230 to a position where the height position of the center of the first film roll R1a held by the holding section 230 is aligned with the height of the center of the supporting shaft 114 disposed in the film roll replacement position. However, since the first film roll R1a is a heavy object, a large electric cylinder will be needed if the holding section 230 carrying the first film roll R1a is to be moved by an electric cylinder alone. Therefore, the film roll replacement device 200 preferably uses an air cylinder in addition to an electric cylinder.

[0171] As a specific control, for example, when moving the holding section 230, the controller 290 controls an electro-pneumatic regulator (not shown in the figure) to gradually increase an internal pressure of the air cylinder. When a slight movement of the holding section 230 (a movement of the first film roll R1a held in the holding section 230) is sensed using the distance sensor 286 or the like, the controller 290 controls the electric cylinder to bring the height position of the center of the first film roll R1a held in the holding section 230 into alignment with the height of the center of the supporting shaft 114 disposed in the film roll replacement position while pressure generated by the electro-pneumatic regulator (not shown in the figure) is kept constant.

(B-2) Mounting of first film roll onto supporting shaft of bag-making and packaging machine

[0172] The following is a description of how the first film roll R1a is mounted onto the supporting shaft 114 by the film roll replacement device 200 after the height position of the center of the first film roll R1a held by the holding section 230 and the height position of the center of the supporting shaft 114 disposed in the film roll replacement position have come into alignment.

[0173] It is presumed in the description below that at the point in time depicted in FIG. 13A, as seen in plan view, the holding section 230 is disposed in front of the gate 220 in an adjacent position (initial position), and the right-side pushing member 240 and the left-side pushing member 250 are disposed in the non-contact positions previously described.

[0174] First, the controller 290 controls the action of the right-side pushing-member-driving unit 242 to move the right-side pushing member 240 to a contact position where said member can be in contact with the right end surface of the first film roll R1a, and particularly a contact position where said member can at least be in contact with the winding core WC of the first film roll R1a.

[0175] Next, the controller 290 controls the action of the third driving unit 237 to move the holding section 230 from the initial position leftward toward the supporting shaft 114 disposed in the film roll replacement position in FIG. 13B on the left side, and transfer the first film roll R1a held in the holding section 230 to the supporting part 112. This step shall now be described in detail.

[0176] When the controller 290 controls the action of the third driving unit 237 to move the holding section 230 leftward, the supporting shaft 114 is inserted into the hollow part of the winding core WC of the first film roll R1a held by the holding section 230, and the first film roll R1a of the holding section 230 is transferred to the supporting shaft 114. Particularly, when there is little difference between the outer diameter of the supporting shaft 114 and a diameter of the hollow part of the winding core WC, there are cases in which even if the holding section 230 is moved to the left, the first film roll R1a will not move to the left beyond a certain point due to friction between an inner surface of the hollow part of the winding core WC and an outer surface of the supporting shaft 114. However, because the right-side pushing member 240 is disposed adjacent to the first end portion 231a (right end portion) of the holding section 230, when the first film roll R1a comes to be disposed to the right of the first end portion 231a of the holding section 230, a right end surface of the first film roll R1a is pushed by the right-side pushing member 240 driven by the third driving unit 237, and the supporting shaft 114 is inserted deeper into the hollow part of the winding core WC of the first film roll R1a (see FIG. 13B). In other words, at this time, the controller 290 controls the action of the third driving unit 237 to cause the end surface of the first film roll R1a held by the holding section 230 to be pushed by the right-side pushing member 240 and the first film roll R1a moves to the supporting shaft 114.

[0177] When the region over which the holding section 230 can move left is sufficiently wide, the supporting shaft 114 can be sufficiently inserted into the hollow part of the winding core WC of the first film roll R1a by the right-side pushing member 240 alone, and the first film roll R1a can be set at a predetermined position on the supporting shaft 114.

[0178] Such a design makes it necessary to ensure sufficient area for the holding section 230 to move, presenting a possibility that the floor area required for installing the bag-making and packaging machine 3 and the film roll replacement device 200 will increase. Therefore, the film roll replacement device 200 is preferably designed as follows.

[0179] When the second end portion 231b of the holding section 230 reaches the vicinity of a supporting end of the supporting shaft 114, the controller 290 controls the action of the second driving unit 236 to move the holding section 230 slightly downward, and controls the action of the third driving unit 237 to move the holding section 230 rightward to the initial position.

[0180] The controller 290 then controls the action of the right-side pushing-member-driving unit 242 to move the right-side pushing member 240 to the non-contact position. The controller 290 also controls the action of the left-side pushing-member-driving unit 252 to move the left-side pushing member 250 to a contact position where said member can be in contact with the right end surface of the first film roll R1a that has been moved to the supporting shaft 114, and particularly a contact position where said member can at least be in contact with the right end surface of the winding core WC of the first film roll R1a.

[0181] Next, the controller 290 controls the action of the third driving unit 237 to move the holding section 230 and the left-side pushing member 250 to the left to a predetermined position (the position depicted in FIG. 13D). This predetermined position is determined in advance according to factors such as the dimensions of the film rolls R1 to be used. As a result of the controller 290 controlling the actions of the film roll replacement device 200 in this manner, the first film roll R1a is positioned by the left-side pushing member 250 to be disposed in an appropriate position on the supporting shaft 114.

[0182] In the state depicted in FIG. 13D, the left-side pushing member 250 and the supporting shaft 114 are disposed in overlapping positions in the left-right direction. However, because the recess 250a is formed as previously described in the left-side pushing member 250, the supporting shaft 114 and the left-side pushing member 250 do not come into contact even if the left-side pushing member 250 and the supporting shaft 114 are disposed in overlapping positions in the left-right direction.

[0183] The controller 290 then issues a notification to the packaging machine controller 4 that the supply of the first film roll R1a to the supporting shaft 114 has ended. The controller 290 also controls the action of the third driving unit 237 to move the holding section 230 to the initial position (the same position as that depicted in FIG. 13A) at a predetermined timing (see FIG. 13E). The controller 290 controls the action of the left-side pushing-member-driving unit 252 to move the left-side pushing member 250 to the non-contact position described above (see FIG. 13E). Furthermore, the controller 290 controls the action of the second driving unit 236 to move the holding section 230 to the height position depicted in FIG. 12A at a predetermined timing.

[0184] If the timing at which the controller 290 moves the holding section 230 to the initial position and moves the left-side pushing member 250 to the non-contact position is delayed until the timing at which the packaging machine controller 4 controls the action of the fixing mechanism of the supporting shaft 114 to fix the first film roll R1a and the supporting shaft 114 together, the left-side pushing member 250 can also be given the function of restricting the position of the first film roll R1a.

[0185] Though this is not a detail pertaining to the actions of the film roll replacement device 200, at the point in time when the supply of the first film roll R1a to the supporting shaft 114 has ended and the first film roll R1a has been fixed to the supporting shaft 114, the packaging machine controller 4 preferably causes the first film roll R1a to rotate via the support-shaft-driving unit 116 and reads a bar code or matrix-type two-dimensional code (not shown in the figure) on the film roll R1 via the scanner 190 disposed near the supporting shaft 114 disposed in the film roll replacement position. The packaging machine controller 4 then preferably confirms whether or not the type of film roll R1 specified by the bar code or matrix-type two-dimensional code read by the scanner 190 matches the type of film roll R1 that should be mounted on the supporting shaft 114. This feature would make it possible to check if the correct film roll R1 has been supplied to the bag-making and packaging machine 3 even if the film roll R1 is automatically supplied to the bag-making and packaging machine 3.

(3) Characteristics

(3-1)

[0186] The film roll replacement device 200 according to one embodiment of the film roll supply device of the claimed invention supplies the first film roll R1a to the bag-making and packaging machine 3. The film roll replacement device 200 is provided with: a holding section 230, which is one example of the receiver; and a first driving unit 235, which is one example of the first driver. The holding section 230 receives the first film roll R1a to be supplied to the bag-making and packaging machine 3. The first driving unit 235 changes an orientation of the holding section 230 between a first orientation used when receiving the first film roll R1a and a second orientation used when supplying the first film roll R1a to the bag-making and packaging machine 3.

[0187] When work to replace a film roll R1 using a film roll replacement device is automated from the standpoint of, *inter alia*, reducing a worker burden, improving work efficiency of the worker, and suppressing downtime of the bag-making and packaging machine 3, there is a risk that an adverse event such as scratching of a surface of a film F on the film roll R1 will occur during transfer of the film roll R1 to the holding section 230 for supplying the film roll R1 to the bag-making and packaging machine 3.

[0188] However, because the film roll replacement device 200 is configured such that the orientation of the holding section 230 to support the first film roll R1a to be supplied to the bag-making and packaging machine 3 is changed from the second orientation used when supplying the first film roll R1a to the bag-making and packaging machine 3 to the first orientation used when receiving the first film roll R1a, the occurrence of adverse events such as scratching of a surface of the film F on the first film roll R1a is readily suppressed.

(3-2)

[0189] In the film roll replacement device 200, the first driving unit 235 rotates the holding section 230 about a rotation axis O to change the orientation of the holding section 230. The rotation axis O extends in the direction same as an axial direction of the first film roll R1a held by the holding section 230.

[0190] In the film roll replacement device 200, the orientation of the holding section 230 can be changed using a comparatively simple movement (rotary action).

(3-3)

[0191] The film roll replacement device 200 is provided with a conveyor 210 as a preliminary placement section on which the first film roll R1a being transferred to the holding section 230 is preliminarily placed. The conveyor 210 is one example of the preliminary placement section, on which the first film roll R1a being transferred to the holding section 230, serving as one example of the receiver, is preliminarily placed.

[0192] Because the film roll replacement device 200 has the conveyor 210, it is possible to set the first film roll R1a on the conveyor 210 in advance so that the film roll replacement device 200 can execute an action to replace the film roll R1 of the bag-making and packaging machine 3 at a timing when replacement of the film roll is required.

[0193] In the embodiment described above, the film roll replacement device 200 is assumed to have the preliminary placement section (conveyor 210 in the present embodiment). However, even if the film roll replacement device 200 does not have the preliminary placement section, changing the orientation of the holding section 230, by the first driving unit 235, between the first orientation suited to receiving the first film roll R1a and the second orientation used when supplying the first film roll R1a to the bag-making and packaging machine 3, can facilitate to supply the first film roll R1a to the holding section 230 with an AGV or the like.

(3-4)

[0194] In the film roll replacement device 200, the holding section 230 allows the first film roll R1a to move from the conveyor 210 to the holding section 230 when the holding section 230 is in the first orientation and restricts the first film roll R1a from moving from the conveyor 210 to the holding section 230 when the holding section 230 is in the second orientation.

[0195] In the film roll replacement device 200, because the first film roll R1a is restricted from moving when the holding section 230 is in the second orientation, it is possible to suppress a phenomenon where the first film roll R1a moves from the conveyor 210 to the holding section 230 at an unintended timing.

[0196] Additionally, adopting this configuration makes it possible to suppress the occurrence of the phenomenon where the first film roll R1a moves from the conveyor 210 to the holding section 230 at an unintended timing even when installation of the gate 220 is omitted.

(3-5)

[0197] In the film roll replacement device 200, the conveyor 210 supports the first film roll R1a at a location higher than the location at which the first film roll R1a is transferred to the holding section 230 in the first orientation.

[0198] Because the film roll replacement device 200 is configured such that the conveyor 210 supports the first film roll R1a higher than the first film roll R1a supported by the holding section 230 in the first orientation, the first film roll R1a can be moved to the holding section 230 without being lifted.

(3-6)

[0199] In the film roll replacement device 200, the holding section 230 has the first holding surface 232a serving as one example of the first surface. The conveyor 210 has the conveyor surface 210a serving as one example of the preliminary placement surface on which the first film roll R1a is preliminarily placed. When the first film roll R1a is transferred from the conveyor 210 to the holding section 230 in the first orientation, the first film roll R1a moves on the conveyor surface 210a and the first holding surface 232a. When the first film roll R1a moves on the conveyor surface 210a and the first holding surface 232a, the conveyor surface 210a and the first holding surface 232a are parallel. Alternatively, when the first film roll R1a moves on the conveyor surface 210a and the first holding surface 232a, the first holding surface 232a is downwardly inclined from the proximal side toward the distal side relative to the conveyor 210.

[0200] In the film roll replacement device 200, due to the conveyor surface 210a and the first holding surface 232a being disposed as described above, the first film roll R1a can be smoothly moved from the conveyor surface 210a to the first holding surface 232a of the holding section 230 without being lifted.

[0201] In cases in which the conveyor surface 210a and the first holding surface 232a are parallel and horizontal when the first film roll R1a moves on the conveyor surface 210a and the first holding surface 232a, the first holding surface 232a is preferably disposed at a position at the height same as the conveyor surface 210a or lower than the conveyor surface 210a at this timing. Additionally, in cases in which the first holding surface 232a is downwardly oriented from the proximal side toward the distal side relative to the conveyor surface 210a when the first film roll R1a moves on the conveyor surface 210a and the first holding surface 232a, the end section of the conveyor 210 on the holding-section 230 side is preferably disposed at a position higher than the end section of the first holding surface 232a on the proximal side relative to the conveyor 210 at this timing.

(3-7)

[0202] In the film roll replacement device 200, the holding section 230 has a second holding surface 234a serving as one example of the second surface. When the holding section 230 is in the first orientation, the second holding surface 234a restricts movement of the first film roll R1a that moves on the first holding surface 232a from the proximal side toward the distal side relative to the conveyor 210.

[0203] Because the film roll replacement device 200 has the second holding surface 234a, it is possible to suppress the occurrence of adverse events, such as the first film roll R1a that has moved onto the holding section 230 falling from the holding section 230 or failing to be disposed at a desired position on the holding section 230.

[0204] The holding section 230 may also have, separately from the second holding surface 234a for supporting the first film roll R1a, a member to restrict movement of the first film roll R1a that moves on the first holding surface 232a from the proximal side toward the distal side relative to the conveyor 210.

(3-8)

[0205] In the film roll replacement device 200, the holding section 230 includes a first holding member 232 serving as one example of a first plate-shaped member having the first holding surface 232a, and a second holding member 234 serving as one example of a second plate-shaped member having the second holding surface 234a. When the first holding member 232 and the second holding member 234 are viewed from a direction parallel to the first holding surface 232a and the second holding surface 234a, the first holding surface 232a and the second holding surface 234a are disposed in a V shape.

[0206] In particular, when the first holding member 232 and the second holding member 234 of the holding section 230 in the second orientation are viewed from a direction parallel to the first holding surface 232a and the second holding surface 234a, the first holding surface 232a and the second holding surface 234a are disposed in a V shape so as to have line symmetry with respect to a vertical line.

[0207] In the film roll replacement device 200, due to the first holding surface 232a and the second holding surface 234a being disposed in a V shape, the position of the first film roll R1a can be precisely positioned using the first holding surface 232a of the first holding member 232 and the second holding surface 234a of the second holding member 234.

[0208] Additionally, due to the first holding surface 232a and the second holding surface 234a to support the film roll R1 from below being disposed in a V shape, a central position of the film roll R1 supported by the holding surface 230,regardless of the diameter of the film roll R1, is disposed at roughly the same position in the front-rear direction on the holding section 230 in the second orientation. Therefore, the film roll replacement device 200 may control only a vertical-direction position of the holding section 230 when supplying the first film roll R1a to the bag-making and packaging machine 3, provided that the front-rear-direction position of the rotation axis O about which the holding section 230 is rotated is not changed. In other words, as it is unnecessary to control the front-rear-direction position of the holding section 230 when the first holding surface 232a and the second holding surface 234a are disposed in a V shape, it is possible to control the position of the first film roll R1a supplied to the bag-making and packaging machine 3 using a simple configuration.

(3-9)

[0209] In the film roll replacement device 200, the angle formed by the first holding surface 232a and the second holding surface 234a is within the range of 90°±30°.

[0210] In the film roll replacement device 200, due to the angle formed by the first holding surface 232a and the second holding surface 234a being within the aforementioned angular range, the position of the first film roll R1a can be precisely positioned using the first holding surface 232a and the second holding surface 234a.

(3-10)

[0211] In the film roll replacement device 200, when the holding section 230 is in the second orientation, the first holding surface 232a and the second holding surface 234a support the first film roll R1a on the holding section 230 from below.

[0212] In the film roll replacement device 200, the first holding surface 232a and the second holding surface 234a can function as support surfaces for the first film roll R1a when the orientation of the holding section 230 is set to the second orientation.

(4) Modifications

[0213] Modifications of the present embodiment are presented below. The modifications may be combined as appropriate provided no contradictions occur therebetween.

(4-1) Modification A

[0214] In the above embodiment, the controller 290 measures the diameter D of the first film roll R1a based on the signal output by the encoder 284 attached to a motor serving as the first-member-driving unit 282.

[0215] However, a measurement method based on the signal output by the encoder 284 is not provided by way of limitation to the method of measuring the diameter D of the first film roll R1a.

[0216] For example, the film roll replacement device 200 may have a first sensor 285 instead of the encoder 284 as shown in FIG. 15. In addition, the first-member-driving unit 282 may be an air cylinder or another driving mechanism other than a motor in this case. The first sensor 285 is located, for example, directly below the first member 280 or directly above the first member 280. The first sensor 285 is a laser distance sensor that contactlessly measures a first distance (a distance in the up-down direction in this modification) from a first reference position (e.g., a position where the first sensor 285 is installed) to the first member 280 in contact with the outer peripheral surface of the first film roll R1a.

[0217] The controller 290, serving as a first measuring unit, measures (calculates) the diameter D of the first film roll R1a based on the first distance measured by the first sensor 285. For example, a distance between the first reference position and the conveying surface of the conveyor 210 (the surface on which the first film roll R1a is placed) is stored in advance in a storage device of the controller 290. The controller 290 calculates the diameter D of the first film roll R1a from the first distance and the distance from the first reference position to the conveying surface of the conveyor 210.

(4-2) Modification B

[0218] In the above embodiment, the controller 290 serving as a first measuring unit measures the diameter D of the first film roll R1a, and based on the diameter D of the first film roll R1a, the controller 290 controls the action of the second driving unit 236 to move the holding section 230 to a position where the height position of the center of the first film roll R1a held by the holding section 230 is aligned with the height of the center of the support shaft 114 of the bag-making and packaging machine 3.

[0219] However, the controller 290 may measure the height position of the first film roll R1a held by the holding section 230 without measuring the diameter D of the first film roll R1a, and the controller 290 may use this measurement result as a basis to control the action of the second driving unit 236 to move the holding section 230 to a position where the height position of the center of the first film roll R1a held by the holding section 230 is aligned with the height of the center of the support shaft 114 of the bag-making and packing machine 3. A specific example shall now be described with reference to FIG. 16. FIG. 16 is an enlarged view of the holding section 230 of the film roll replacement device 200, and is a drawing for describing the method of measuring the height position up to the center of the first film roll R1a.

[0220] In Modification B, the film roll replacement device 200 does not have the first member 280, the first-member-driving unit 282, or the encoder 284. In Modification B, the controller 290, serving as a second measuring unit, measures the height position of the center of the first film roll R1a held by the holding section 230. The controller 290 uses, for example, the measurement result from the distance sensor 286 previously described. In Modification B, the distance sensor 286 functions as a sensor that contactlessly measures a second distance from a second reference position (the position of the distance sensor 286) to the outer peripheral surface (the lowest part) of the first film roll R1a held by the holding section 230.

[0221] In the storage device of the controller 290 are stored, for example, a height h1' between the distance sensor 286 and the floor surface, and a height h2' between the distance sensor 286 and the intersection point X between the straight line imagined as an extension of the first holding surface 232a and the straight line imagined as an extension of the second holding surface 234a (see FIG. 16). It can be seen from the structure of the holding section 230 in the present modification that in a left-side view, the center C of the first film roll R1a, the intersection point X, and a line the intersection point Y, that is extended from the center C of the first film roll R1a and that is perpendicular to the first holding surface 232a form a right isosceles triangle. Therefore, if the distance sensor 286 is able to measure a second distance (h2'+h3') from the position of the distance sensor 286 serving as the second reference position to the outer peripheral surface (the lowest part) of the second film roll R1b, the controller 290 can calculate the distance from the floor surface to the center C of the first film roll R1a, using the formula h1'+h2'+Root(2)×h3'/(Root(2)-1). The values of h1' and h2' are known, and the value of h3' can be calculated by subtracting the known value h2' from the second distance measured by the distance sensor 286.

[0222] In this modification, a case is assumed in which the angle formed by the first holding surface 232a and the second holding surface 234a is 90°, but the angle formed by the first holding surface 232a and the second holding surface 234a need not be 90°. In this case, the figure formed by connecting the center C of the first film roll R1a, the intersection point X, and the intersection point Y would not be a right isosceles triangle, but if the angle formed between the line segment joining the center C of the first film roll R1a and the line segment joining the intersection point X and the intersection point Y or the like is known, the height position of the first film roll R1a held by the holding section 230 can be measured (calculated) using a trigonometric function.

(4-3) Modification C

[0223] In the above embodiment, the first member 280 comes into contact with the outer peripheral surface of the first film roll R1a from above, but this feature is not provided by way of limitation. For example, the first member 280 may come into contact with the outer peripheral surface of the first film roll R1a from a side (e.g., from the rear). In this case as well, the controller 290 can measure the diameter D of the first film roll R1a using the same method as in the above embodiment.

(4-4) Modification D

[0224] In the above embodiment, the holding section 230, the right-side pushing member 240, and the left-side pushing member 250 are driven together by the third driving unit 237, but this feature is not provided by way of limitation. For example, the holding section 230, the right-side pushing member 240, and the left-side pushing member 250 may be driven by respective separate driving units. In addition, for example, one of the right-side pushing member 240 and the left-side pushing member 250 may together with the holding section 230 be driven by the third driving unit 237, and the other of the right-side pushing member 240 and the left-side pushing member 250 may be driven by a driving unit separate from the third driving unit 237.

(4-5) Modification E

[0225] In the above embodiment, the film roll replacement device 200 is a stationary device. However, the film roll replacement device 200 is not limited to being stationary, and may be, for example, a self-propelled device having wheels or another movement mechanism.

(4-6) Modification F

[0226] In the above embodiment, the controller 290 functions as a first measuring unit to measure the diameter of the first film roll, and in Modification B, the controller 290 functions as a second measuring unit to measure the height position of the center of the first film roll held by the holding section. However, this feature is not provided by way of limitation; the first measuring unit or the second measuring unit may be configured separate from the controller 290.

(4-7) Modification G

[0227] In the above embodiment, the controller 290 measures the diameter of the first film roll R1a, and adjusts the height position of the center of the first film roll R1a based on the measurement result. However, this feature is not provided by way of limitation; the controller 290 may, for example, adjust the height position of the center of the first film roll R1a based on a value of the diameter of the first film roll R1a input from an input device (not shown in the figure).

(4-8) Modification H

[0228] The winding-core-retrieving mechanism 270 need not be provided to the film roll replacement device 200. If the second film roll R1b is automatically removed from the second film roll R1b and the first film roll R1a is automatically attached to the support shaft 114, the winding-core-retrieving mechanism 270 is preferably provided to the film roll replacement device 200 in order to reduce the burden on the worker who takes away the second film roll R1b from the holding section 230 (the winding core WC of the depleted film roll R1).

(4-9) Modification I

[0229] If the winding-core-retrieving mechanism 270 is not provided and there is no need for the winding core WC of the depleted film roll R1 to fall from the gap 230a of the holding section 230, the holding section 230 may be a V-shaped member in which the first holding member 232 and the second holding member 234 of the above embodiment are integrated.

(4-10) Modification J

[0230] In the above embodiment, the holding section 230 is a V-shaped member, but the shape of the holding section 230 is not limited to that of a V For example, the holding section 230 may be a flat plate-shaped member in which a groove extending in the left-right direction (a groove in which the film roll R1 will fit) is formed in the center in the front-rear direction.

[0231] Where the holding section 230 is a flat plate-shaped member, for example, the holding section 230 may, as the first orientation, take downwardly inclined orientation from the proximal side toward the distal side relative to the conveyor 210 such that the film roll R1 being supplied from the conveyor 210 readily moves, and may, as the second orientation, take a horizontal orientation such that the film roll R1 fitted into the groove does not roll out from the groove, although the holding section 230 is not limited to this configuration.

[0232] In the case described above, the holding section 230 preferably has a member to restrict movement of the first film roll R1a moving from the proximal side toward the distal side relative to the conveyor 210, such that the film roll R1 being supplied from the conveyor 210 does not roll and fall.

(4-11) Modification K

[0233] In the above embodiment, it is assumed that the diameters of the replacement film rolls R1 (the first film roll R1a) are not uniform, but the film rolls R1 may all have the same diameter. In this case, there is no need for the second driving unit 236 to perform positioning of the height position of the center of the first film roll R1a held by the holding section 230 and the height position of the center of the support shaft 114 of the bag-making and packaging machine 3.

(4-12) Modification L

[0234] In the embodiment described above, a case is illustrated in which the holding section 230 is rotated such that the position of the intersection point X of a straight line imagined as an extension of the first holding surface 232a and a straight line imagined as an extension of the second holding surface 234a (see FIG. 14) is used as the rotational center of the rotation axis O. However, the position of the rotation axis of the holding section 230 is not limited to the position illustrated in the embodiment described above.

[0235] One example of a configuration in which the rotational center O1 of the holding section 230 is disposed at a position other than the intersection point X of a straight line imagined as an extension of the first holding surface 232a and a straight line imagined as an extension of the second holding surface 234a is illustrated in FIGS. 21A and 21B. FIG. 21A is a schematic left-side view of the film roll replacement device 200 according to modification L, and depicts a state in which the orientation of the holding section 230 is a second orientation. FIG. 21B is a schematic left-side view of the film roll replacement device 200 according to modification L, and depicts a state in which the orientation of the holding section 230 is a first orientation.

[0236] The film roll replacement device 200 according to modification L is similar to the film roll replacement device 200 according to the embodiment described above except for the position of the rotation axis O1 of the holding section 230; therefore, the configuration of the holding section 230, etc., other than the position of the rotation axis O1 is not described here.

[0237] In the film roll replacement device 200 according to the embodiment described above, when the holding section 230 takes the second orientation, the intersection point X of a straight line imagined as an extension of the first holding surface 232a and a straight line imagined as an extension of the second holding surface 234a is disposed roughly directly below the center of the film roll R (center of the winding core WC) held by the holding section 230 in the second orientation (see FIGS. 11 and 12D). Additionally, in the embodiment described above, the gap 230a is provided in the holding section 230 as described previously, and when the holding section 230 takes the second orientation, the winding core WC of the used film roll R1 serving as the second film roll R1b is caused to fall from the gap 230a. Therefore, when the holding section 230 takes the second orientation, the intersection point X of a straight line imagined as an extension of the first holding surface 232a and a straight line imagined as an extension of the second holding surface 234a is disposed at a position superposed on the gap 230a in the front-rear direction (see FIG. 11).

[0238] Therefore, a configuration in which the holding section 230 is rotated around the intersection point X when the orientation of the holding section 230 is changed to the second orientation, and the winding core WC of the used film roll R1 falls from the gap 230a, may cause problems such as a mechanism to rotate the holding section 230 hinders retrieval of the winding core WC or the configuration of the film roll replacement device 200 becomes complicated.

[0239] Thus, in the film roll replacement device 200 according to modification L, the rotation axis O1 is disposed at a position offset from directly below the center of the film roll R1 (center of the winding core WC) held by the holding section 230 in the second orientation in the front-rear direction, or more specifically a position offset from directly below the gap 230a in the holding section 230 in the second orientation in the front-rear direction (see FIGS. 21A and 21B). Even when the rotation axis O1 is disposed at such a position, rotating the holding section 230 about the rotation axis O1 makes it possible to change the orientation of the holding section 230 between the first orientation (see FIG. 21B) and the second orientation (see FIG. 21A).

[0240] FIGS. 21A and 21B depict the rotation axis O1 at a position superposed on the first holding member 232 in the front-rear direction, but the position of the rotation axis O1 is not limited to the position depicted in FIGS. 21A and 21B. For example, the position of the rotation axis O1 may be a position superposed on the second holding member 234 in the front-rear direction or may be a position not superposed on either the first holding member 232 or the second holding member 234 in the front-rear direction. However, if the rotation axis O1 is disposed at a position spaced a large distance from the first holding member 232 and the second holding member 234, the first holding member 232 and the second holding member 234 will move a large distance when the orientation of the holding section 230 is changed, and thus there is a risk that the film roll replacement device 200 will increase in size.

[0241] As yet another example, the rotation axis O1 may be disposed at a location directly below the gap 230a in the holding section 230 in the second orientation in the front-rear direction, other than the intersection point X of a straight line imagined as an extension of the first holding surface 232a and a straight line imagined as an extension of the second holding surface 234a.

(4-13) Modification M

[0242] In the embodiment described above, the holding section 230 is configured such that the plate-shaped first holding member 232 and the plate-shaped second holding member 234 are combined, and the first holding surface 232a and the second holding surface 234a are disposed in a V shape. However, the holding section having such a V shape may be realized using other structures.

[0243] For example, the holding section 230’ may be configured such that a plurality of rollers 238 extending in the left-right direction are lined up to form a plurality of V shapes in a side view, as shown in FIG. 22 (FIG. 22 is a left-side view). In such cases, the holding section 230’ holds the film roll R1 using a holding surface of a first roller group 232’ including a plurality of rollers 238 (i.e., a virtual plane 232a’ linking parts of the rollers 238 in the first roller group 232’ supporting the film roll R) that is disposed on the rearward side, and a holding surface of a second roller group 234’ including a plurality of rollers 238 (i.e., a virtual plane 234a’ linking parts of the rollers 238 in the second roller group 234’ supporting the film roll R) that is disposed on the frontward side.

(4-14) Modification N

[0244] In the embodiment described above, the holding section 230 is formed by combining the plate-shaped first holding member 232 and the plate-shaped second holding member 234. However, the holding section 230 may be realized using another structure.

[0245] For example, the holding section 230" may have a structure in which two shafts 239 extending in the left-right direction are lined up in the front-rear direction, as shown in FIG. 23. When configured in this manner, the holding section 230" holds the film roll R1 fitted between the two shafts. In this case, the holding section 230" may have a configuration for adjusting a front-rear-direction gap between the shafts such that the film roll R1 can be suitably held even when the diameter of the film roll R1 changes.

[0246] Additionally, for example, the holding section 230" may be a roller conveyor in which a plurality of rollers 239a extending in the left-right direction are lined up in the front-rear direction, as shown in FIG. 24. In this configuration, a movement-restricting member 239b to restrict the film roll R1 from moving forward is preferably provided to the frontward side of the roller conveyor. When configured in this manner, the holding section 230" holds the film roll R1 carried on the roller conveyor serving as the holding section 230".

[0247] The claimed invention is useful as a film roll supply device that makes it possible to improve replacement of a film roll in a bag-making and packaging machine.

REFERENCE SIGNS LIST

[0248]

3	Bag-making and packaging machine
200	Film roll replacement device (film roll supply device)
210	Preliminary placement section
210a	Conveyor surface (preliminary placement surface)
230	Holding section (receiver)
232	First holding member
232a	First holding surface (first surface)
234	Second holding member
234a	Second holding surface (second surface)
235	First driving unit (first driver)
O	Rotation axis
R1a	First film roll (film roll)

CITATION LIST

PATENT LITERATURE

[0249] [Patent Literature 1] Japanese Laid-open Patent Publication No. 2002-337817

Claims

1. A film roll supply device supplying a film roll to a bag-making and packaging machine, comprising:

a receiver configured to receive the film roll to be supplied to the bag-making and packaging machine; and

a first driver configured to change an orientation of the receiver between a first orientation used when receiving the film roll and a second orientation used when supplying the film roll to the bag-making and packaging machine.

2. The film roll supply device according to claim 1, wherein the first driver is configured to rotate the receiver about a rotation axis to change the orientation of the receiver, and the first rotation axis extends in a direction same as an axial direction of the film roll held by the receiver.

3. The film roll supply device according to claim 1 or 2, further comprising a preliminary placement section on which the film roll being transferred to the receiver is preliminary placed.

4. The film roll supply device according to claim 3, wherein the receiver is configured to allow the film roll to move from the preliminary placement section to the receiver when the receiver is in the first orientation, and to restrict the film roll from moving from the preliminary placement section to the receiver when the receiver is in the second orientation.

5. The film roll supply device according to claim 3 or 4, wherein the preliminary placement section is configured to support the film roll at a location higher than the film roll transferred to the receiver in the first orientation.

6. The film roll supply device according to claims 3 to 5, wherein

the receiver has a first surface;
the preliminary placement section has a preliminary placement surface on which the film roll is configured to be preliminarily placed;
the film roll supply device is configured such that when the film roll is transferred from the preliminary placement section to the receiver in the first orientation, the film roll moves on the preliminary placement surface and the first surface; and
when the film roll moves on the preliminary placement surface and the first surface, either the preliminary placement surface and the first surface are parallel or the first surface is downwardly inclined from a proximal side toward a distal side relative to the preliminary placement section.

7. The film roll supply device according to claim 6, wherein the receiver has a second surface and when the receiver is in the first orientation, the second surface is configured to restrict movement of the film roll that moves on the first surface from the proximal side toward the distal side relative to the preliminary placement section.

8. The film roll supply device according to claim 7, wherein the receiver includes a first plate-shaped member having the first surface and a second plate-shaped member having the second surface; and when the first plate-shaped member and the second plate-shaped member are viewed from a direction parallel to the first surface and the second surface, the first surface and the second surface are disposed in a V shape.

9. The film roll supply device according to claim 7 or 8, wherein an angle formed by the first surface and the second surface is within a range of $90° \pm 30°$.

10. The film roll supply device according to any one of claims 7 to 9, wherein when the receiver is in the second orientation, the first surface and the second surface support the film roll on the receiver from below.

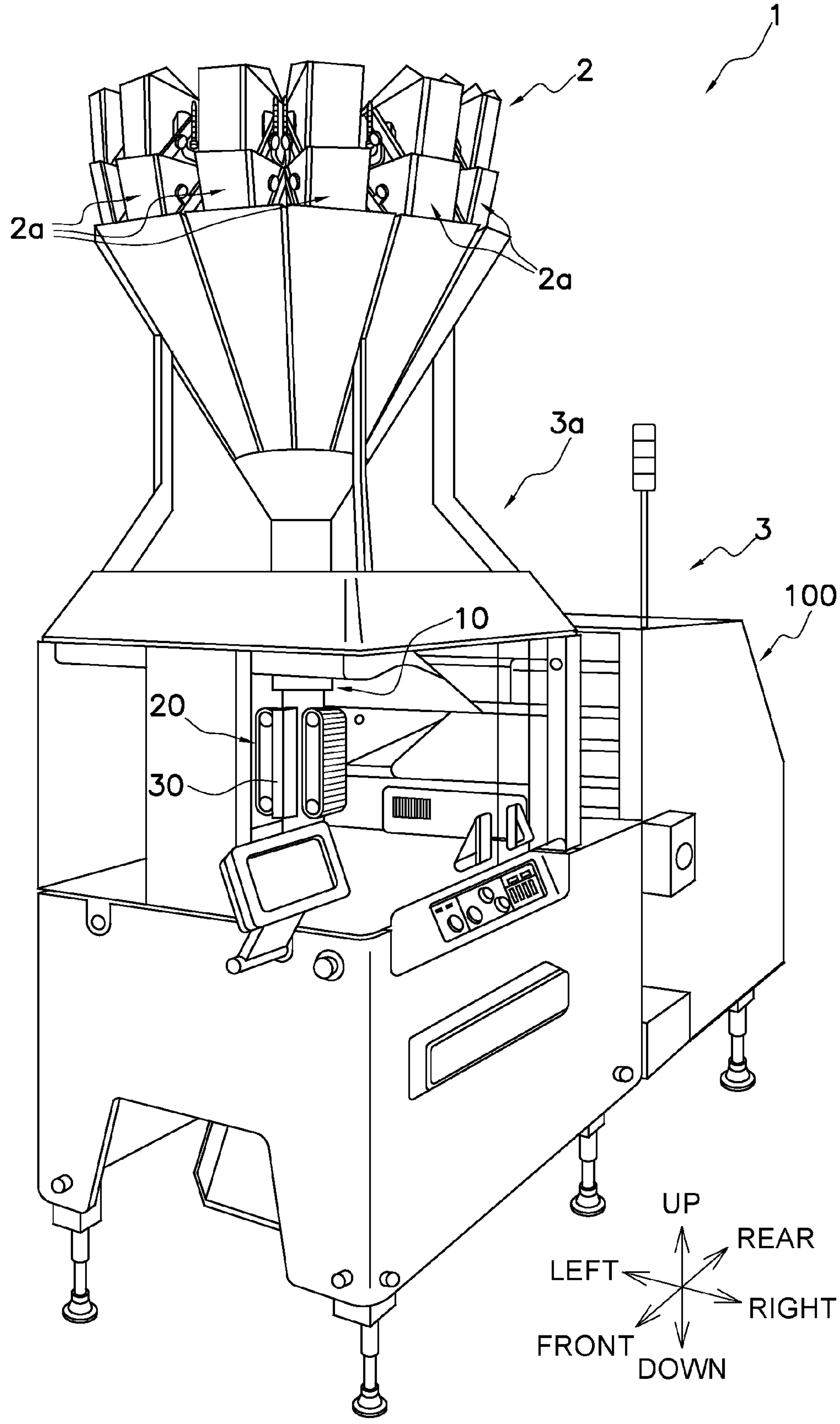
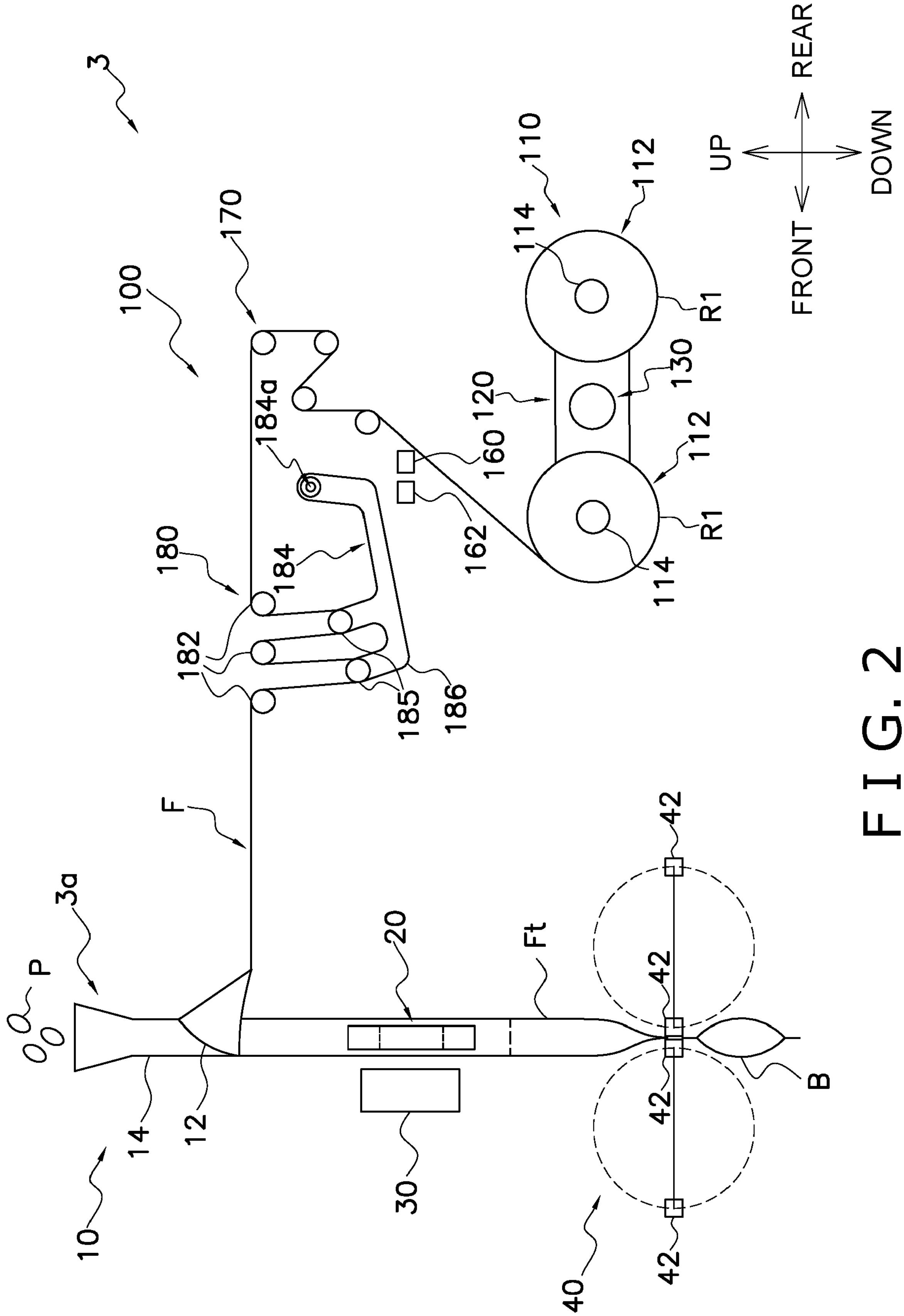


FIG. 1


3
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110
112
114
R1
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120
160
162
184a
184
180
182
185
186
F
3a
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Ft
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14
12
30
40
B
UP
DOWN
FRONT
REAR

FIG. 2

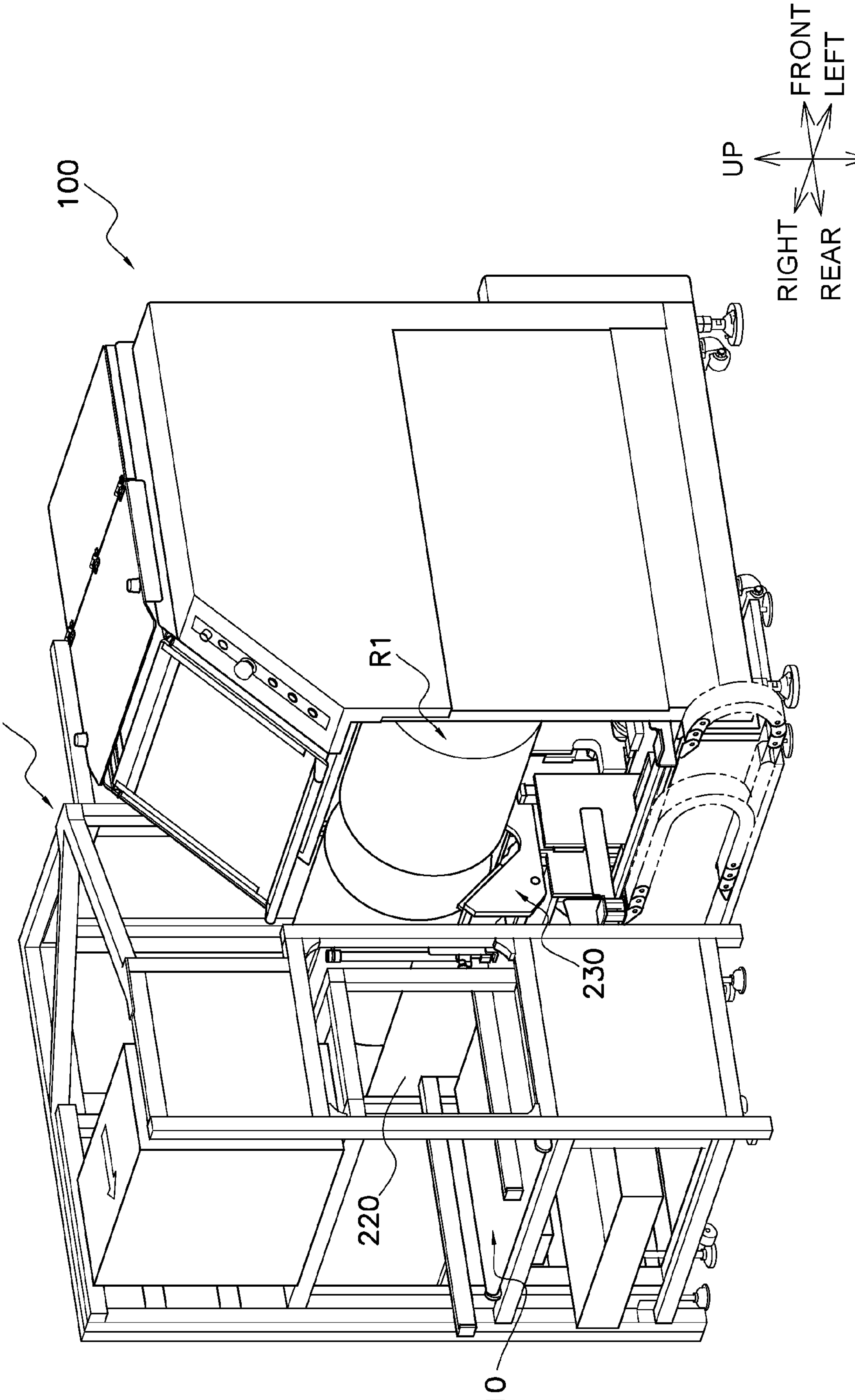


FIG. 3

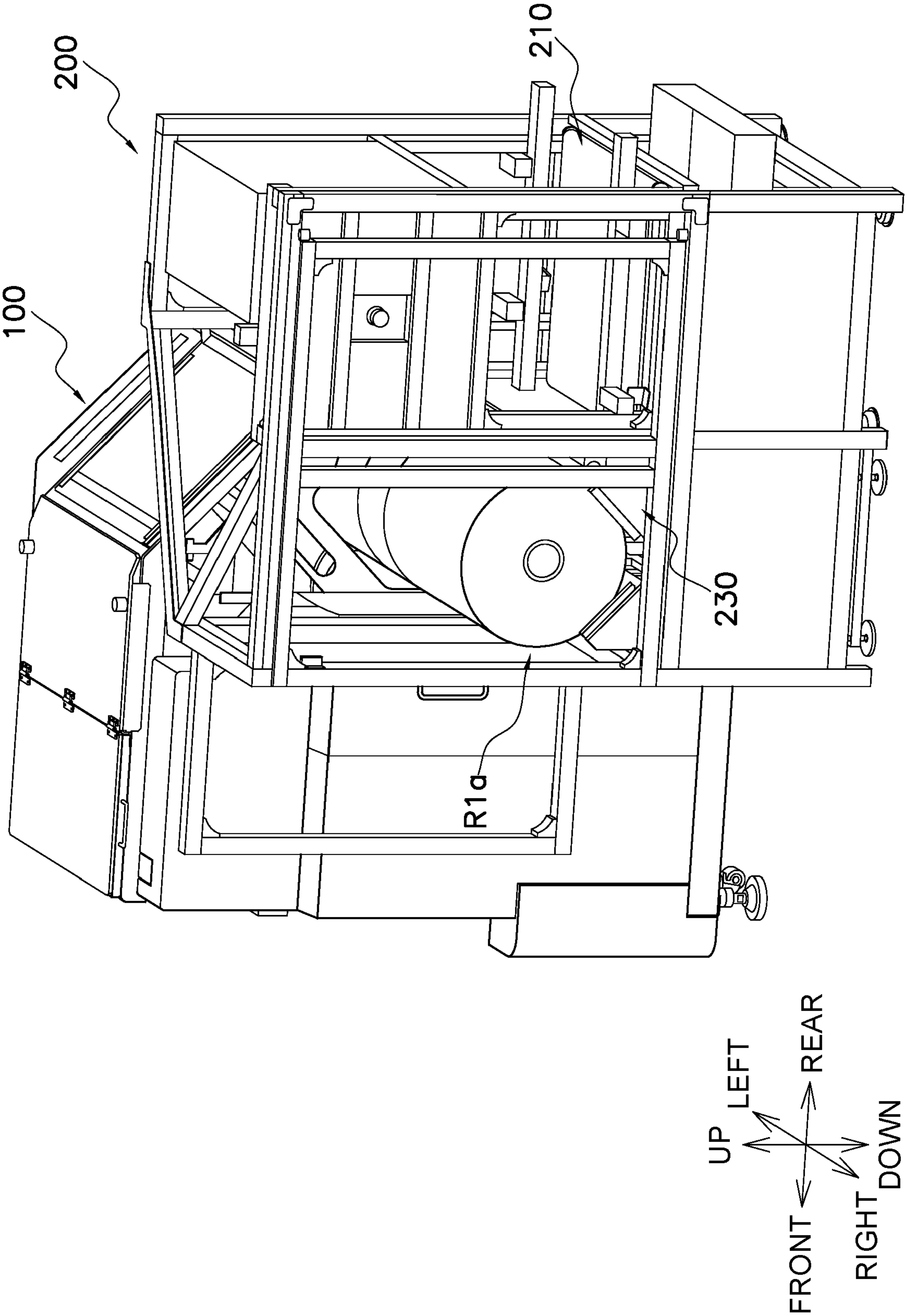
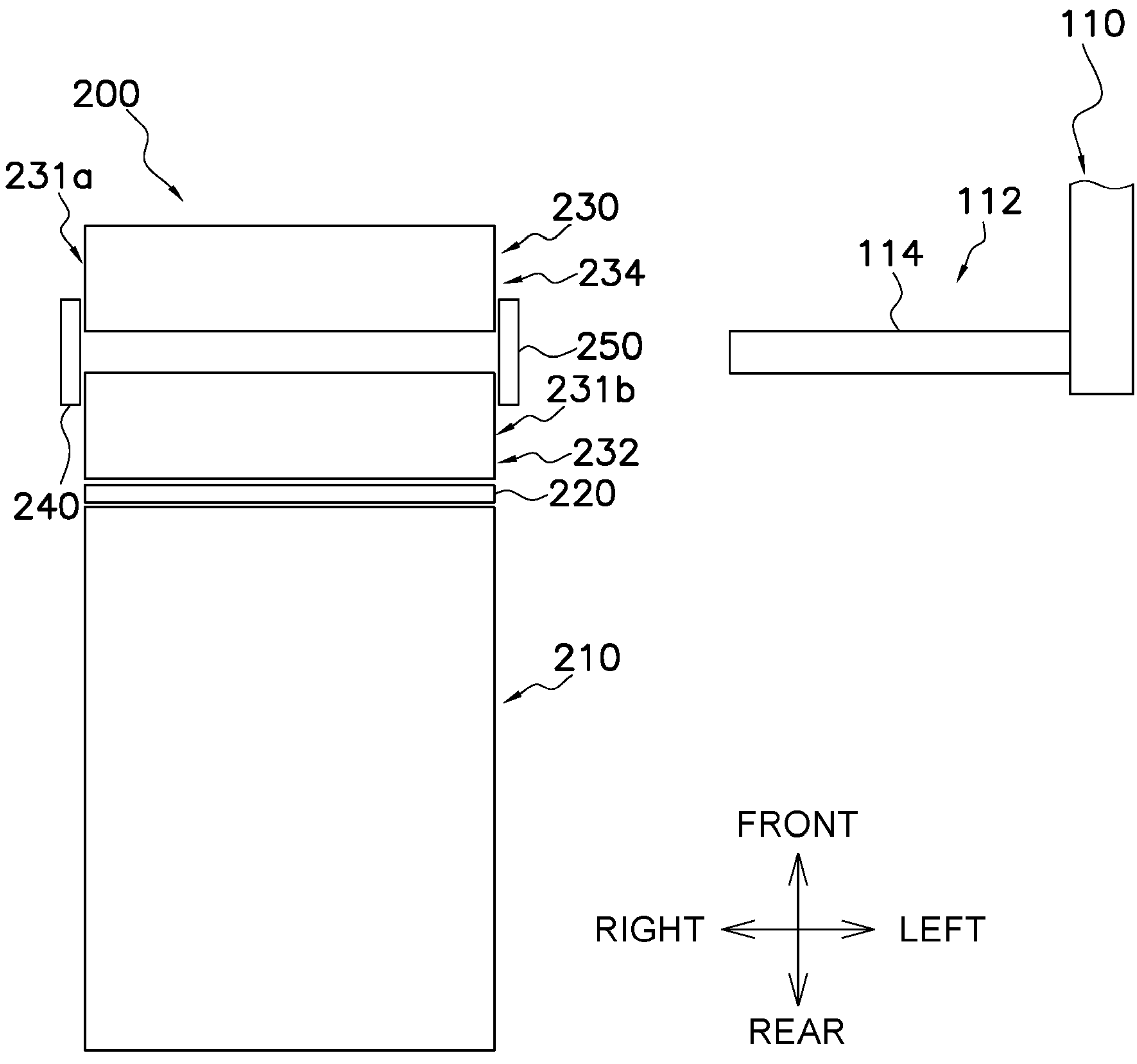


FIG. 4



110
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231a
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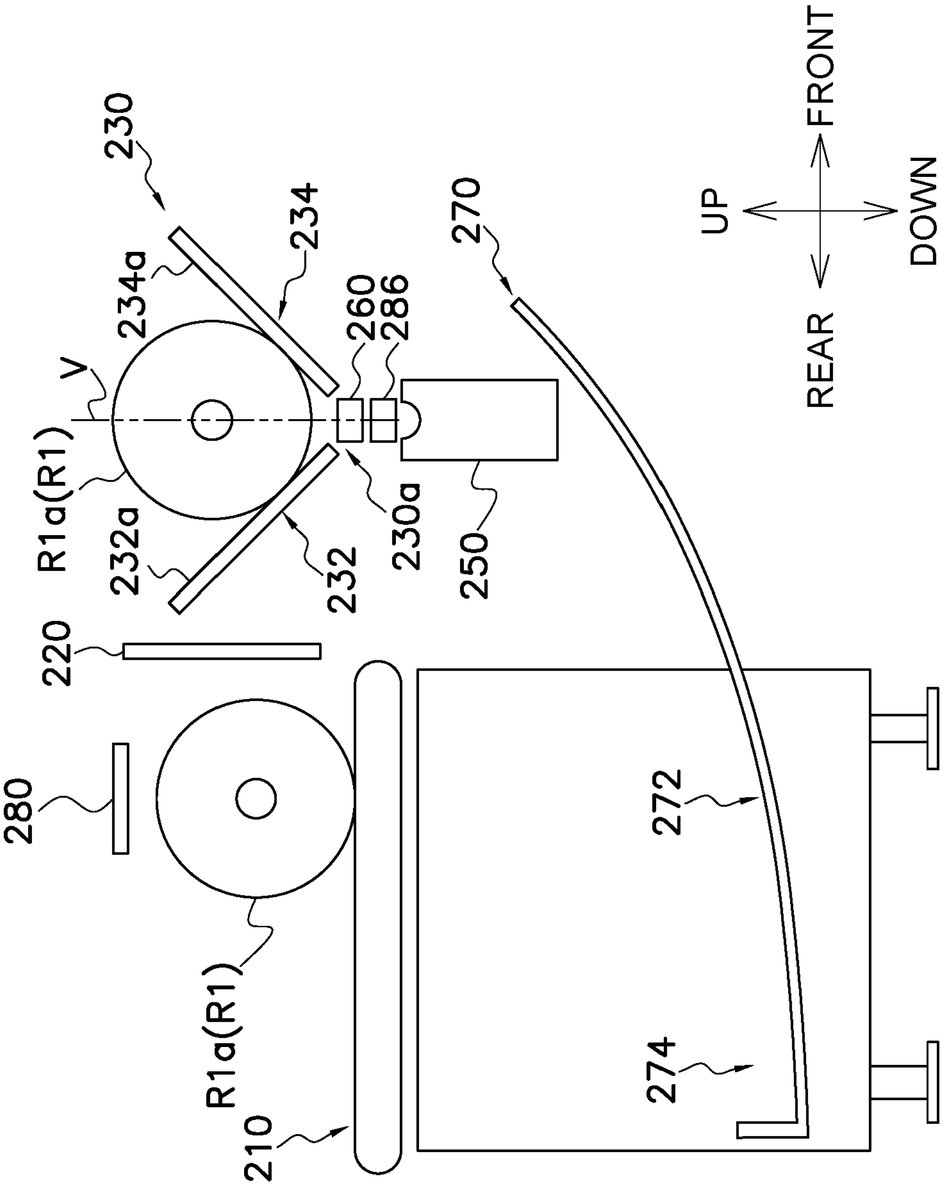
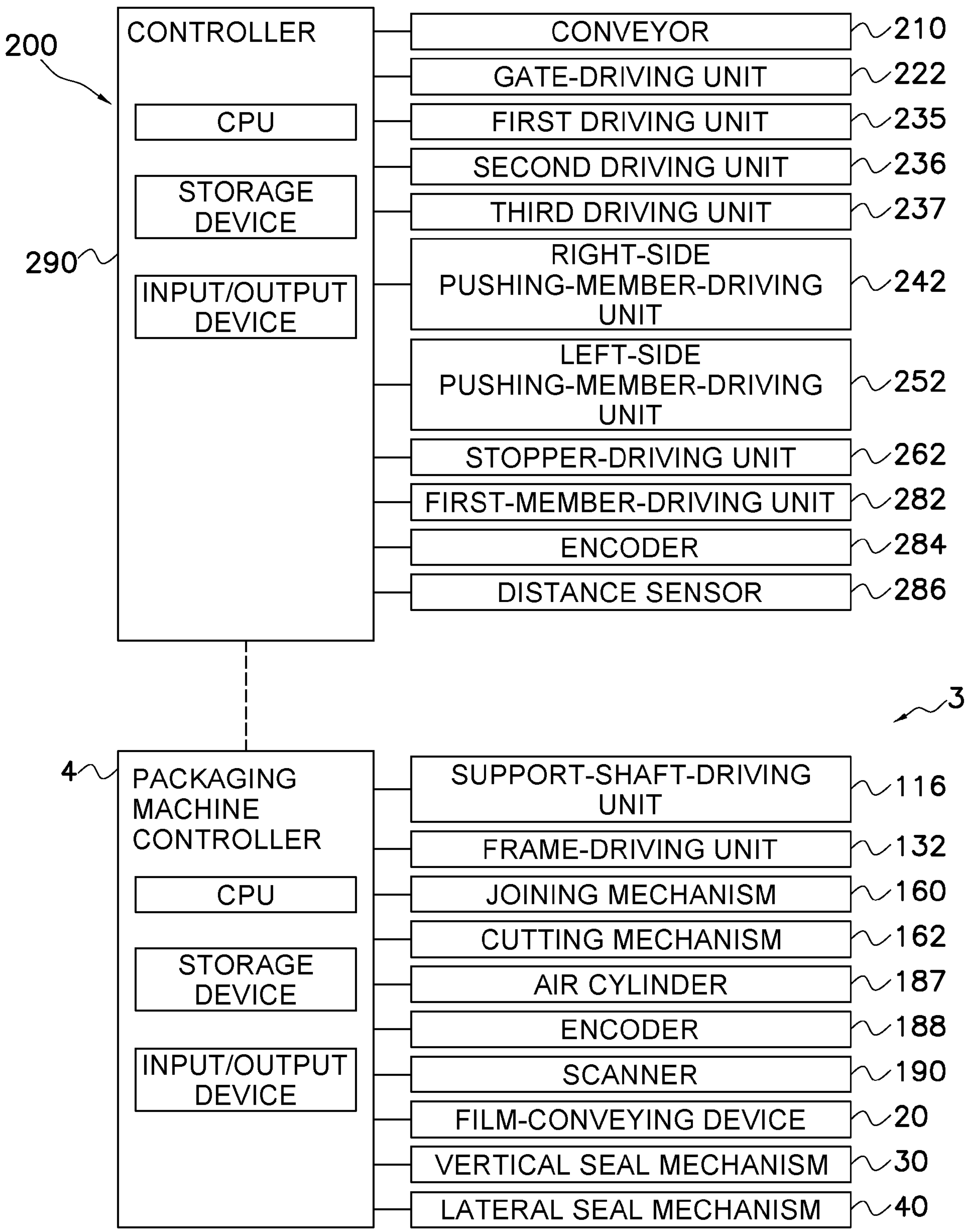
112
234
114
250
231b
232
240
220
210
FRONT
RIGHT
LEFT
REAR

F I G. 5


230
234
234a
V
260
286
R1a(R1)
232a
232
230a
250
270
UP
FRONT
DOWN
REAR
220
280
272
R1a(R1)
274
210

F I G. 6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CPU
STORAGE DEVICE
INPUT/OUTPUT DEVICE
290
CONVEYOR
210
GATE-DRIVING UNIT
222
FIRST DRIVING UNIT
235
SECOND DRIVING UNIT
236
THIRD DRIVING UNIT
237
RIGHT-SIDE PUSHING-MEMBER-DRIVING UNIT
242
LEFT-SIDE PUSHING-MEMBER-DRIVING UNIT
252
STOPPER-DRIVING UNIT
262
FIRST-MEMBER-DRIVING UNIT
282
ENCODER
284
DISTANCE SENSOR
286
3
4
PACKAGING MACHINE CONTROLLER
CPU
STORAGE DEVICE
INPUT/OUTPUT DEVICE
SUPPORT-SHAFT-DRIVING UNIT
116
FRAME-DRIVING UNIT
132
JOINING MECHANISM
160
CUTTING MECHANISM
162
AIR CYLINDER
187
ENCODER
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SCANNER
190
FILM-CONVEYING DEVICE
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VERTICAL SEAL MECHANISM
30
LATERAL SEAL MECHANISM
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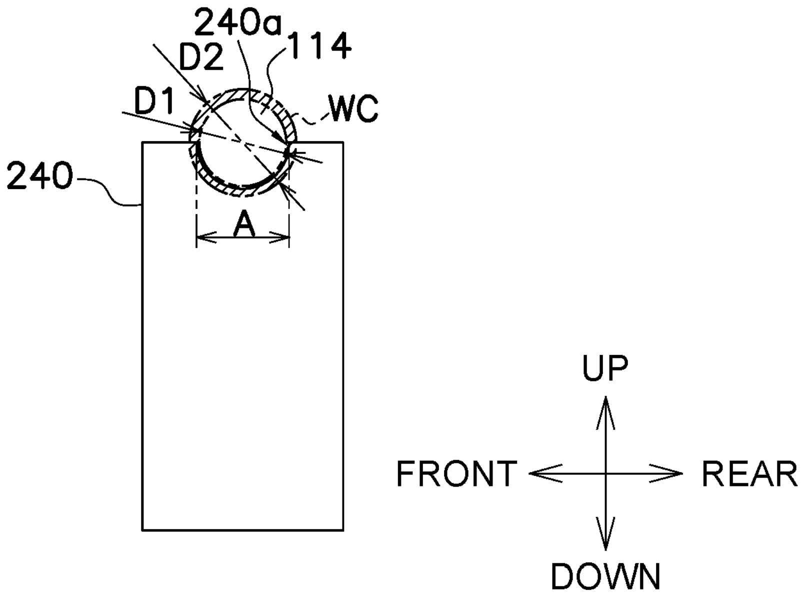
F I G. 7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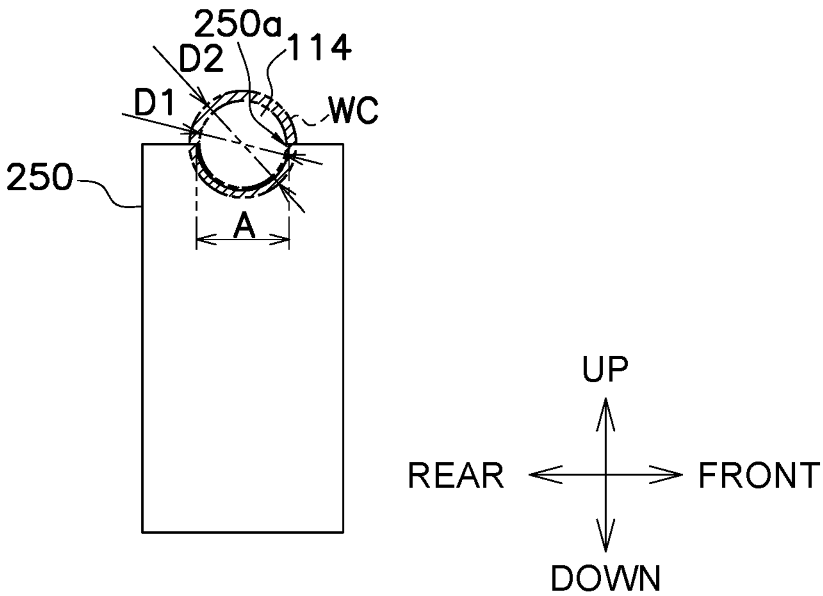
114
D2
D1
WC
240
A
UP
FRONT
REAR
DOWN

F I G. 8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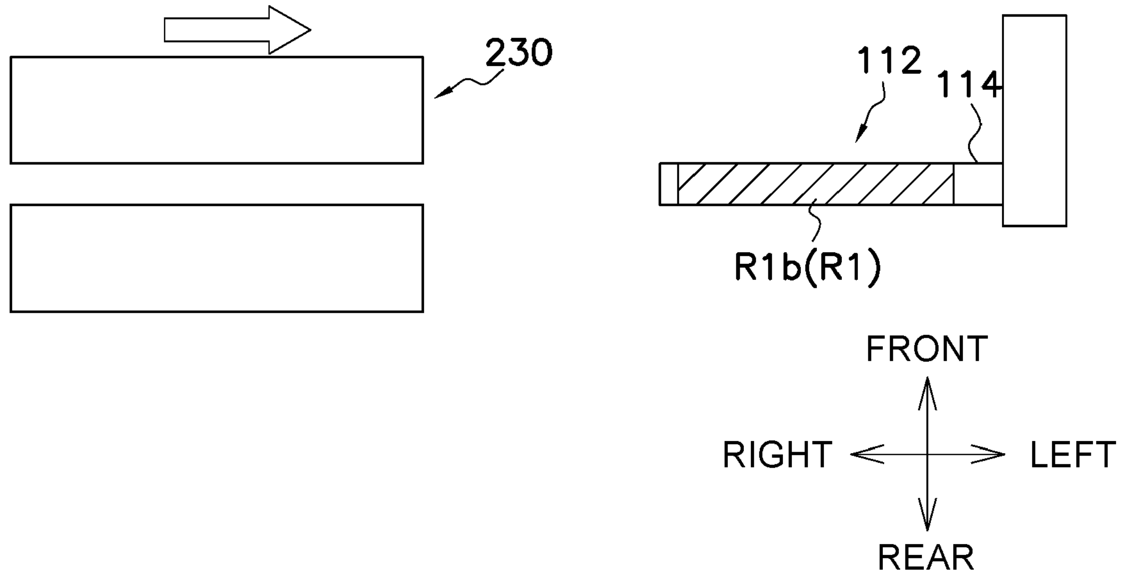
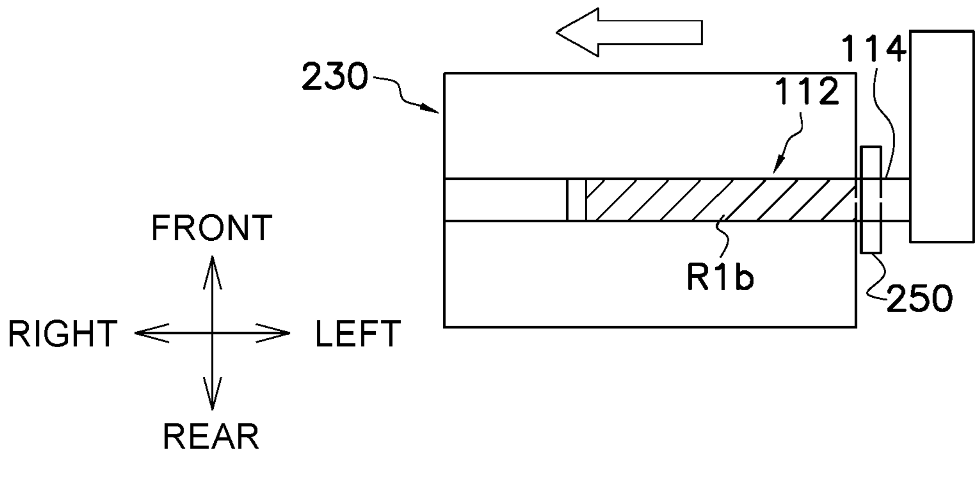
D2
D1
WC
250
A
UP
REAR
FRONT
DOWN

F I G. 9



F I G. 10A



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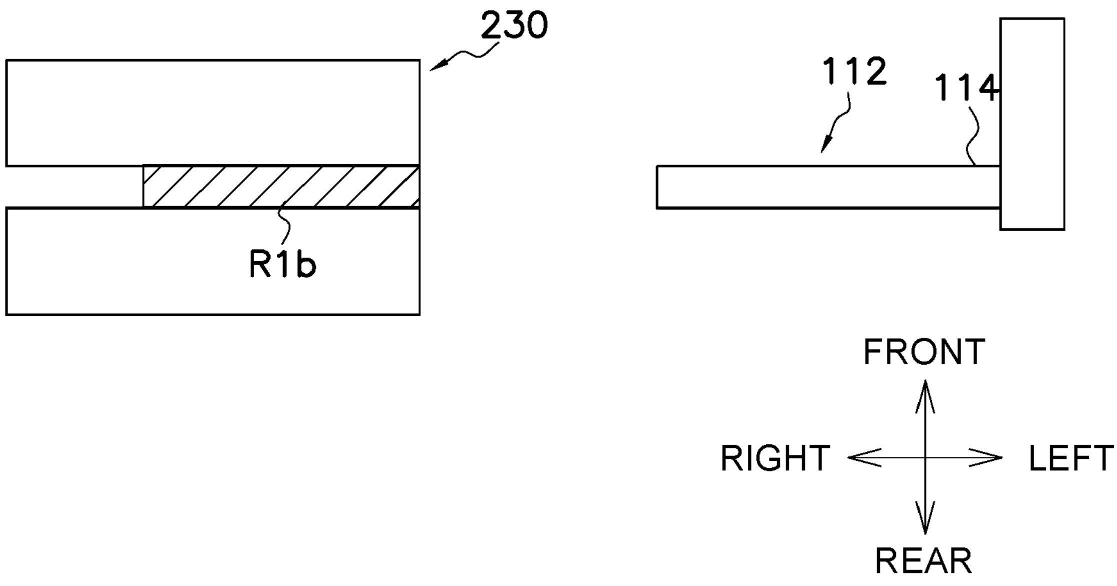
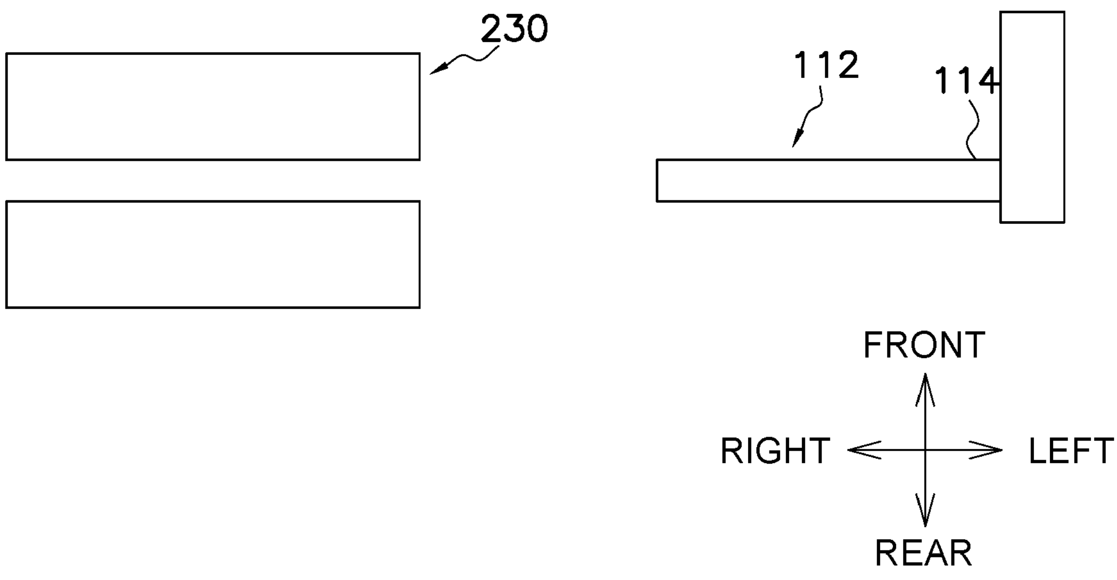
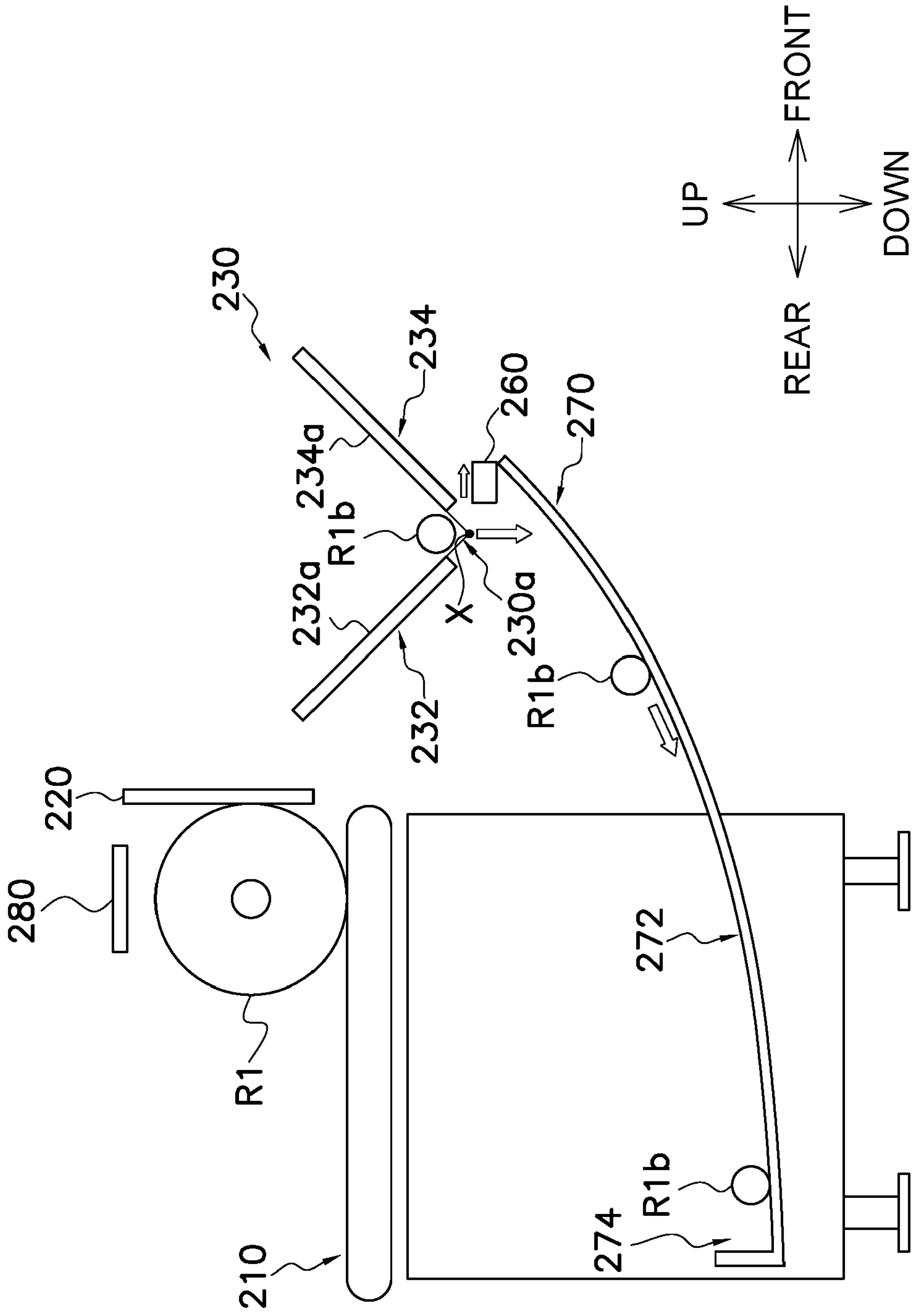


F I G. 10C



F I G. 10D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R1b
232a
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R1b
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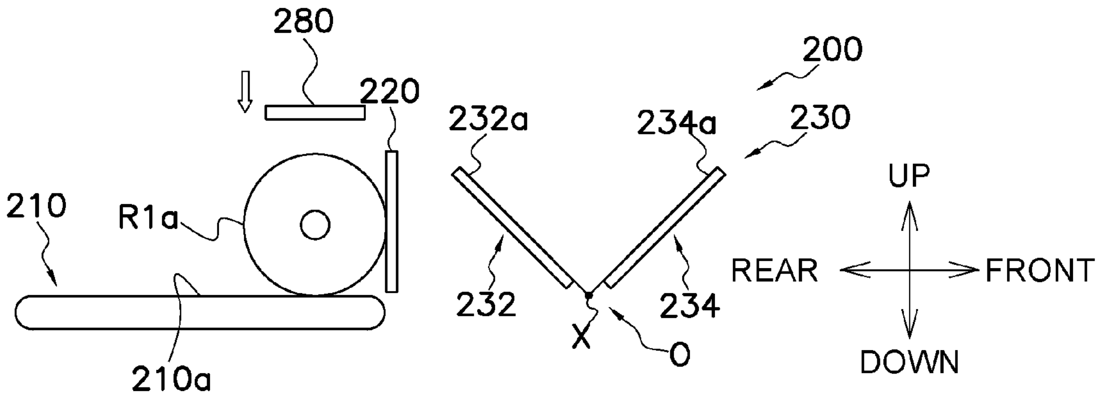
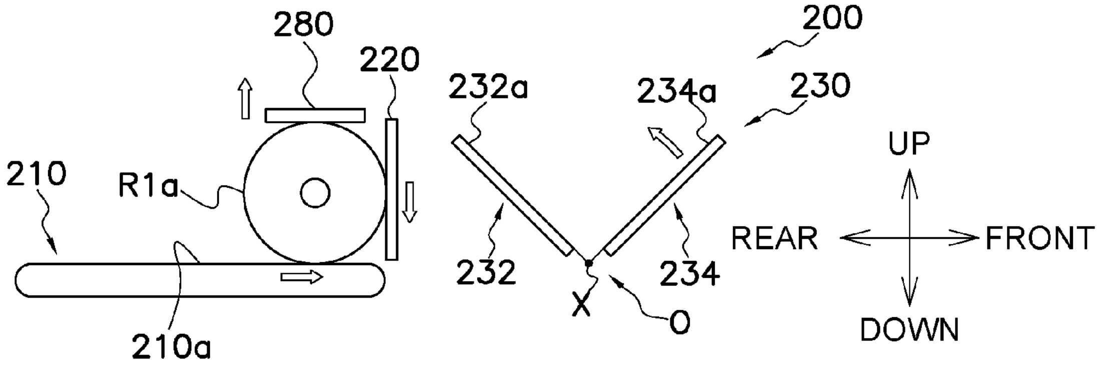
R1
272
R1b
274
210
UP
FRONT
DOWN
REAR

FIG. 11



F I G. 12A



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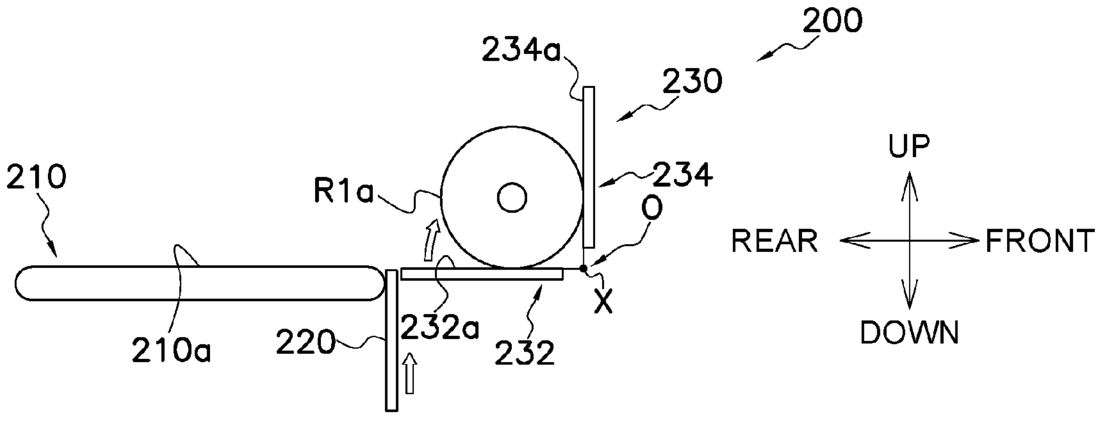
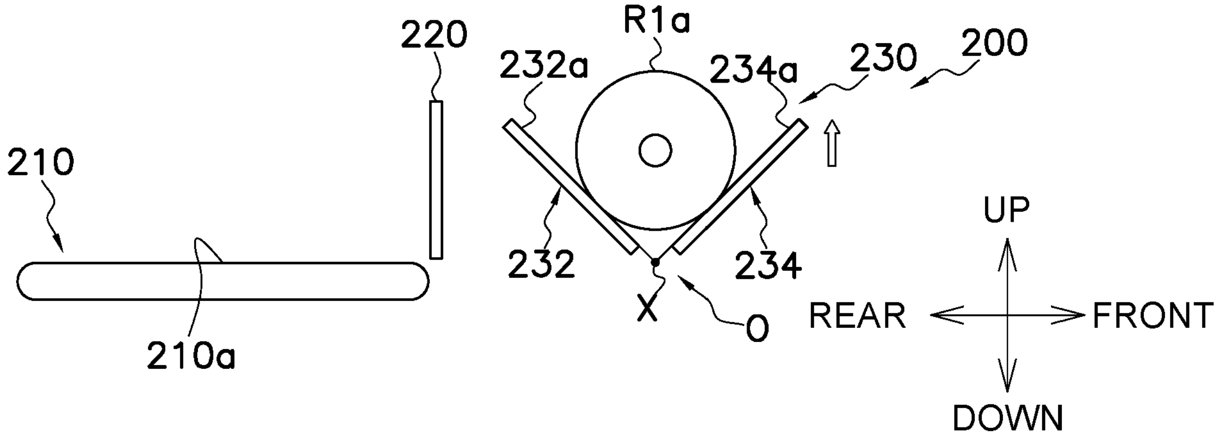
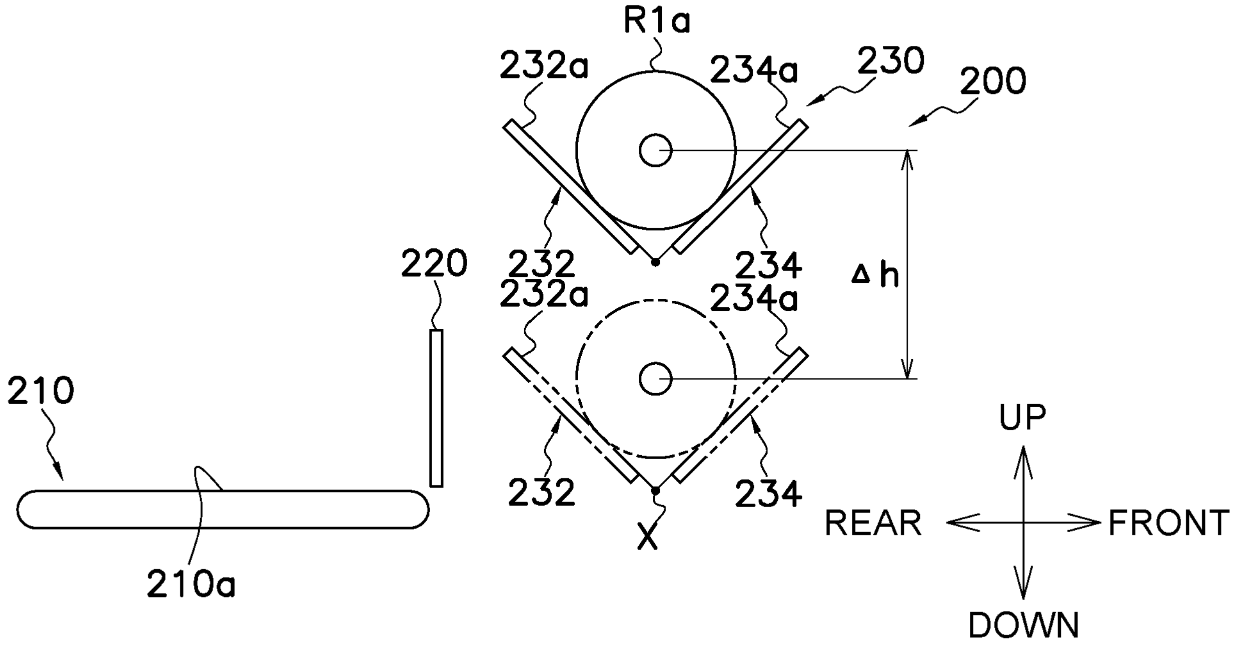


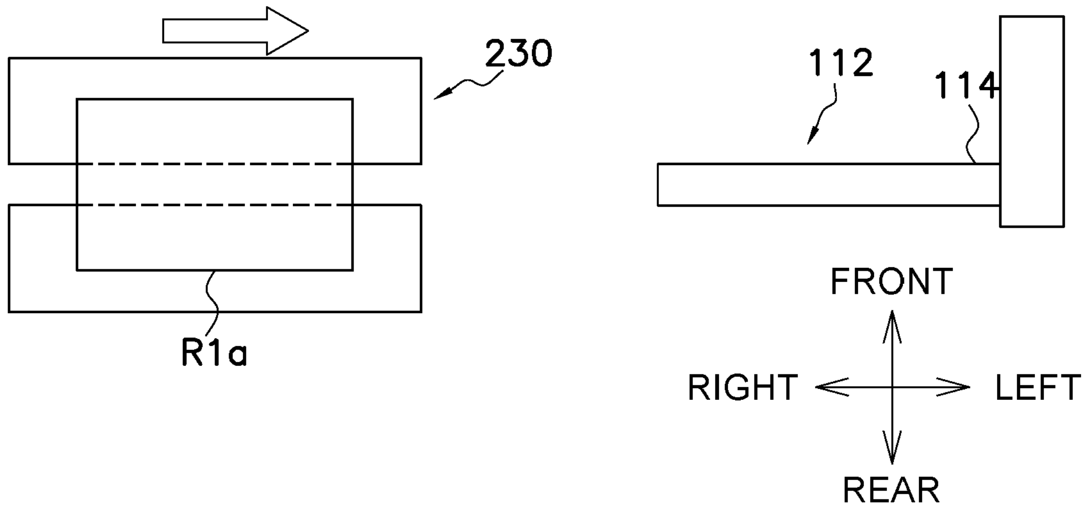
F I G. 12C



F I G. 12D



F I G. 12E



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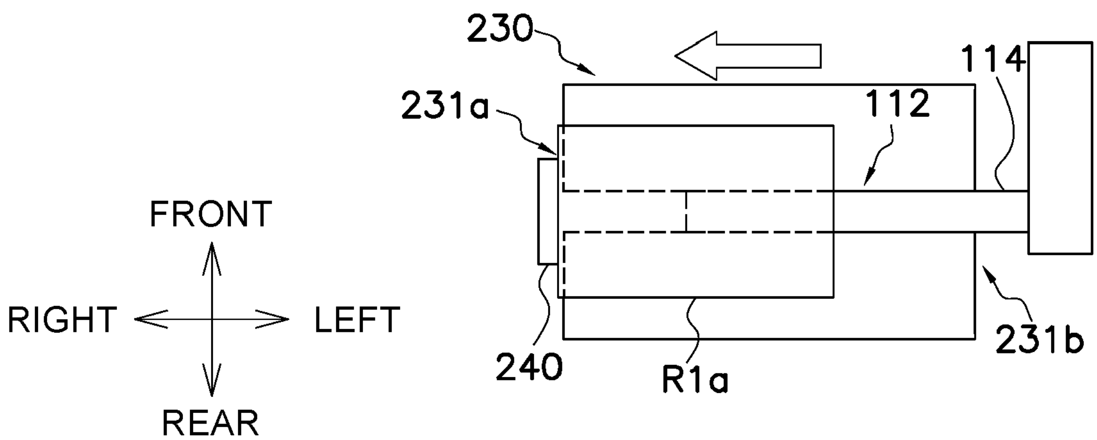

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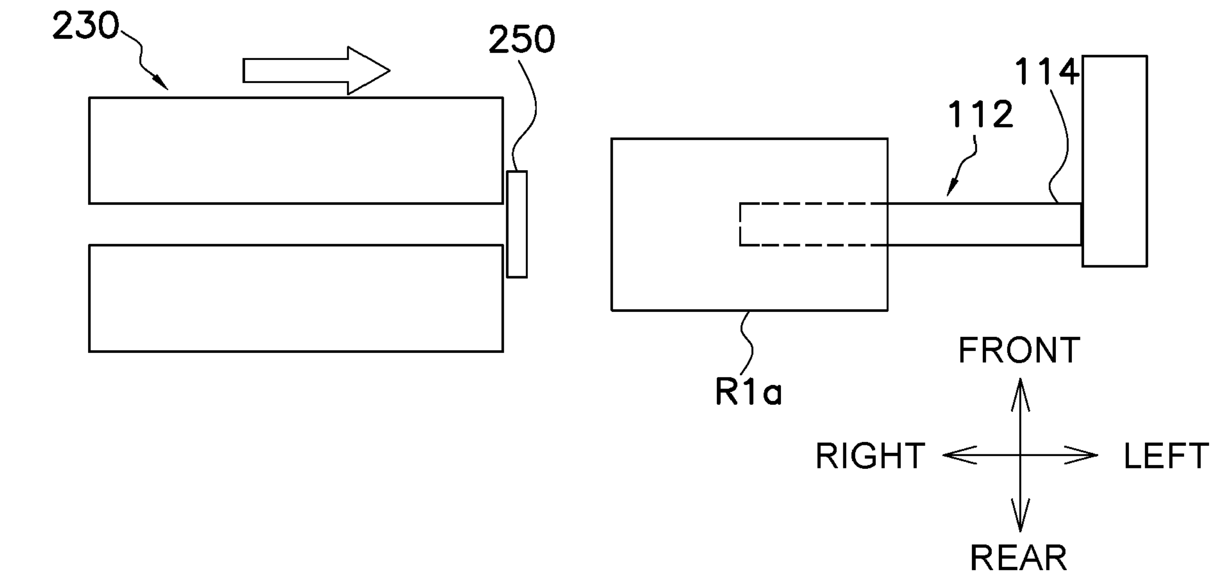

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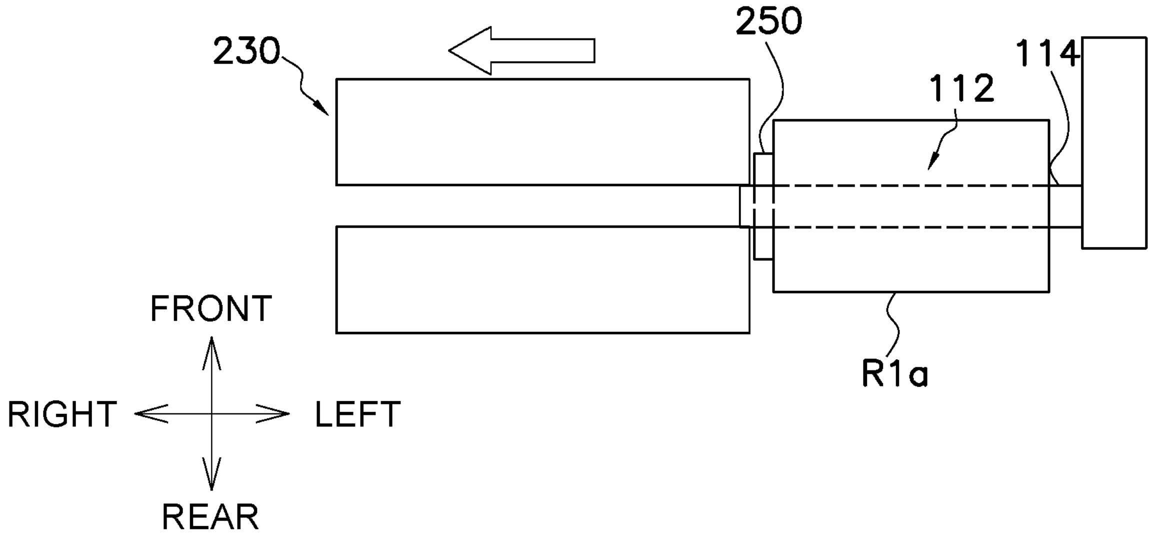

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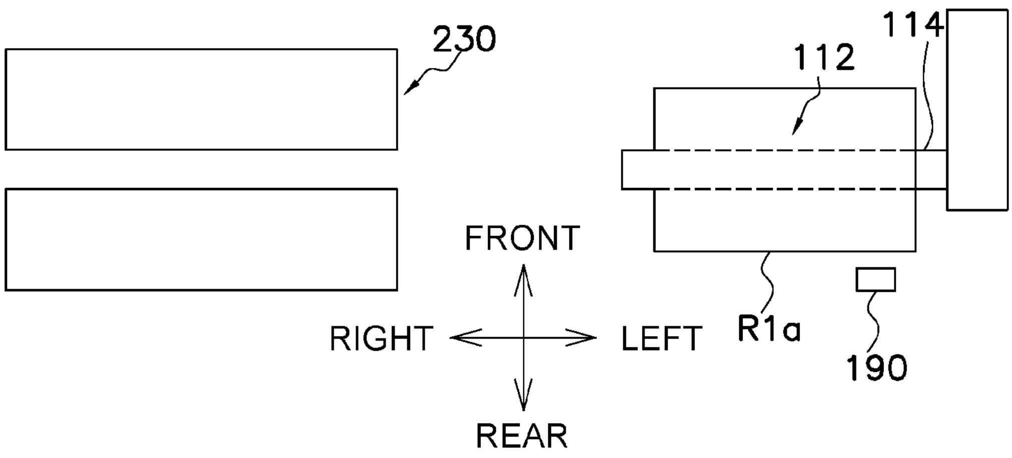

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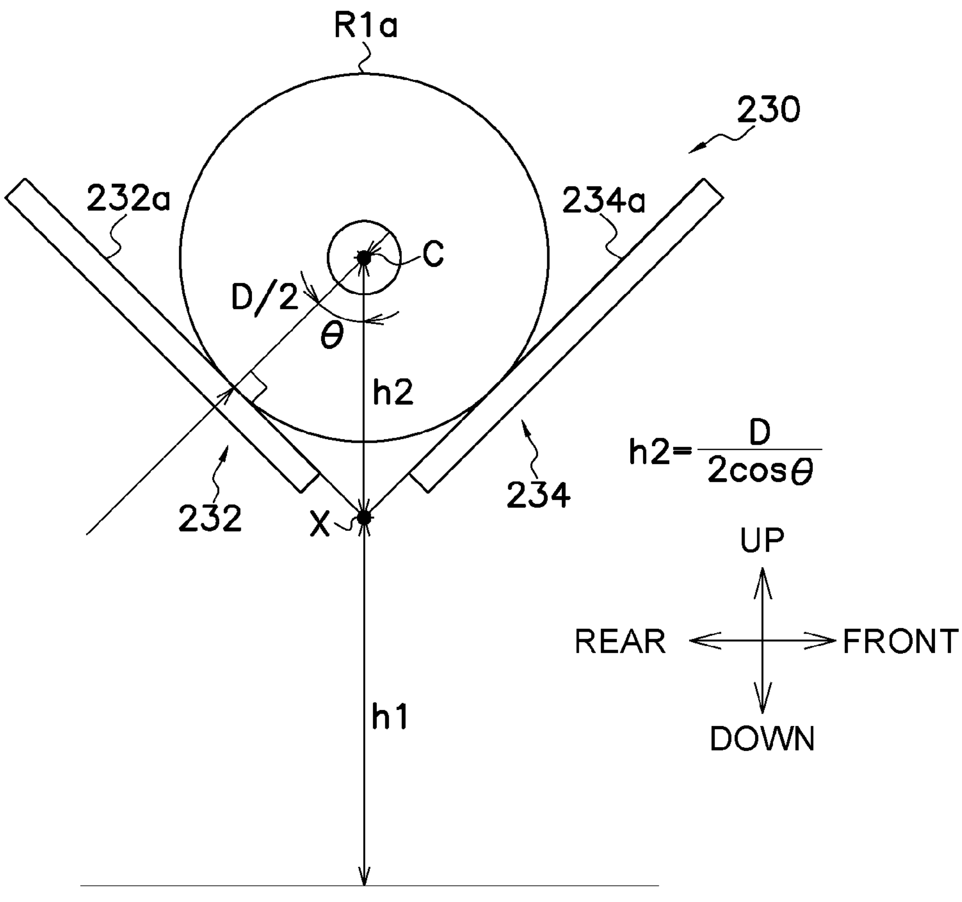
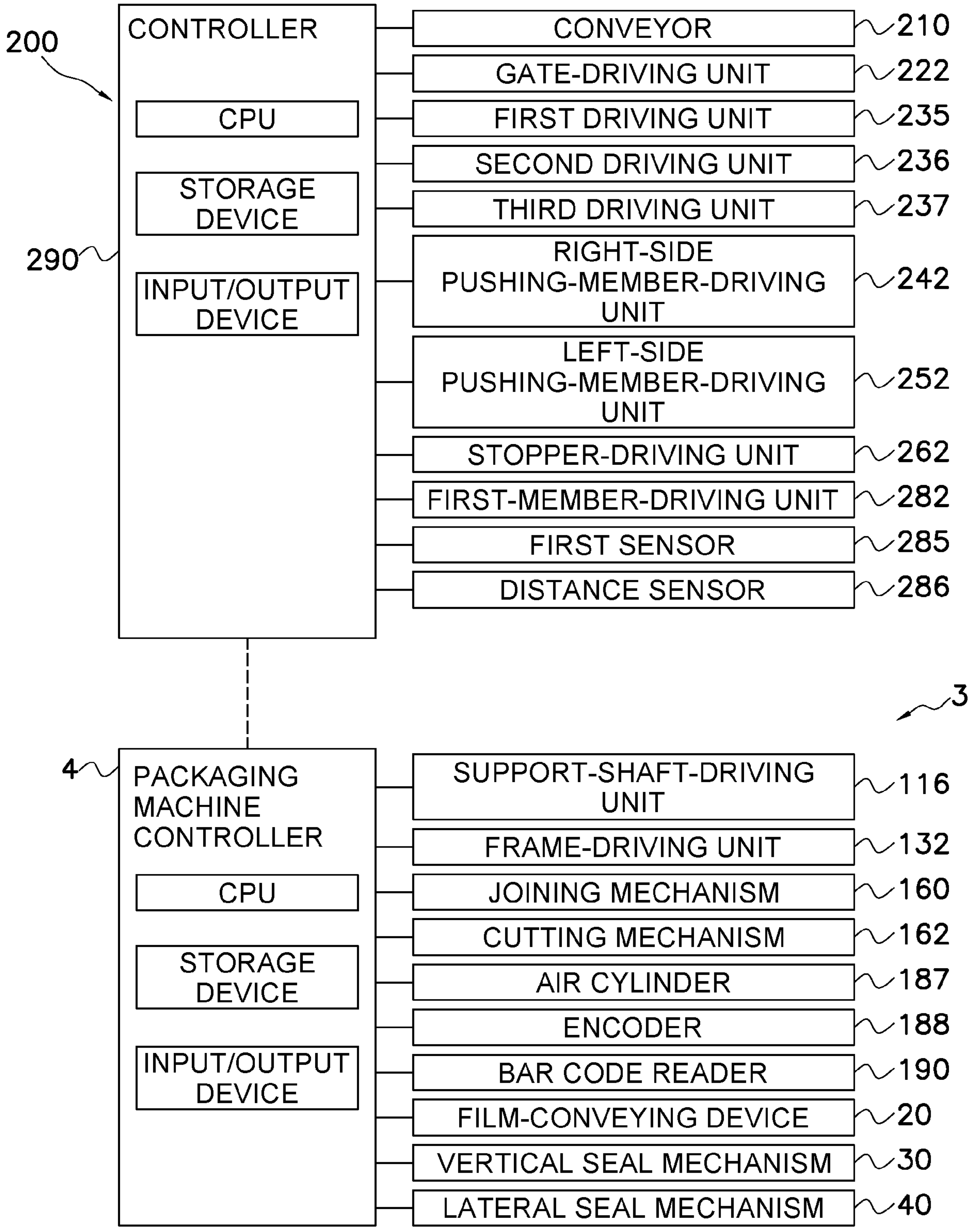


F I G. 14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INPUT/OUTPUT DEVICE
CONVEYOR
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SECOND DRIVING UNIT
236
THIRD DRIVING UNIT
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RIGHT-SIDE PUSHING-MEMBER-DRIVING UNIT
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LEFT-SIDE PUSHING-MEMBER-DRIVING UNIT
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STOPPER-DRIVING UNIT
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FIRST-MEMBER-DRIVING UNIT
282
FIRST SENSOR
285
DISTANCE SENSOR
286
3
4
PACKAGING MACHINE CONTROLLER
CPU
STORAGE DEVICE
INPUT/OUTPUT DEVICE
SUPPORT-SHAFT-DRIVING UNIT
116
FRAME-DRIVING UNIT
132
JOINING MECHANISM
160
CUTTING MECHANISM
162
AIR CYLINDER
187
ENCODER
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BAR CODE READER
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FILM-CONVEYING DEVICE
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LATERAL SEAL MECHANISM
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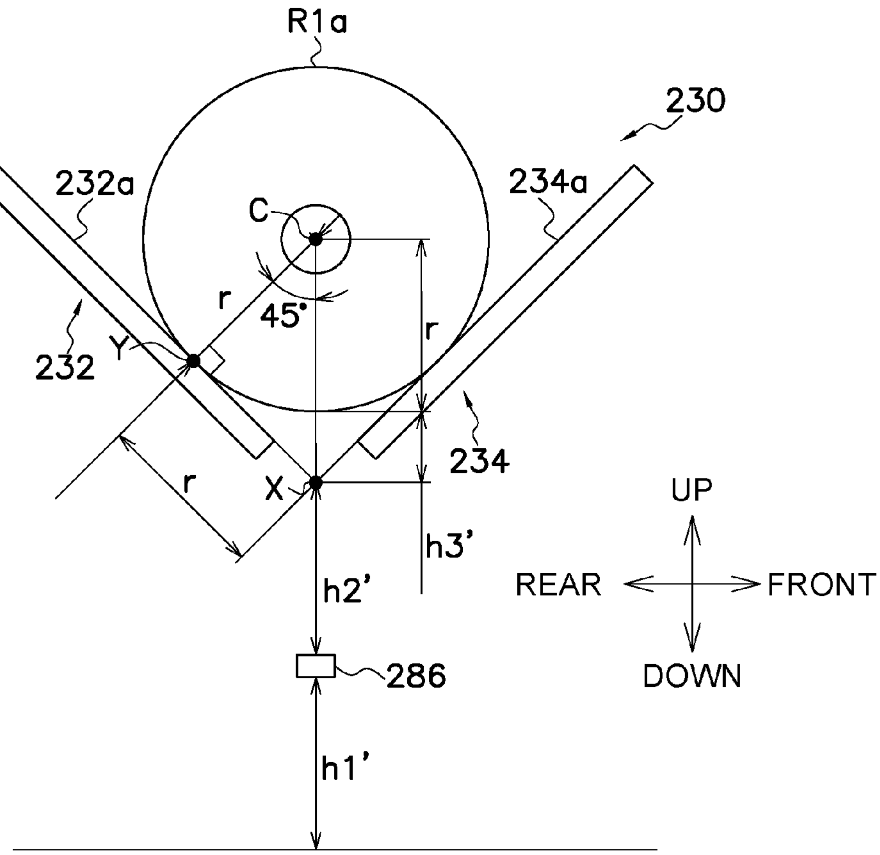
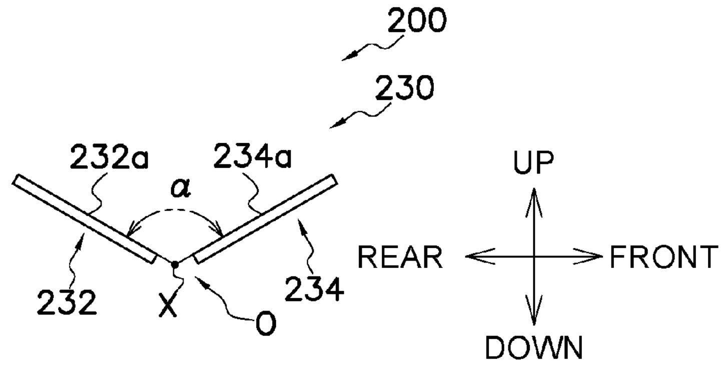
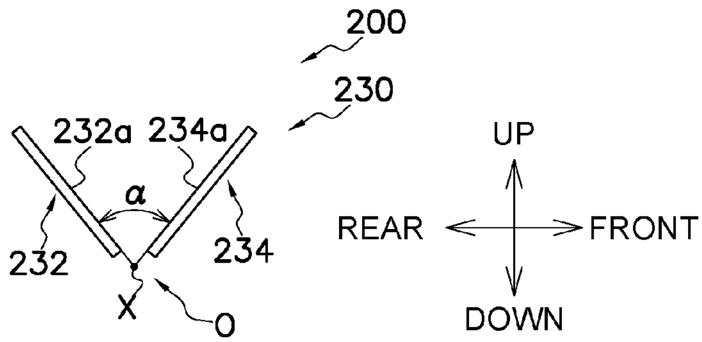
FIG. 15



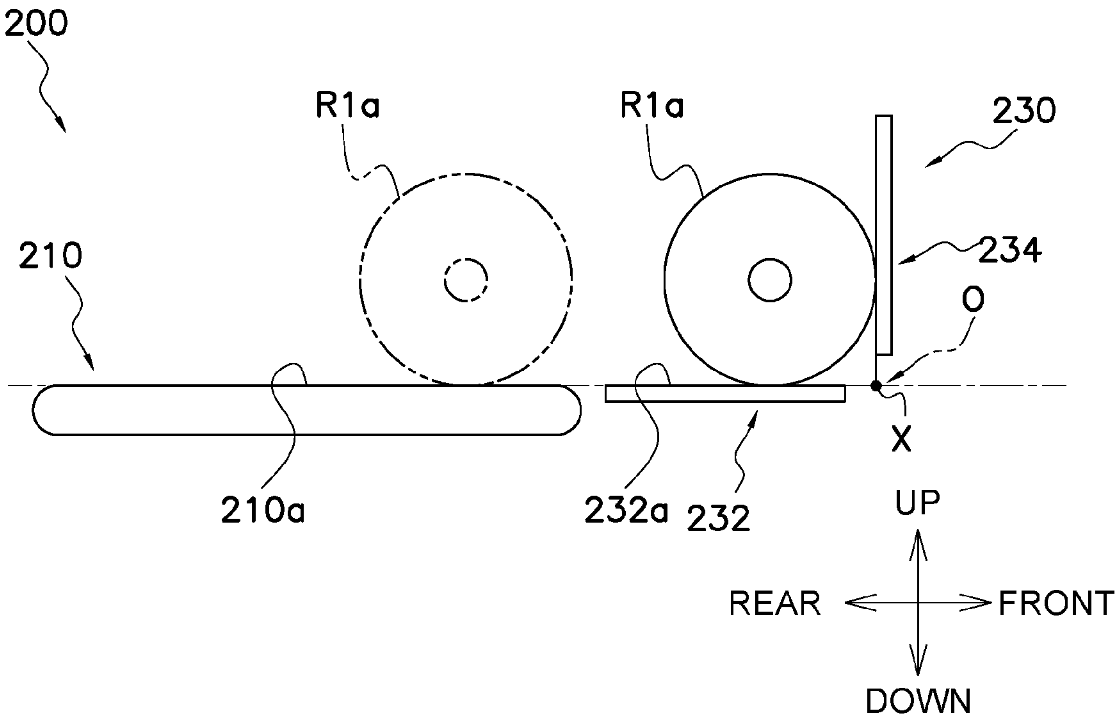
F I G. 16



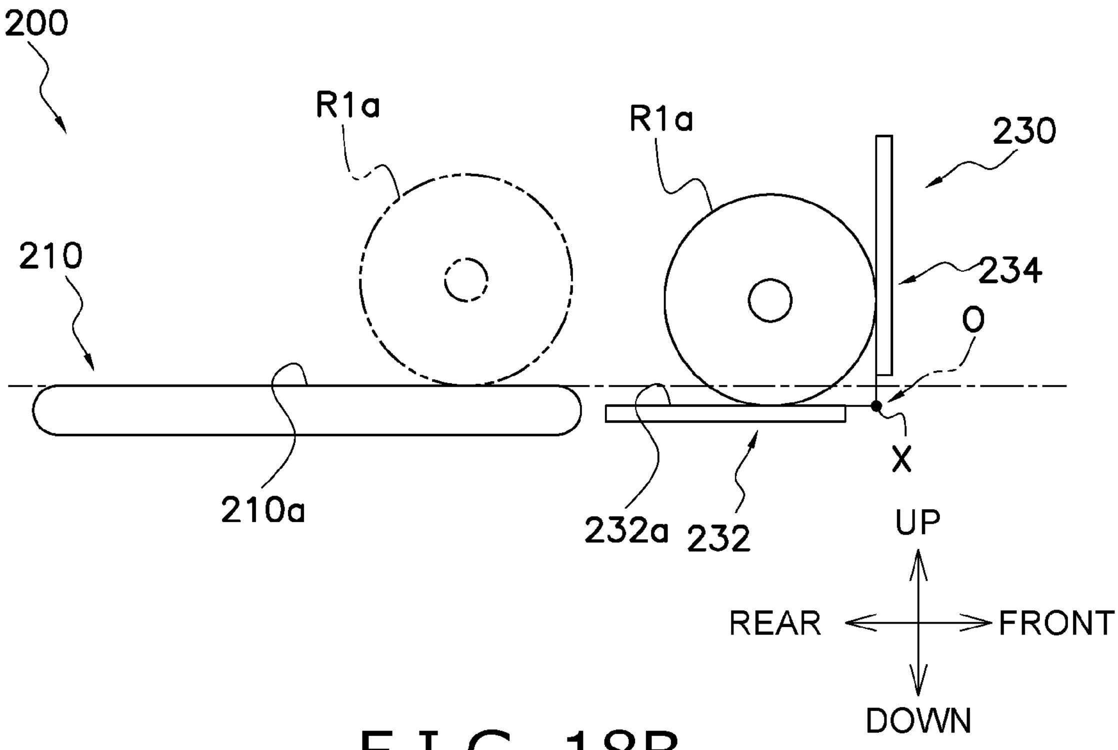
F I G. 17A



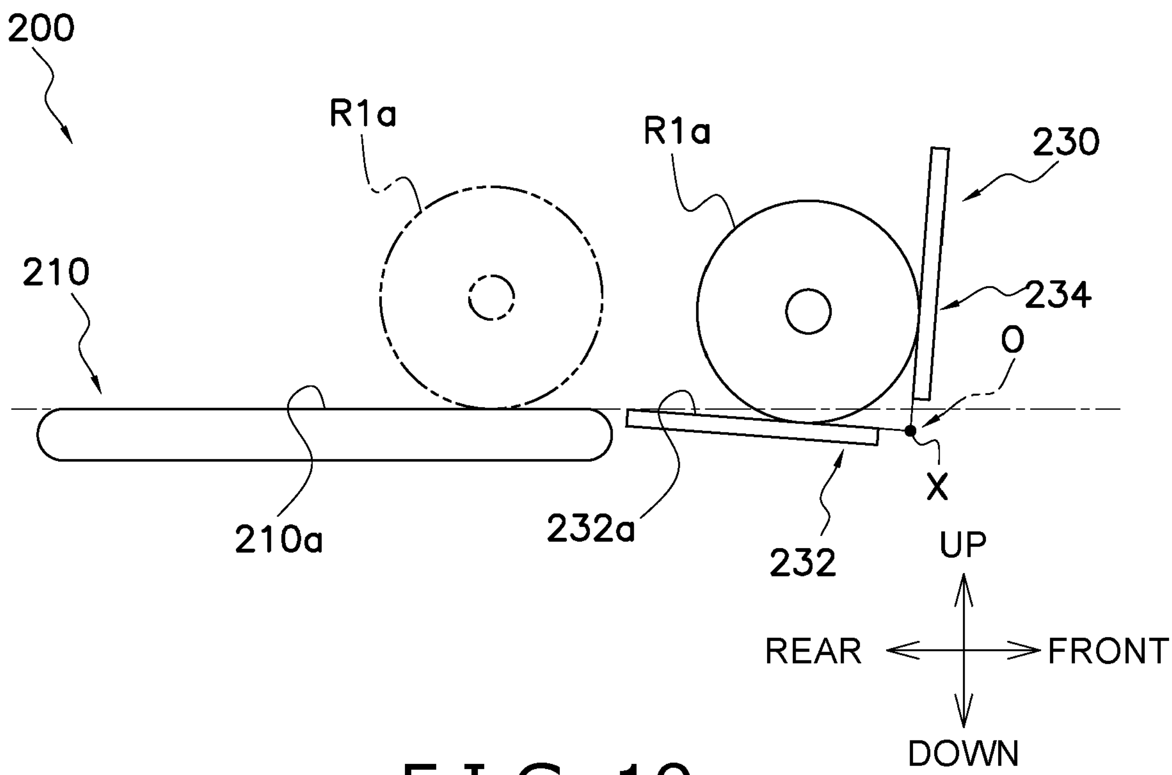
F I G. 17B



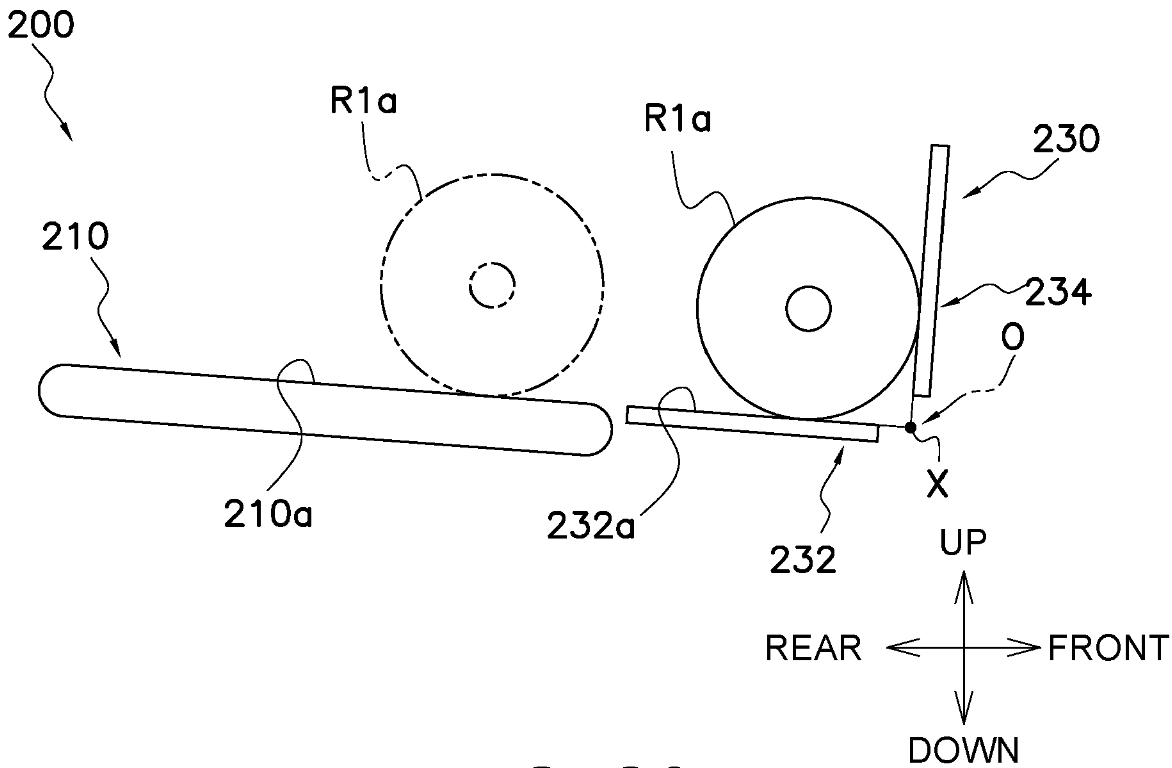
F I G. 18A



F I G. 18B


200
R1a
R1a
230
210
234
O
210a
232a
232
X
UP
REAR
FRONT
DOWN

F I G. 19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R1a
R1a
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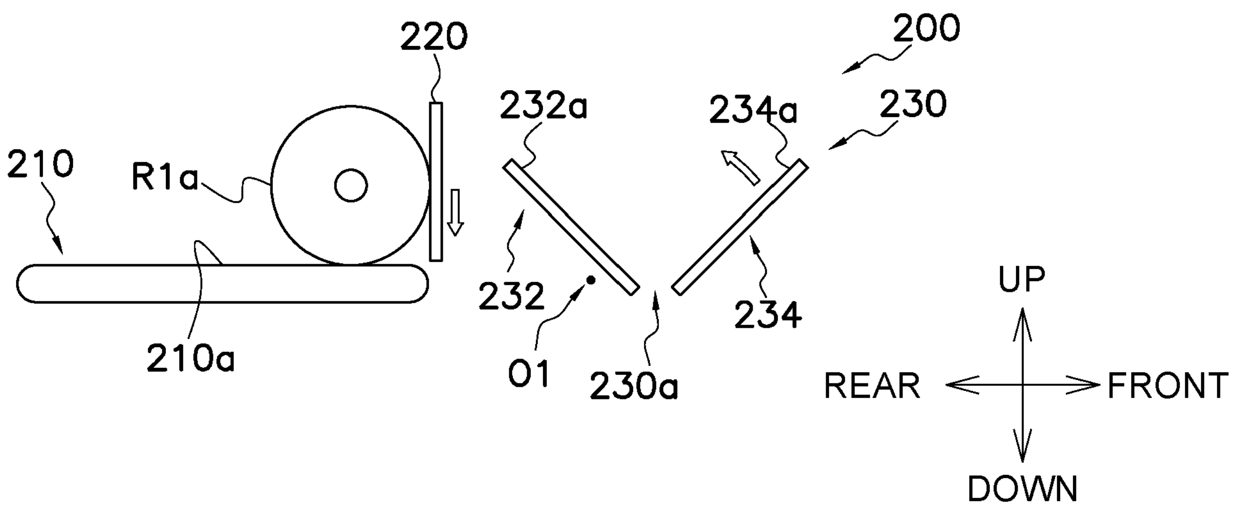
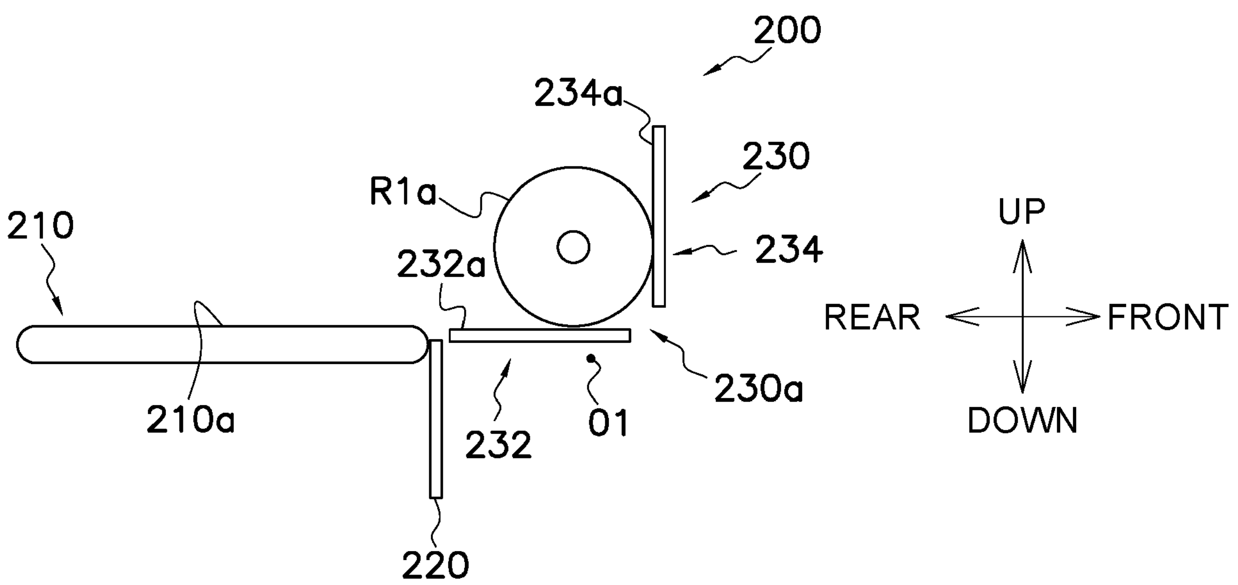
234
O
210a
232a
232
X
UP
REAR
FRONT
DOWN

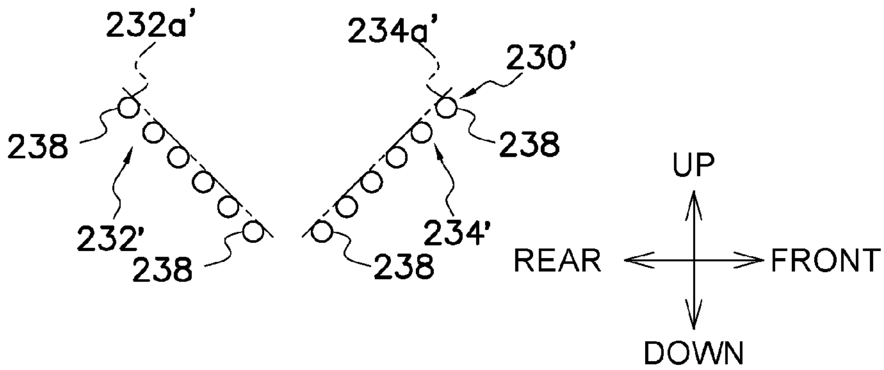
F I G. 20



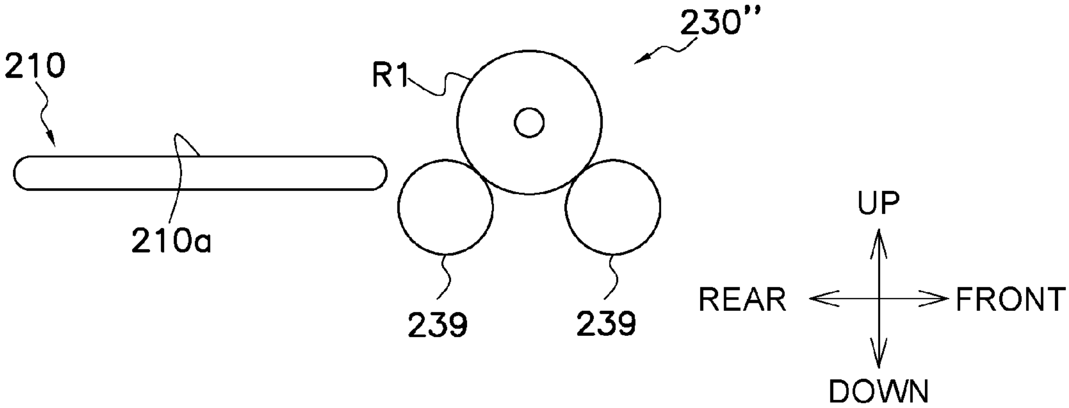
F I G. 21A



F I G. 21B



F I G. 22



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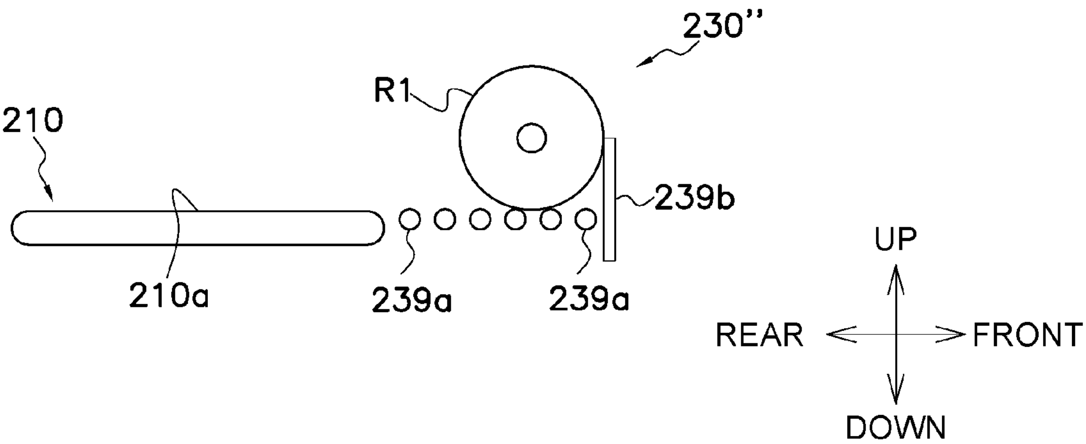

F I G. 24

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European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 23 19 6114

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	EP 0 524 828 B1 (ISHIDA SEISAKUSHO [JP]) 20 December 1995 (1995-12-20) * column 1, lines 1-25, 40-50 * * column 5, line 25 - column 6, line 3 * * figures 1-4 * -----	1-5 6-10	INV. B65H19/12 B65B41/16
X A	US 2018/141772 A1 (PRANKL IRMENGARD [DE] ET AL) 24 May 2018 (2018-05-24) * paragraphs [0026], [0041], [0053], [0072] - [0075] * * figures 1, 2, 6A-6C * -----	1-3 4-10	

TECHNICAL FIELDS SEARCHED (IPC)

B65H
B65B

The present search report has been drawn up for all claims

2

Place of search	Date of completion of the search	Examiner
The Hague	26 January 2024	Cescutti, Gabriel

CATEGORY OF CITED DOCUMENTS

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26-01-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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- JP 2022143032 A **[0001]**
- JP 2002337817 A **[0003] [0004] [0249]**