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(54)

BOXING SYSTEM

(57)

A boxing system (100) is equipped with a first conveyor (10) and a second conveyor (20) that convey packages (O) at predetermined intervals in a conveyance area da, a robot (30) that simultaneously holds and transports a package group (G), and a control device (70). The control device (70) controls the robot (30) to cause it to accumulate the package groups (G) in a boxing area (aa). A first command generating component (72) of the control device (70) generates a first command to have the package group (G) directly transported from the conveyance area to the boxing area. A second command generating component (72) generates a second command to transport the package group (G) from the conveyance area to a temporary placement area (ta) different from the boxing area. A third command generating component (73) generates a third command to transport the package group (G) from the temporary placement area to the boxing area. A command component (75) causes the robot (30) to execute the first command, the second command, and the third command to accumulate the package groups (G) in the boxing area.

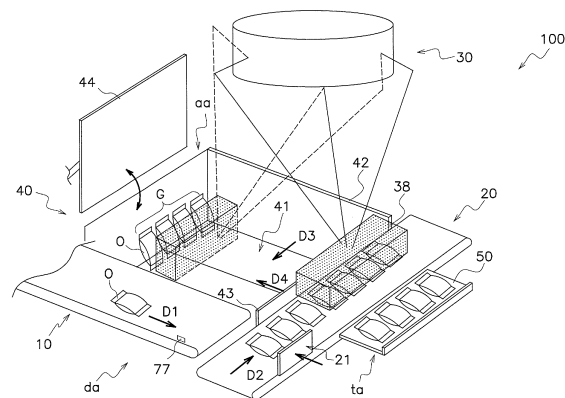


FIG. 1

Description

TECHNICAL FIELD

[0001] The present invention relates to a boxing system.

BACKGROUND ART

[0002] Conventionally, there has been a boxing system that conveys objects by means of a conveyance device, utilizes a robot to transfer the objects to another location midway in the conveyance, and then boxes the objects. For example, JP-A No. 2011-213412 discloses a boxing system equipped with robots having arms and suction components. The robots suck and take hold of, by means of the suction components, objects conveyed by one conveyance device and then drive the arms to transfer the objects to another conveyance device.

SUMMARY OF INVENTION

<Technical Problem>

[0003] In this connection, in the boxing system disclosed in the above document (JP-A No. 2011-213412), in order to accelerate the boxing process, a boxing process that forms an object group comprising a predetermined number of objects and then moves the object group to a box is performed.

[0004] Here, in a case where a plurality of the object groups are to be packed in one box, it is preferred that a predetermined number of object groups to be boxed be packed in the box at one time in order to improve the efficiency of the boxing process. In this case, the predetermined number of object groups are first accumulated in a predetermined area, and then the predetermined number of object groups are transported from the predetermined area to the box. While the predetermined number of object groups are being transported from the predetermined area to the box, a new accumulation process cannot be executed in the predetermined area, and the accumulation process temporarily stops. As a result, even if the conveyance devices and the robots are operated at a high speed, it is difficult to sufficiently accelerate the boxing process.

[0005] It is a problem of the present invention to provide a boxing system that can realize an acceleration of the boxing process.

<Solution to Problem>

[0006] A boxing system pertaining to the present invention is equipped with a conveyance device, a robot, and a control device. The conveyance device is configured to convey objects at predetermined intervals in a conveyance area. The robot is configured to simultaneously hold and transport an object group comprising a

plurality of the objects. The control device is configured to control the robot to cause it to accumulate the object groups in a boxing area. The control device has a first command generating component, a second command generating component, a third command generating component, and a command component. The first command generating component is configured to generate a first command to have the object group directly transported from the conveyance area to the boxing area. The second command generating component is configured to generate a second command to transport the object group from the conveyance area to a temporary placement area different from the boxing area. The third command generating component is configured to generate a third command to transport the object group from the temporary placement area to the boxing area. The command component is configured to cause the robot to execute the first command, the second command, and the third command to accumulate the object groups in the boxing area.

[0007] In the boxing system pertaining to the present invention, the objects conveyed by the conveyance device in the conveyance area are directly transported to the boxing area or are transported to the boxing area after first being transported to the temporary placement area. Because of this, an acceleration of the boxing process can be realized.

[0008] Furthermore, it is preferred that the command component is configured to cause the robot to execute the second command so that the object group is transported from the conveyance area to the temporary placement area during a period of time until it becomes possible to accumulate the object groups in the boxing area. Because of this, the object groups can be formed during the period of time until it becomes possible to accumulate them.

[0009] Moreover, it is preferred that the boxing system be further equipped with a shutter, a pusher, and a holding unit. The shutter includes an accumulation surface on which the object groups become accumulated and an opening and closing mechanism that is configured to open and closes the accumulation surface. The pusher is configured to apply force to the object groups accumulated on the accumulation surface to thereby gather the object groups in one location on the accumulation surface. The holding unit is configured to hold a box under the accumulation surface. The box has an opening made to face the accumulation surface. Furthermore, the shutter is configured to drive, after the object groups have been gathered in the one location on the accumulation surface by the pusher, the opening and closing mechanism to open and close the accumulation surface to thereby move the object groups on the accumulation surface to the box. Furthermore, the command component is configured to cause the robot to execute the second command until the shutter opens and closes. Because of this, the object groups can be effectively formed utilizing the time until the plurality of objects accumulated on the ac-

cumulation surface are moved to the box.

[0010] Furthermore, it is preferred that the command component is configured to cause, after causing the robot to execute the second command, the robot to execute the first command at least once and then cause the robot to execute the third command. The object group is transported to the temporary placement area and then, an amount of time later, is transported to the boxing area. Because of this, a sufficient amount of time can be ensured until it becomes possible to accumulate the objects in the boxing area.

[0011] Furthermore, it is preferred that the conveyance device has a first conveyance device and a second conveyance device. The first conveyance device is configured to receive the objects from an upstream apparatus and convey at the predetermined intervals the objects in a first posture. The second conveyance device is placed downstream of the first conveyance device and configured to convey the objects in a second posture that have been conveyed thereto by the first conveyance device. The second posture is a posture different from the first posture. Furthermore, the robot is configured to simultaneously hold and transport the object group which consists of a plurality of the objects in the second posture conveyed by the second conveyance device. The second conveyance device conveys the objects in such a way that it is easy for the robot to take hold of a plurality of the objects. Because of this, the object groups can be formed more effectively.

[0012] Furthermore, it is preferred that the boxing system is configured such that the position at which the robot takes hold of the object group be changed in accordance with the position at which the object group is conveyed. The robot does not wait for an object group to be conveyed to a predetermined position and take hold of the object group but rather moves to the position at which it has become possible for an object group to be formed and takes hold of the object group. Because of this, the boxing process can be effectively executed.

<Advantageous Effects of Invention>

[0013] According to the boxing system pertaining to the present invention, an acceleration of the boxing process can be realized.

BRIEF DESCRIPTION OF DRAWINGS

[0014]

FIG. 1 is a schematic view of a boxing system pertaining to an embodiment of the present invention. FIG. 2 is a drawing showing height positions of a first conveyor and a second conveyor.

FIG. 3 is a schematic view of a robot and shows a case where a suction head has a parallel inclination with respect to a horizontal plane.

FIG. 4 shows an example of the robot where the

inclination of the suction head with respect to the horizontal plane has been changed and the suction head has rotated in the horizontal plane.

FIG. 5 is a drawing for describing a movable suction unit and configurations connected to the movable suction unit.

FIG. 6 is a drawing for describing the flow of a boxing process.

FIG. 7 is a control block diagram.

FIG. 8 is a flowchart showing the flow of the boxing process.

FIG. 9A is a schematic plan view showing the flow of an accumulation process and the boxing process.

FIG. 9B is a schematic plan view showing the flow of the accumulation process and the boxing process.

FIG. 9C is a schematic plan view showing the flow of the accumulation process and the boxing process.

FIG. 9D is a schematic plan view showing the flow of the accumulation process and the boxing process.

FIG. 9E is a schematic plan view showing the flow of the accumulation process and the boxing process.

FIG. 9F is a schematic plan view showing the flow of the accumulation process and the boxing process.

FIG. 10 is a schematic view of a stopper pertaining to example modification B.

FIG. 11 is a drawing showing the motion of the stopper pertaining to example modification B.

FIG. 12 shows an example of a first conveyor pertaining to example modification C.

FIG. 13 shows a usage example of the boxing system pertaining to example modification D.

DESCRIPTION OF EMBODIMENT

(1) Schematic Configuration of Boxing System

[0015] FIG. 1 is a schematic view of a boxing system 100 pertaining to an embodiment of the present invention. The boxing system 100 is a system that is installed in a production line in a food factory and boxes packages (objects) O produced in the production line of the food factory. The packages O comprise objects packaged in a packaging material. For example, the packages O are bags filled with objects such as potato chips.

[0016] In the production line in the food factory, a bag-making and packaging machine (not shown in the drawings) and a package inspection apparatus are placed upstream of the boxing system 100. The bag-making and packaging machine creates the packages O. That is, the bag-making and packaging machine fills the bags with the objects while making the bags. The package inspection apparatus executes at least one of a weight inspection, a contamination inspection, and a seal inspection regarding the packages O. The packages O judged to be conforming items in the package inspection apparatus are fed to the boxing system 100.

[0017] As shown in FIG. 1, the boxing system 100 is mainly configured from a first conveyor (first conveyance

device) 10, a second conveyor (conveyance device) 20, a robot 30, an accumulation unit 40, and a temporary placement plate 50. Furthermore, the boxing system 100 is equipped with a holding unit 60 below the accumulation unit 40 (see FIG. 6). Moreover, the boxing system 100 is equipped with a control device 70 for controlling the operations of the first conveyor 10, the second conveyor 20, the robot 30, and the accumulation unit 40 (see FIG. 7). It should be noted that the control device 70 may also be disposed in the constituent elements of the first conveyor 10, the second conveyor 20, the robot 30, and the accumulation unit 40. Alternatively, one control device 70 disposed in the boxing system 100 may be configured to control the constituent elements.

[0018] The boxing system 100 is disposed in a final processing area in the food factory. As shown in FIG. 1, the final processing area is mainly divided into a conveyance area da, a boxing area aa, and a temporary placement area ta. The first conveyor 10 and the second conveyor 20 are disposed in the conveyance area da. The accumulation unit 40 and the holding unit 60 are disposed in the boxing area aa. The temporary placement plate 50 is disposed in the temporary placement area ta. The conveyance area da is placed in the neighborhood of the boxing area aa so as to partially surround the boxing area aa. The temporary placement area ta is placed in the neighborhood of the conveyance area da. Specifically, the temporary placement area ta is disposed in the neighborhood of the second conveyor 20. The robot 30 is disposed in a space above the conveyance area da and the boxing area aa.

[0019] The packages O fed from the apparatus placed upstream are delivered to the first conveyor 10 in the boxing system 100. The first conveyor 10 conveys the packages O to the second conveyor 20. The second conveyor 20 conveys the packages O in such a way that it is easy to form a package group (object group) G. The package group G consists of a predetermined number (plurality) of the packages O. That is, the second conveyor 20 conveys the plural packages O conveyed thereto by the first conveyor 10 in such a way that it is easy for the robot 30 to suck the predetermined number of packages O. In the present embodiment, the package group G consists of four packages O (see FIG. 1).

[0020] The robot 30 accumulates a predetermined number (plurality) of package groups G in the accumulation unit 40. In the present embodiment, the "predetermined number of package groups G" means five package groups G (see FIG. 6). Specifically, the robot 30 sucks and holds, and transports to the boxing area aa, the predetermined number of packages O (the package group G) among the plural packages O conveyed by the second conveyor 20. Furthermore, the robot 30 sucks and holds the predetermined number of packages O (the package group G) from the plural packages O conveyed by the second conveyor 20 and temporarily places the package group G on the temporary placement plate 50. Then, the robot 30 transports the package group G on the tempo-

rary placement plate 50 to the accumulation unit 40.

[0021] The holding unit 60 is disposed under the accumulation unit 40. The holding unit 60 holds, under the accumulation unit 40, a box B for packing the predetermined number of package groups G. The predetermined number of package groups G accumulated in the accumulation unit 40 are packed in the box B.

(2) Detailed Configuration of Boxing System

(2-1) First Conveyor

[0022] The first conveyor 10 conveys the plural packages O toward the second conveyor 20. Specifically, the first conveyor 10 conveys the packages O that have been made by the bag-making and packaging machine and traveled through the package inspection apparatus.

[0023] The first conveyor 10 conveys the packages O at predetermined intervals in the conveyance area da. Here, the "predetermined intervals" means distance intervals or time intervals of the packages O that are conveyed thereto from the upstream apparatus.

[0024] The first conveyor 10 is a belt conveyor having an endless belt entrained about drive rollers and driven rollers. The first conveyor 10 conveys the packages O in a first posture. Here, the first posture is the posture of the packages O as they have been received from the apparatus placed upstream. That is, the first conveyor 10 conveys the packages O downstream without changing their posture. In the present embodiment, the first posture is a posture where seal portions positioned on the tops and bottoms of the packages O are positioned on the conveyance direction upstream side and downstream side. In other words, the first posture is a posture where the upward and downward direction of the packages O extends along a conveyance direction D1.

[0025] The first conveyor 10 conveys the packages O along the conveyance direction D1. The first conveyor 10 continuously conveys the packages O. The first conveyor 10 has a configuration capable of conveying the packages O at a speed of 100 to 130 packages per minute. In the present embodiment, the first conveyor 10 conveys the packages O at a speed of 120 packages per minute. Furthermore, the first conveyor 10 conveys the packages O downstream at a speed of 60 m/min when conveying the packages O at about 50 cm intervals.

(2-2) Second Conveyor

[0026] The second conveyor 20 is placed downstream of the first conveyor 10 and conveys the plural packages O received from the first conveyor 10. The second conveyor 20 conveys the plural packages O received from the first conveyor 10 in such a way that it is easy to form the package group (object group) G. As mentioned above, the package group G consists of the predetermined number (four) of packages O. The second conveyor 20 functions as a location for delivering the pack-

age group G to the robot 30. That is, the second conveyor 20 conveys the plural packages O in such a way that it is easy for the robot 30 to suck the package group O. Like the first conveyor 10, the second conveyor 20 is also a belt conveyor having an endless belt entrained about drive rollers and driven rollers.

[0027] As shown in FIG. 1, the second conveyor 20 is placed in the conveyance area da in such a way that its upstream side end portion is adjacent to the downstream side end portion of the first conveyor 10. Furthermore, the second conveyor 20 extends in a direction orthogonal to the direction in which the first conveyor 10 extends. That is, a conveyance direction D2 in which the packages O are conveyed by the second conveyor 20 is orthogonal to the conveyance direction D1 in which the packages O are conveyed by the first conveyor 10. That is, in the final processing area, the conveyance area da is arranged in an L-shape and the plural packages O are conveyed in an L-shape.

[0028] The second conveyor 20 has a configuration where its height position is capable of being changed. As shown in FIG. 2, the second conveyor 20 is adjusted to a height position at which it catches, in a lower position, the packages O that have been conveyed thereto by the first conveyor 10. In other words, the second conveyor 20 is adjusted to be in a position a predetermined dimension h lower than the first conveyor 10. The predetermined dimension h is appropriately changed in accordance with the length dimension of the packages O. Specifically, as the length dimension of the packages O becomes greater, the predetermined dimension h becomes greater, and as the length dimension of the packages O becomes smaller, the predetermined dimension h also becomes smaller.

[0029] A stopper 21 is disposed on the upstream side end portion side of the second conveyor 20. The stopper 21 regulates the positions of the packages O that have fallen from the first conveyor 10. The stopper 21 has a configuration where its position is capable of being adjusted in the width direction of the belt of the second conveyor 20. Specifically, the stopper 21 is placed above the belt of the second conveyor 20 and at a predetermined interval from the belt. The dimension, in the width direction of the belt of the second conveyor 20, from the stopper 21 to the end portion of the second conveyor 20 in the neighborhood of the downstream side end portion of the first conveyor 10 is adjusted so as to be a length equal to the package O length $1 + \alpha$ (see FIG. 2).

[0030] The second conveyor 20 conveys the packages O in a second posture. Here, the second posture is a posture different from the first posture. The second posture is a posture where the seal portions of the packages O are positioned on the top and bottom in the width direction orthogonal to the conveyance direction D2 of the second conveyor 20. In other words, the second posture is a posture where the upward and downward direction of the packages O extends along the width direction of the belt of the second conveyor 20. That is, the posture

of the packages O with respect to the conveyance direction D2 of the second conveyor 20 changes 90° from the posture of the packages O with respect to the conveyance direction D1 of the first conveyor 10.

[0031] The second conveyor 20 conveys the packages O along the conveyance direction D2. The second conveyor 20 operates intermittently on the basis of the detection of the packages O by a sensor 77. The second conveyor 20 conveys the packages O downstream at the same speed as that of the first conveyor 10 or a faster speed than that of the first conveyor 10.

(2-3) Robot

[0032] The robot 30 simultaneously holds and transports the predetermined number (plurality) of packages O (the package group G) conveyed by the second conveyor 20. In other words, the robot 30 simultaneously holds and transports four packages O from the plural packages O on the belt of the second conveyor 20.

[0033] The robot 30 transports the package group G to the accumulation unit 40 disposed in the boxing area aa. Furthermore, the robot 30 transports the package group G to the temporary placement plate 50 disposed in the temporary placement area ta and then transports to the accumulation unit 40 the package group G transported to the temporary placement plate 50. The robot 30 is driven on the basis of commands generated by the control device 70 described later.

[0034] The robot 30 is a parallel link robot. As shown in FIG. 3, the robot 30 is mainly equipped with a base 32, three servo motors 33a, 33b, and 33c, three arms 34a, 34b, and 34c, and a movable suction unit 38.

(2-3-1) Base

[0035] The base 32 configures the upper end portion of the robot 30. The base 32 is, as mentioned above, placed in a space above the conveyance area da and the boxing area aa. The three servo motors 33a, 33b, and 33c described later are attached at equidistant intervals under the base 32.

(2-3-2) Arms and Servo Motors

[0036] The three arms 34a, 34b, and 34c are driven by the servo motors 33a, 33b, and 33c, respectively. The upper ends of the arms 34a, 34b, and 34c are coupled to output shafts of the servo motors 33a, 33b, and 33c, respectively. The lower ends of the arms 34a, 34b, and 34c are coupled to the movable suction unit 38. That is, the arms 34a, 34b, and 34c extend from the output shafts of the servo motors 33a, 33b, and 33c, respectively, to the movable suction unit 38. The lower ends of the arms 34a, 34b, and 34c move in the horizontal direction and the vertical direction as a result of the amount of rotation and the direction of rotation of the output shafts of the servo motors 33a, 33b, and 33c being appropriately con-

trolled.

(2-3-3) Movable Suction Unit

[0037] The movable suction unit 38 sucks the predetermined number of packages O (the package group G). The movable suction unit 38 moves in the horizontal direction and the vertical direction as a result of the arms 34a, 34b, and 34c being driven. Specifically, the movable suction unit 38 has a configuration where it is movable to arbitrary positions in a fixed three-dimensional space as a result of the lower ends of the arms 34a, 34b, and 34c being moved in the horizontal direction and the vertical direction. In the present embodiment, the movable suction unit 38 is movable in the region on the downstream side of the first conveyor 10, the entire region of the second conveyor 20, and above the boxing area aa and the temporary placement area ta as a result of the movable suction unit 38 moving in the fixed three-dimensional space. That is, the picking range of the robot 30 is the region on the downstream side of the first conveyor 10, the entire region of the second conveyor 20, the boxing area aa, and the temporary placement area ta.

[0038] The movable suction unit 38 has a suction head 38a and plural suction components 38b. The suction head 38a is attached via a rotary cylinder 39 to the lower ends of the arms 34a, 34b, and 34c. The suction head 38a changes its inclination with respect to a reference plane (horizontal plane) orthogonal to the vertical direction (see arrow A1 in FIG. 4). Specifically, the suction head 38a can change its inclination 70° with respect to the horizontal plane. Furthermore, the suction head 38a rotates in the horizontal plane (see arrow A2 in FIG. 4). The suction head 38a changes its orientation with respect to the horizontal plane and/or rotates in the horizontal plane when accumulating the package groups G in the boxing area aa.

[0039] The suction head 38a comprises a rectangular upper surface and lower surface and side surfaces placed between the upper surface and the lower surface, and an inside space is formed by the upper surface, the lower surface, and the side surfaces. Furthermore, the suction head 38a has a coupling port 38c and plural openings not shown in the drawings. The coupling port 38c and the plural openings allow the inside space and the outside space to be communicated with each other. The coupling port 38c is disposed in the upper surface of the suction head 38a. A suction hose 36 is connected to the coupling port 38c. The plural openings are disposed in the lower surface of the suction head 38a. The suction components 38b are attached to the plural openings.

[0040] The plural suction components 38b are sections that contact the packages O. The plural suction components 38b are each made of an elastic member. In the present embodiment, fifteen suction components 38b are attached to the suction head 38a. Specifically, five suction components 38b are attached along the longitudinal direction of the suction head 38a, and three suction com-

ponents 38b are attached along the transverse direction. In the present embodiment, a total of four packages O—a leading package O and three packages O conveyed after the leading package O—are sucked by the fifteen suction components 38b.

[0041] The movable suction unit 38 has a configuration where it is capable of being switched between a state in which it sucks the packages O (a suction state) and a state in which it does not suck the packages O (a non-suction state). When the movable suction unit 38 is switched to the suction state, it becomes possible for the suction components 38b to suck the packages O. When the movable suction unit 38 is switched to the non-suction state, it becomes impossible for the suction components 38b to suck the packages O. That is, the movable suction unit 38 picks and releases the packages O (the package group G) as a result of being switched between the suction state and the non-suction state.

[0042] As shown in FIG. 5, the suction hose 36 extends from a vacuum pump (suction blower) 36a. A first valve 36b is attached to the suction hose 36. When the first valve 36b is opened, negative pressure is created inside the suction hose 36. Furthermore, a compressed air tube 37 is disposed inside the suction hose 36. The compressed air tube 37 extends from a compressed air supply component 37a. A second valve 37b is attached to the compressed air tube 37. When the second valve 37b is opened, compressed air (high-pressure air) supplied from the compressed air supply component 37a flows to the compressed air tube 37.

[0043] When the first valve 36b is opened and the second valve 37b is closed, the movable suction unit 38 is switched to the state in which it is capable of sucking the packages O (the suction state). That is, at this time, the movable suction unit 38 sucks the package group G by means of the plural suction components 38b. When the first valve 36b is closed and the second valve 37b is opened, the movable suction unit 38 is switched to the state in which it cannot suck the packages O (the non-suction state). That is, at this time, the movable suction unit 38 cancels the suction of the package group G by the plural suction components 38b.

[0044] It should be noted that the position at which the movable suction unit 38 sucks the package group G is changed in accordance with the position at which the package group G is being conveyed. In other words, the position at which the robot 30 sucks the package group G changes in accordance with the conveyance circumstances of the package group G. Specifically, the movable suction unit 38 adjusts the positions of the suction components 38b on one end side in the longitudinal direction of the movable suction unit 38 to the position of the leading package (first package) O of the plural packages O conveyed by the second conveyor 20. Furthermore, the movable suction unit 38 adjusts the position of the suction components 38b on the other end side in the longitudinal direction of the movable suction unit 38 to the position of the fourth package O from the leading

package O.

(2-4) Accumulation Unit

[0045] The accumulation unit 40 is disposed in the boxing area aa and accumulates the predetermined number of package groups G. The accumulation unit 40 is placed above the box B held by the holding unit 60. The accumulation unit 40 accumulates the predetermined number of package groups G and then moves the predetermined number of package groups G to the box B. In the present embodiment, five package groups G are accumulated by the accumulation unit 40 (see FIG. 1 and FIG. 6(a) to (d)). As shown in FIG. 1, the accumulation unit 40 mainly comprises a shutter 41, a first pusher 42, a second pusher 43, and a third pusher 44.

[0046] The shutter 41 is a mechanism capable of being opened and closed with respect to the opening of the box B. The shutter 41 includes an accumulation surface on which the predetermined number of package groups G become accumulated and an opening and closing mechanism that opens and closes the accumulation surface. The package groups G transported by the robot 30 are placed on the accumulation surface. The package groups G are stacked upright on the accumulation surface. The "stacked upright" means that, as shown in FIG. 1, the packages O are lined up in such a way that the flat surfaces (front surfaces and back surfaces) of the packages O intersect the accumulation surface. The shutter 41 consists of two doors. The shutter 41 has a configuration where it opens and closes as a result of the two doors moving toward and away from each other. Specifically, when the two doors move away from each other, the shutter 41 opens, and when the two doors move toward each other, the shutter 41 becomes closed. In a closed state the shutter 41 becomes the accumulation surface capable of accumulating the predetermined number of package groups G.

[0047] The first pusher 42 and the second pusher 43 gather in one location on the accumulation surface the predetermined number of package groups G accumulated on the accumulation surface. Specifically, the first pusher 42 moves from a standby position in a first direction D3 and applies force to the predetermined number of package groups G (see FIG. 1 and FIG. 9A). In other words, the first pusher 42 applies force from outside in the opening and closing direction of the shutter 41 (a side direction of the predetermined number of package groups G). The second pusher 43 moves from a standby position in a direction (second direction) D4 orthogonal to the moving direction of the first pusher 42 (the first direction D3) and applies force to the predetermined number of package groups G (see FIG. 1 and FIG. 9A). Specifically, the second pusher 43 applies force to the predetermined number of package groups G by moving from the downstream side in the stacking direction of the predetermined number of package groups G to the upstream side.

[0048] The third pusher 44 applies force from above to the predetermined number of package groups G accumulated on the accumulation surface to thereby move the predetermined number of package groups G to the box B. That is, the standby position of the third pusher 44 is above the shutter 41. The third pusher 44 has a configuration where it is capable of rotating in the upward and downward direction. The third pusher 44 rotates downward and applies force from above to the predetermined number of package groups G (see FIG. 1 and FIG. 6(c)).

[0049] That is, the predetermined number of package groups G are gathered in one location on the accumulation surface by the first pusher 42 and the second pusher 43 (see FIG. 6(a) and FIG. 6(b)). Then, force is applied to the predetermined number of package groups G from above by the third pusher 44 (see FIG. 6(c)). Then, the opening and closing mechanism is driven to open the accumulation surface to thereby move the predetermined number of package groups on the accumulation surface to the box B (see FIG. 6(d)).

(2-5) Temporary Placement Plate

[0050] The temporary placement plate 50 is a location where the package group G is temporarily placed. The temporary placement plate 50 is, as mentioned above, disposed in the temporary placement area ta. The temporary placement plate 50 extends along the direction in which the second conveyor 20 extends so that the package group G can be placed on it. The temporary placement plate 50 can have at least one package group G placed on it. The temporary placement plate 50 may also have a configuration where plural package groups G can be placed on it. The package group G placed on the temporary placement plate 50 is moved to the accumulation surface of the accumulation unit 40 at a predetermined timing. Here, the predetermined timing is a timing when the robot 30 receives a command (third command) from the control device 70 described later.

(2-6) Holding Unit

[0051] The holding unit 60 is a mechanism that holds the box B. As mentioned above, the holding unit 60 is disposed in the boxing area aa. Specifically, the holding unit 60 is placed under the accumulation surface of the accumulation unit 40. Furthermore, the holding unit 60 holds the box B in such a way that the opening of the box B faces upward. The holding unit 60 holds the box B in such a way that the opening of the box B is in a position under the shutter 41. That is, the holding unit 60 holds, under the accumulation surface, the box B whose opening has been made to face the accumulation surface.

(2-7) Control Device

[0052] The control device 70, as mentioned above,

controls the operations of the first conveyor 10, the second conveyor 20, the robot 30, and the accumulation unit 40. The control device 70 is configured from a CPU, a ROM, a RAM, and so forth.

[0053] FIG. 7 shows a control block of the control device 70. As shown in FIG. 7, the control device 70 is electrically connected to each of the configurations included in the boxing system 100, and sends signals to and receives signals from each of the configurations. Specifically, the control device 70 controls the first conveyor 10 and the second conveyor 20 to cause them to convey the packages O. Furthermore, the control device 70 controls the robot 30 to cause it to transport the predetermined number of package groups G to the boxing area aa (accumulation surface) or the temporary placement area ta. Furthermore, the control device 70 controls the accumulation unit 40 to cause it to move the predetermined number of package groups G into the box B. Moreover, the control device 70 is electrically connected to the sensor 77. The sensor 77 is installed in an arbitrary location. The sensor 77 grasps the timings when the packages O pass by the arbitrary location. In the present embodiment, as shown in FIG. 1, the sensor 77 is disposed in the neighborhood of the downstream side end portion of the first conveyor 10.

[0054] Furthermore, the control device 70 functions as a package information identifying component 71, a first command generating component 72, a second command generating component 73, a third command generating component 74, and a command component 75.

(2-7-1) Package Information Identifying Component
[0055] The package information identifying component 71 identifies the number of packages O being conveyed by the second conveyor 20 and the location of the leading package O on the basis of information obtained by the sensor 77. The location of the leading package O is the position of the package O on the belt of the second conveyor 20. The information stored by the package information identifying component 71 is stored in the control device 70 and updated as needed.

(2-7-2) First Command Generating Component

[0056] The first command generating component 72 generates a command (first command) for having the package group G directly transported from the conveyance area da to the boxing area aa. The first command generating component 72 generates the first command in a case where the predetermined number of packages O are on the belt of the second conveyor 20. Furthermore, the first command generating component 72 generates the first command in a circumstance where it is possible to accumulate the predetermined number of package groups G in the boxing area aa. In other words, the first command generating component 72 generates the first command at a timing when it is possible to place the package group G on the accumulation surface of the shutter 41.

[0057] Specifically, the first command is generated when the shutter 41 is closed and the accumulation process is not completed. It should be noted that at this time the first pusher 42, the second pusher 43, and the third pusher 44 are in their standby positions. More specifically, the first command is generated when the shutter 41 is closed, the first pusher 42, the second pusher 43, and the third pusher 44 are in their standby positions, and the accumulation process regarding the predetermined number of package groups G is not completed (see FIG. 9D and FIG. 9F).

(2-7-3) Second Command Generating Component

[0058] The second command generating component 73 generates a command (second command) for transporting the package group G from the conveyance area da to the temporary placement area ta. That is, the second command is a command to transport the package group G to an area different from the boxing area aa. The second command generating component 73 generates the second command in a case where the predetermined number of packages O are on the belt of the second conveyor 20. Furthermore, the second command generating component 73 generates the second command in a circumstance where it is not possible to accumulate the package groups G in the boxing area aa. In other words, the second command generating component 73 generates the second command at a timing when it is not possible to place the package group G on the accumulation surface of the shutter 41. That is, the second command is generated when preparations for placing the predetermined number of package groups G again on the accumulation surface of the accumulation unit 40 are not finished.

[0059] Specifically, the second command is generated during a period of time after the accumulation process had ended in regard to a previous predetermined number of package groups G and before it becomes possible to accumulate the next predetermined number of package groups G on the accumulation surface of the shutter 41. More specifically, the second command is generated when the first pusher 42, the second pusher 43, and the third pusher 44 are not in their standby positions or when the shutter 41 is not in a closed state (see FIG. 9C).

(2-7-4) Third Command Generating Component

[0060] The third command generating component 74 generates a command (third command) for transporting the package group G from the temporary placement area ta to the boxing area aa. The third command generating component 74 generates the third command after one accumulation process has started and before the one accumulation process has ended and in a case where the predetermined number of packages O are not on the belt of the second conveyor 20. The third command generating component 74 generates the third command after

the circumstance where it is not possible to accumulate the predetermined number of package groups G in the boxing area aa has been eliminated. In other words, the third command generating component 74 generates the third command at a timing when it is possible to place the package group G on the accumulation surface of the shutter 41. Specifically, the third command is generated when preparations for placing the predetermined number of package groups G again on the accumulation surface of the shutter 41 are finished.

(2-7-5) Command Component

[0061] The command component 75 causes the robot 30 to execute the first command, the second command, and the third command to accumulate the package groups G in the boxing area aa.

[0062] The command component 75 causes the robot 30 to execute the first command in a case where the predetermined number of packages O are on the belt of the second conveyor 20 and during a period of time when it is possible to accumulate the predetermined number of package groups G in the boxing area aa.

[0063] Furthermore, the command component 75 causes the robot 30 to execute the second command in a case where the predetermined number of packages O are on the belt of the second conveyor 20 and during a period of time until it becomes possible to accumulate the predetermined number of package groups G in the boxing area aa. That is, the command component 75 causes the robot 30 to execute the second command until the accumulation process is completed in regard to a previous predetermined number of package groups G and the opening and closing of the shutter 41 ends. In other words, the command component 75 causes the robot 30 to execute the second command during a period of time until the shutter 41 becomes closed and can function as the accumulation surface after the shutter 41 has been opened to move the predetermined number of package groups G to the box B.

[0064] Furthermore, the command component 75, after causing the robot 30 to execute the second command, causes the robot 30 to execute the first command at least once and then causes the robot 30 to execute the third command. Specifically, the command component 75 commands the robot 30 to transport a first package group G to the temporary placement area ta (on the temporary placement plate 50) and then at least once commands the robot 30 to transport a second package group G different from the first package group G to the boxing area aa (on the shutter 41). Then, the command component 75 has the first package group G transported from the temporary placement area ta (on the temporary placement plate 50) to the boxing area aa (on the shutter 41).

[0065] It should be noted that, when causing the robot 30 to suck the package group G, the command component 75 commands the robot 30 to suck the package group G on the basis of the package information identified

by the package information identifying component 71. Specifically, the command component 75 commands the robot 30 so that the movable suction unit 38 moves in accordance with the position of the leading package O on the second conveyor 20. That is, in a case where the leading package O is on the upstream side (the neighborhood of the front end portion) of the second conveyor 20, the command component 75 commands the robot 30 to move the movable suction unit 38 to the upstream side of the second conveyor 20. In a case where the leading package O is on the downstream side (the neighborhood of the rear end portion) of the second conveyor 20, the command component 75 commands the robot 30 to move the movable suction unit 38 to the downstream side of the second conveyor 20. The robot 30 drives the arms 34a, 34b, and 34c in accordance with the position of the leading package O on the basis of the commands. **[0066]** Furthermore, the command component 75, when having the package group G transported to the boxing area aa, appropriately commands the robot 30 to adjust the inclination and rotation of the suction head 38a and the like.

(3) Operation of Boxing System

[0067] Next, the operation of the boxing system pertaining to the present embodiment until the predetermined number of package groups G are boxed in one box B will be described. As mentioned above, in the present embodiment, five package groups G are packed in the box B by the accumulation unit 40.

[0068] First, when the packages O on the belt of the first conveyor 10 are conveyed to the downstream side end portion of the first conveyor 10, the packages O on the belt of the first conveyor 10 fall from the downstream side end portion of the first conveyor 10 and move onto the belt of the second conveyor 20 (see FIG. 1, FIG. 2, and FIG. 9A). Moreover, the packages O that have moved onto the belt of the second conveyor 20 are conveyed toward the downstream side end portion of the second conveyor 20. Then, the boxing process is executed by a flow such as shown in FIG. 8, for example.

[0069] First, in step S11 a counter for counting a number n of the package groups G that have been accumulated by the accumulation unit 40 is set. Specifically, n = 1 is input. Then, the flow advances to step S12.

[0070] In step S12 it is determined whether or not there is a package group G in the conveyance area da. Specifically, in the present embodiment, as mentioned above, it is determined whether or not the predetermined number of packages O that can form the package group G are on the belt of the second conveyor 20. In a case where it has been determined in step S12 that the package group G can be formed from the packages O on the belt of the second conveyor 20, the flow advances to step S13. In other words, when it is determined that the predetermined number of packages O are on the belt of the second conveyor 20, the flow advances to step S13.

[0071] In step S13 it is determined whether or not it is possible to transport the package group G to the boxing area aa. That is, in step S 13 it is determined whether or not the accumulation unit 40 is in a state in which it is possible for package groups G to be accumulated by the accumulation unit 40. Here, the "state in which it is possible for package groups G to be accumulated" means a state in which the shutter 41 has been closed after a previously accumulated predetermined number of package groups G have been transported to the box B. For example, in the example shown in FIG. 9B and FIG. 9C, the shutter 41 has not yet been completely closed after the predetermined number of package groups G have been transported to the box B. Consequently, the accumulation unit 40 is not yet in a state in which it is again possible for the package groups G to be accumulated. In a case where it has been determined in step S13 that it is not possible to transport the package group G to the boxing area aa, the flow advances to step S 14.

[0072] In step S14 the package group G is transported from the conveyance area da to the temporary placement area ta. That is, in step S 14 the package group G on the belt of the second conveyor 20 is transported onto the temporary placement plate 50. At this time, the command component 75 of the control device 70 causes the robot 30 to execute the second command. Because of this, as shown in FIG. 9C, the robot 30 sucks and holds, and transports to the temporary placement plate 50 in the temporary placement area ta, the predetermined number of packages O forming the package group G. Specifically, the robot 30 sucks and holds the predetermined number of packages O (the package group G) on the belt of the second conveyor 20, moves the package group G onto the temporary placement plate 50, and cancels the suction state. Then, the flow returns to step S12.

[0073] In a case where it has been determined in step S13 that it is possible to transport the package group G to the boxing area aa, the flow advances to step S15.

[0074] In step S15 the package group G is transported from the conveyance area da to the boxing area aa. That is, in step S15 the package group G on the belt of the second conveyor 20 is transported onto the shutter 41 (accumulation surface) of the accumulation unit 40. Specifically, the robot 30 sucks and holds the predetermined number of packages O (the package group G) on the belt of the second conveyor 20, moves the package group G onto the closed shutter 41 (accumulation surface), and cancels the suction state. In other words, the command component 75 causes the robot 30 to execute the first command in a case where it has been judged that the predetermined number of packages O are on the belt of the second conveyor 20 and it is possible to transport the package group G to the boxing area aa. Because of this, as shown in FIG. 9D, the robot 30 sucks and holds, and transports to the accumulation surface in the boxing area aa, the predetermined number of packages O (the package group G) on the belt of the second conveyor 20. Then, the flow advances to step S19.

[0075] In a case where it has been determined in step S12 that there is not a package group G in the conveyance area da, the flow advances to step S16. That is, in a case where the predetermined number of packages O are not on the belt of the second conveyor 20 and, as a result, it has been determined that the package group G cannot be formed, the flow advances to step S16.

[0076] In step S16 it is determined whether or not there is a package group G in the temporary placement area ta. That is, in step S16 it is determined whether or not the package group G has been placed on the temporary placement plate 50. In a case where it has been determined in step S16 that the package group G has not been placed on the temporary placement plate 50, the flow returns to step S12. In a case where it has been determined in step S16 that the package group G has been placed on the temporary placement plate 50, the flow advances to step S 17.

[0077] In step S 17 it is determined whether or not the first command was executed after the second command was executed by the robot 30. That is, in step S17 it is determined whether or not, after one package group (a first package group) G was transported from the conveyance area da to the temporary placement area ta, another package group (a second package group) G was transported from the conveyance area da to the boxing area aa. In a case where the first command is not being executed in step S 17, the flow returns to step S12. In a case where the first command is being executed in step S17, the flow advances to step S18. That is, in a case where the transport of the package group G from the conveyance area da to the boxing area aa is taking place before transporting to the boxing area aa the package group G placed in the temporary placement area ta (see FIG. 9D), the flow advances to step S18.

[0078] In step S18 the package group G is transported from the temporary placement area ta to the boxing area aa. That is, in step S18 the package group G on the temporary placement plate 50 is transported onto the shutter 41 (accumulation surface) of the accumulation unit 40 (see FIG. 9E). Specifically, the robot 30 sucks and holds the package group G on the temporary placement plate 50, moves the package group G onto the closed shutter 41 (accumulation surface), and then cancels the suction state. Then, the flow advances to step S19.

[0079] In step S19 it is determined whether or not $n = 5$. That is, it is determined whether or not the number of package groups G transported from the conveyance area da to the boxing area aa has reached the predetermined number (five). In a case where n is not equal to 5, that is, $n < 5$, in step S19, the flow advances to step S20.

[0080] In step S20, $n = n+1$ is input. Then, the flow returns to step S12. That is, the robot 30 moves the package groups G from the second conveyor 20 or the temporary placement plate 50 to the accumulation surface until the predetermined number of package groups G (in the present embodiment, five package groups G) are accumulated on the accumulation surface (see FIG. 9F).

[0081] In a case where $n = 5$ in step S19, the flow advances to step S21.

[0082] In step S21 the boxing process is commanded. That is, the first pusher 42 and the second pusher 43 are driven to gather the predetermined number of package groups G in one location on the accumulation surface (see FIG. 6(b) and FIG. 9A). Furthermore, the third pusher 44 is driven to apply force from above to the predetermined number of package groups G (see FIG. 6(c)). Then, the shutter 41 is opened to transport the predetermined number of package groups G to the box B (see FIG. 6(d)). At this time, the first pusher 42, the second pusher 43, and the third pusher 44 return to their standby positions. When the transport of the predetermined number of package groups G to the box B is completed, the shutter 41 is closed (see FIG. 9B and FIG. 9C).

(4) Characteristics of Boxing System

(4-1)

[0083] The boxing system 100 pertaining to the embodiment is equipped with the first conveyor 10 and the second conveyor 20 (conveyance devices), the robot 30, and the control device 70. The first conveyor 10 and the second conveyor 20 convey packages (objects) O at predetermined intervals in the conveyance area da. The robot 30 simultaneously holds and transports a package group (object group) G consisting of a plurality of the packages O. The control device 70 controls the robot 30 to cause it to accumulate the package groups G in the boxing area aa. The control device 70 has the first command generating component 72, the second command generating component 73, the third command generating component 74, and the command component 75. The first command generating component 72 generates the first command to have the package group G directly transported from the conveyance area da to the boxing area aa. The second command generating component generates the second command to transport the package group G from the conveyance area da to the temporary placement area ta different from the boxing area aa. The third command generating component 74 generates the third command to transport the package group G from the temporary placement area ta to the boxing area aa. The command component 75 causes the robot 30 to execute the first command, the second command, and the third command to accumulate the package groups G in the boxing area aa.

[0084] In the boxing system 100 pertaining to the embodiment, the packages O are continuously conveyed downstream by the conveyance device (the first conveyor 10 and the second conveyor 20). Furthermore, one robot 30 holds and transports the plurality of packages O (the package group G) conveyed by the second conveyor 20. In order to enhance the processing capability of the boxing system, it is conceivable to increase the speed at which the conveyance device and/or the robot

are driven. Furthermore, in order to improve the efficiency of the boxing process, it is preferred that the predetermined number of package groups be packed at one time in the box rather than the package groups being packed one group at one time in the box. In this case, the predetermined number of package groups are accumulated beforehand in a predetermined area, and the predetermined number of package groups accumulated in the predetermined area are transported from the predetermined area to the box. Here, the package groups cannot be transported to the predetermined area while the predetermined number of package groups are being transported from the predetermined area to the box. That is, a new accumulation process cannot be executed while the boxing process is being executed, and the accumulation process temporarily stops. However, the packages continue to be conveyed by the conveyance device. Consequently, there arises the need to drive the conveyance device at a low speed or stop the conveyance device. When the speed of the conveyance device is reduced or the conveyance device is stopped, the processing capability of the boxing system goes down. Consequently, the speed of the boxing process cannot always be increased even if the speed at which the conveyance device and the robot are driven has been increased.

[0085] However, in the boxing system 100 pertaining to the embodiment, it is possible to directly transport to the boxing area aa, and it is also possible to transport to the temporary placement area ta, the predetermined number of packages O (the package group G) conveyed in the conveyance area da. Because of this, the package group G can be temporarily placed in the temporary placement area ta in a case where it cannot be transported to the boxing area aa. For that reason, there is no need to reduce the speed of the conveyance device (the first conveyor 10 and the second conveyor 20) or temporarily stop the accumulation process. As a result, an acceleration of the boxing process can be realized.

(4-2)

[0086] In the boxing system 100 pertaining to the embodiment, the command component 75 causes the robot 30 to execute the second command so that the package group G is transported from the conveyance area da to the temporary placement area ta during a period of time until it becomes possible to accumulate the package groups (object groups) G in the boxing area aa. Because of this, the package groups G can be formed in the temporary placement area ta during the period of time until it becomes possible to accumulate them.

(4-3)

[0087] The boxing system 100 pertaining to the embodiment is further equipped with the shutter 41, the first pusher 42 and the second pusher 43 (a pusher), and the holding unit 60. The shutter 41 includes the accumulation

surface on which the package groups (object groups) G are accumulated and the opening and closing mechanism that opens and closes the accumulation surface. The first pusher 42 and the second pusher 43 apply force to the package groups G accumulated on the accumulation surface to thereby gather the package groups G in one location on the accumulation surface. The holding unit 60 holds the box B under the accumulation surface. The box B has an opening made to face the accumulation surface. Furthermore, after the package groups G have been gathered in one location on the accumulation surface by the first pusher 42 and the second pusher 43, the opening and closing mechanism of the shutter 41 is driven to open and close the accumulation surface to thereby move the package groups G on the accumulation surface to the box B. Furthermore, the command component 75 causes the robot 30 to execute the second command until the shutter 41 opens and closes.

[0088] In the boxing system 100 pertaining to the embodiment, the predetermined number of package groups G are accumulated on the accumulation surface of the shutter 41 when the accumulation surface of the shutter 41, which is capable of being opened and closed, is closed. The predetermined number of package groups G on the accumulation surface are accumulated in one location on the accumulation surface by the first pusher 42 and the second pusher 43. Then, the accumulation surface is opened. The box B having the opening facing the accumulation surface is held under the accumulation surface. For that reason, when the accumulation surface is opened, the predetermined number of package groups G are directly transported to the box B. In the boxing system 100 pertaining to the embodiment, the package groups G can be effectively formed in the temporary placement area ta utilizing the time until the predetermined number of package groups G are transported from the accumulation surface to the box B.

(4-4)

[0089] In the boxing system 100 pertaining to the embodiment, the command component 75, after causing the robot 30 to execute the second command, causes the robot 30 to execute the first command at least once and then causes the robot 30 to execute the third command. The package group G is transported to the temporary placement area ta and then, an amount of time later, is transported to the boxing area aa.

[0090] Specifically, in the embodiment, one package group (the first package group) G is transported from the conveyance area da to the temporary placement area ta, and then at least one other package group (the second package group) G is transported from the conveyance area da to the boxing area aa. Then, the package group (the first package group) G in the temporary placement area ta is transported to the boxing area aa. In this way, an amount of time is disposed until the first package group G is transported to the boxing area aa after the

first package group G has been transported to the temporary placement area ta. By disposing an amount of time, the boxing area aa again becomes able to accumulate the predetermined number of package groups G.

5 That is, by disposing an amount of time, a sufficient amount of time can be ensured until it becomes possible to accumulate the package groups G in the boxing area aa.

10 (4-5)

[0091] The boxing system 100 pertaining to the embodiment has, as the conveyance device, the first conveyor (the first conveyance device) 10 and the second conveyor (the second conveyance device) 20. The first conveyor 10 receives the packages (objects) O from an upstream apparatus and conveys at the predetermined intervals the packages O in the first posture. The second conveyor 20 is placed downstream of the first conveyor 10 and conveys, in the second posture different from the first posture, the packages O that have been conveyed thereto by the first conveyor 10. Furthermore, the robot 30 simultaneously holds and transports the package group G which consists of a plurality of the packages O in the second posture conveyed by the second conveyor 20. The second conveyor 20 conveys the packages O in such a way that it is easy for the robot 30 to take hold of the plurality of the packages O (the package group G). Because of this, the robot 30 can be allowed to effectively take hold of the plurality of the packages O.

(4-6)

[0092] Furthermore, in the embodiment, the position at which the robot 30 takes hold of the package group (object group) G is changed in accordance with the position at which the package group G is conveyed. The robot 30 does not wait for the package group G to be conveyed to a predetermined position and take hold of the package group G in the predetermined position but rather moves the movable suction unit 38 to the position at which it has become possible for the package group G to be formed and takes hold of the package group G. That is, in a case where it is possible for the package group G to be formed by the plurality of the packages O conveyed by the second conveyor 20, the robot 30 moves the movable suction unit 38 in accordance with the conveyance position of the leading package O among the predetermined number of packages O configuring the package group G. Because of this, the boxing process can be effectively executed.

(5) Example Modifications

55 (5-1) Example Modification A

[0093] In the embodiment, belt conveyors are employed as the first conveyor 10 and the second conveyor

20, but rather than using belts, roller conveyors having numerous rollers lined up may also be employed as the first conveyor 10 and the second conveyor 20.

(5-2) Example Modification B

[0094] In the embodiment, the second conveyor 20 has a configuration where its height position is capable of being changed, and the height position of the second conveyor 20 is appropriately changed in accordance with the length dimension of the packages O.

[0095] Here, instead of changing the height position of the second conveyor, a stopper 121 having a configuration different from that of the stopper 21 pertaining to the embodiment may also be employed.

[0096] The stopper 121 is also placed above the belt of the second conveyor 20 and at a predetermined interval from the belt. Furthermore, the stopper 121 also has a configuration where its position is capable of being adjusted in the width direction of the belt of the second conveyor 20.

[0097] Specifically, as shown in FIG. 10, the stopper 121 mainly comprises a vertical plate 121a, a horizontal movable plate 121b, and an air cylinder 121c.

[0098] The vertical plate 121a regulates the position of the packages O that have fallen from the first conveyor 10. The vertical plate 121a extends in a direction orthogonal to the conveyance surface of the belt. The vertical plate 121a is supported by a support component 121d attached to the air cylinder 121c. The horizontal movable plate 121b catches, from below, the packages O that have fallen from the first conveyor 10. Furthermore, the horizontal movable plate 121b moves the packages O onto the belt of the second conveyor 20. The horizontal movable plate 121b is made of a material that can allow the packages O to slide on it while moving the packages O onto the belt of the second conveyor 20; for example, the horizontal movable plate 121b comprises a resin material. The horizontal movable plate 121b is a member whose cross-sectional shape is L-shaped, with the long section extending horizontally with respect to the conveyance surface of the belt and the short section being coupled to the air cylinder 121c. The horizontal movable plate 121b is driven relative to the vertical plate 121a as a result of the air cylinder 121c being driven. Specifically, the air cylinder 121c is driven to thereby move the short section of the horizontal movable plate 121b in a direction away from the vertical plate 121a. Here, the direction away from the vertical plate 121a coincides with a direction away from the downstream end of the first conveyor 10.

[0099] When the package O falls from the first conveyor 10, the package O is received by the horizontal movable plate 121b (see FIG. 11(a)). Then, the air cylinder 121b is driven so that the horizontal movable plate 121b moves in a direction away from the downstream side end portion of the first conveyor 10 and delivers the package O to the second conveyor 20 (see FIG. 11(b)). In other

words, the package O on the horizontal movable plate 121b slides and falls from the horizontal movable plate 121b onto the belt of the second conveyor 20 as a result of the horizontal movable plate 121b being driven by the air cylinder 121c.

[0100] Because of this, it becomes possible for the packages O of different sizes to be suitably received by the second conveyor 20 without having to employ a configuration that changes the height position of the second conveyor 20 such as in the embodiment.

(5-3) Example Modification C

[0101] Furthermore, in the boxing system 100 pertaining to the embodiment, a first conveyor (a shuttle conveyor) 110 whose length is capable of being extended and contracted may also be employed instead of the first conveyor 10 (see FIG. 12). According to this configuration also, it becomes possible for the packages O of different sizes to be suitably received by the second conveyor 20 without having to employ a configuration that changes the height position of the second conveyor 20.

(5-4) Example Modification D

[0102] In the embodiment, an example of a case where the predetermined number of packages O (the package group G) are transported to the boxing area aa is described. Specifically, when the accumulation unit 40 in the boxing area aa is not in a state in which it is possible to accumulate the package groups G, the package groups G are temporarily placed on the temporary placement plate 50 in the temporary placement area ta and not on the shutter 41 (accumulation surface).

[0103] Here, the boxing system 100 pertaining to the embodiment can also be employed in the case of boxing large packages (large bags) LO larger in size than the packages O. At this time, the boxing system 100 may be given a configuration not having the temporary placement plate 50 (see FIG. 13). In this case, the second conveyor 20 is utilized for the temporary placement of the packages LO instead of the temporary placement plate 50. Furthermore, the robot 30 sucks and takes hold of the package LO on the belt of the first conveyor 10 and not the package LO on the belt of the second conveyor 20. The second conveyor 20 may be driven or not driven. Furthermore, the robot 30 sucks and takes hold of one large package LO rather than the predetermined number of packages O and, when the accumulation unit 40 in the boxing area aa is not in a state in which it is possible to accumulate the package groups G, places the large package LO on the belt of the second conveyor 20.

[0104] That is, in a case where it is not possible to accumulate the packages LO in the boxing area aa, the robot 30 transports onto the belt of the second conveyor 20 the package LO on the belt of the first conveyor 10 and, when it becomes possible to accumulate the pack-

ages LO in the boxing area aa, transports onto the accumulation surface of the shutter 41 the package LO on the belt of the second conveyor 20.

[0105] In this way, the boxing system 100 can be used to box not only the small packages (small bags) O but also the large packages (large bags) LO. 5

REFERENCE SIGNS LIST

[0106]

10, 110	First Conveyor	
20	Second Conveyor	
21, 121	Stopper	
30	Robot	15
38	Movable Suction Unit	
40	Accumulation Unit	
41	Shutter	
42	First Pusher (Pusher)	
43	Second Pusher (Pusher)	20
44	Third Pusher	
70	Control Device	
71	Package Information Identifying Component	
72	First Command Generating Component	
73	Second Command Generating Component	25
74	Third Command Generating Component	
75	Command Component	
100	Boxing System	
O	Package (Small Bag) (Object)	
LO	Package (Large Bag)	30
G	Package Group (Object Group)	
B	Box	

Claims

1. A boxing system comprising:

a conveyance device configured to convey objects at predetermined intervals in a conveyance area; 40
a robot configured to simultaneously hold and transport an object group comprising a plurality of the objects; and
a control device configured to control the robot to cause the robot to accumulate the object groups in a boxing area, 45
wherein the control device has

a first command generating component 50
configured to generate a first command to have the object group directly transported from the conveyance area to the boxing area,

a second command generating component 55
configured to generate a second command to transport the object group from the conveyance area to a temporary placement ar-

ea different from the boxing area,
a third command generating component configured to generate a third command to transport the object group from the temporary placement area to the boxing area, and
a command component configured to cause the robot to execute the first command, the second command, and the third command to accumulate the object groups in the boxing area.

2. The boxing system according to claim 1, wherein the command component is configured to cause the robot to execute the second command so that the object group is transported from the conveyance area to the temporary placement area during a period of time until it becomes possible to accumulate the object groups in the boxing area.

3. The boxing system according to claim 2, further comprising
a shutter including an accumulation surface on which the object groups are accumulated and an opening and closing mechanism configured to open and close the accumulation surface, 25
a pusher configured to apply force to the object groups accumulated on the accumulation surface to thereby gather the object groups in one location on the accumulation surface, and
a holding unit configured to hold, under the accumulation surface, a box whose opening has been made to face the accumulation surface, 30
wherein
the shutter is configured to drive, after the object groups have been gathered in the one location on the accumulation surface by the pusher, the opening and closing mechanism to open and close the accumulation surface to thereby move the object groups on the accumulation surface to the box, and
the command component is configured to cause the robot to execute the second command until the shutter opens and closes.

4. The boxing system according to any of claims 1 to 3, wherein the command component is configured to cause, after causing the robot to execute the second command, the robot to execute the first command at least once and then cause the robot to execute the third command.

5. The boxing system according to any of claims 1 to 4, wherein
the conveyance device has

a first conveyance device configured to receive the objects from an upstream apparatus and convey at the predetermined intervals the objects in a first posture and

a second conveyance device placed downstream of the first conveyance device and configured to convey the objects in a second posture that have been conveyed thereto by the first conveyance device, the second posture being a posture different from the first posture, and 5

the robot is configured to simultaneously hold and transport the object group which comprises a plurality of the objects in the second posture conveyed by the second conveyance device. 10

6. The boxing system according to claim 5, wherein the boxing system is configured such that the position at which the robot takes hold of the object group is changed in accordance with the position at which the object group is conveyed. 15

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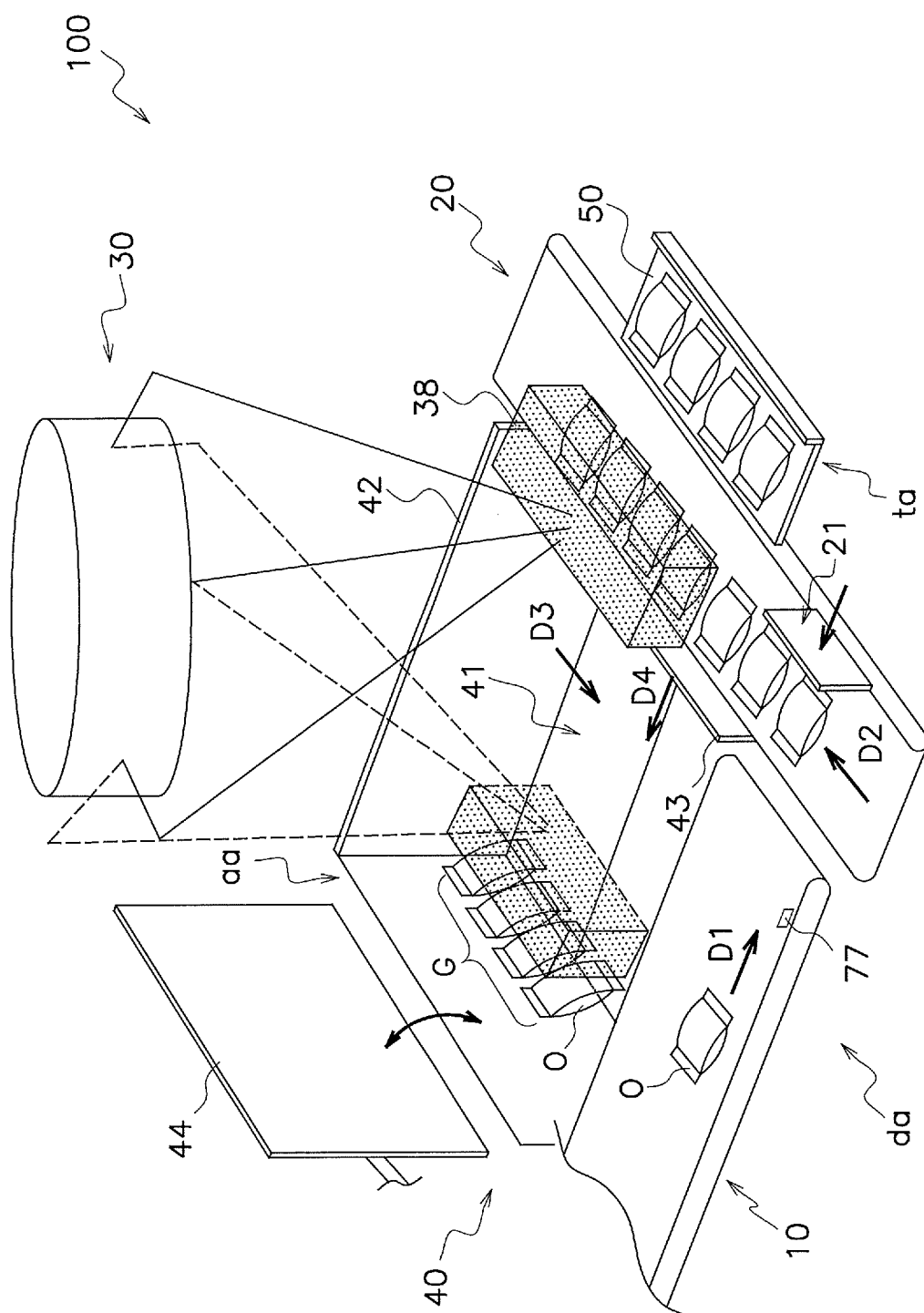


FIG. 1

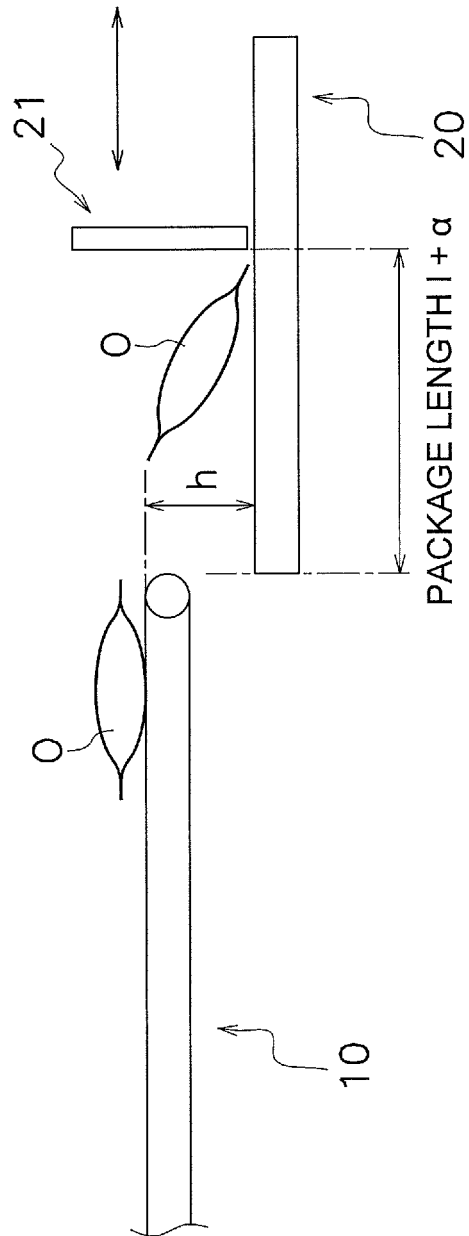


FIG. 2

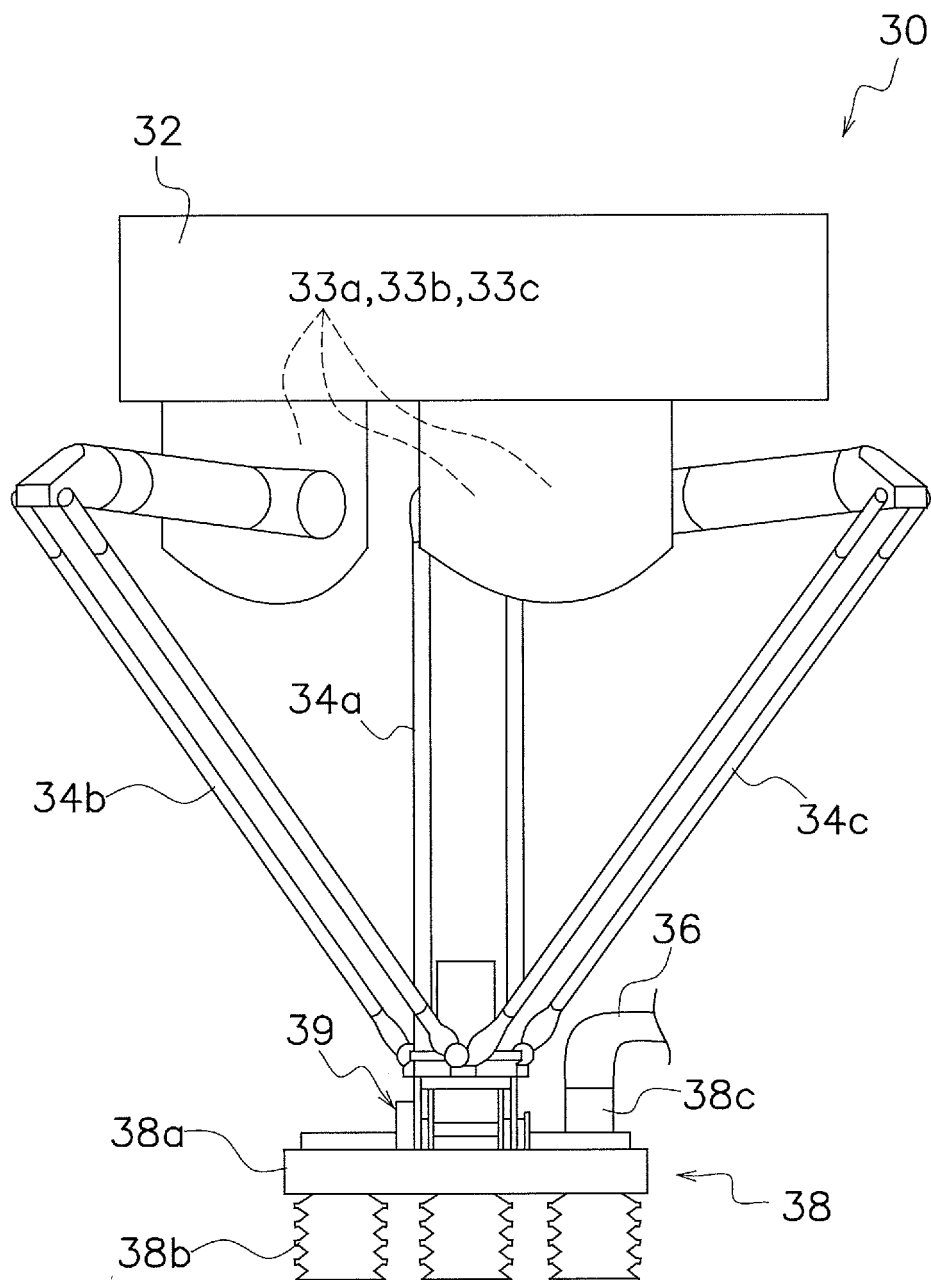


FIG. 3

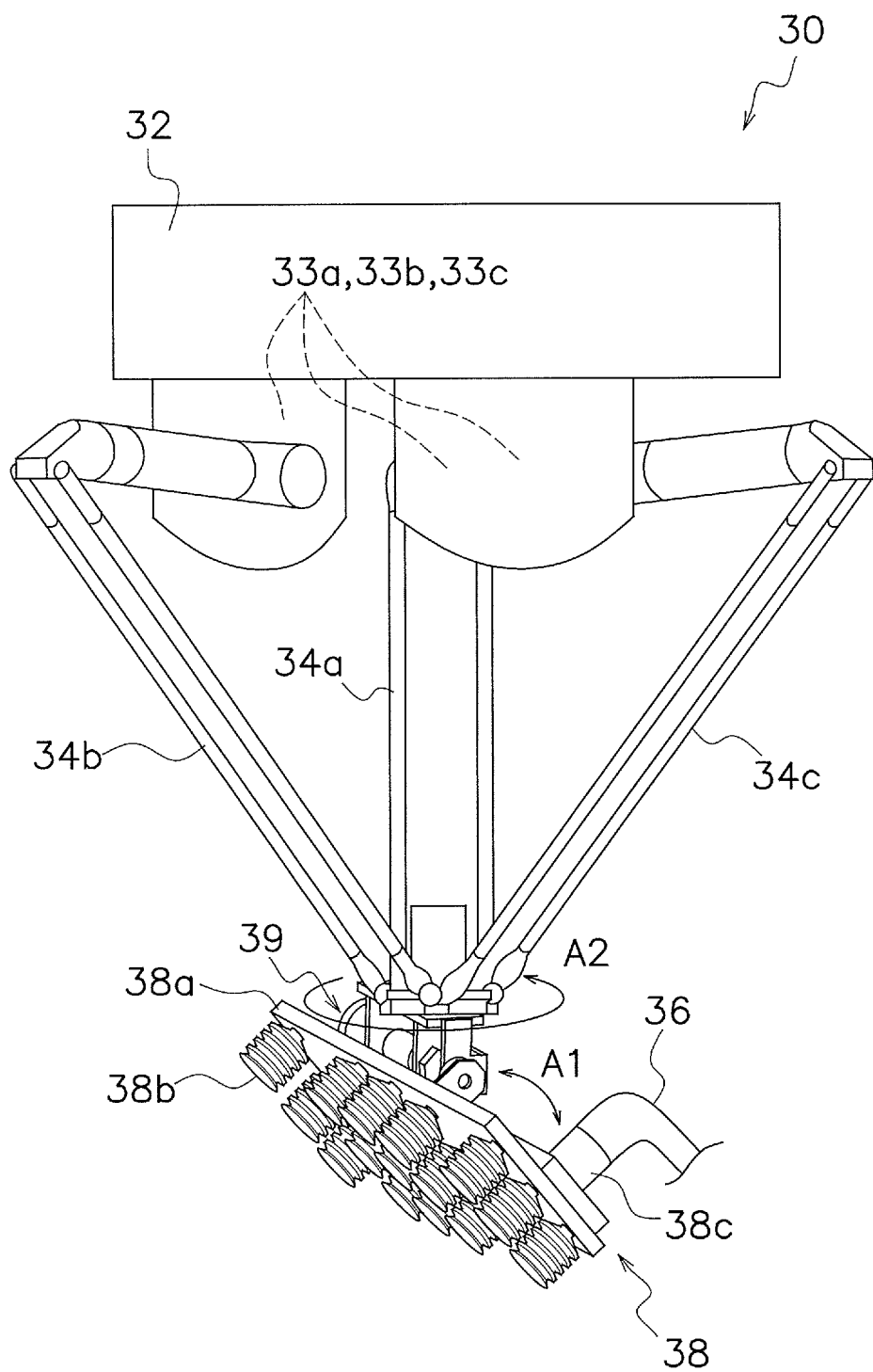
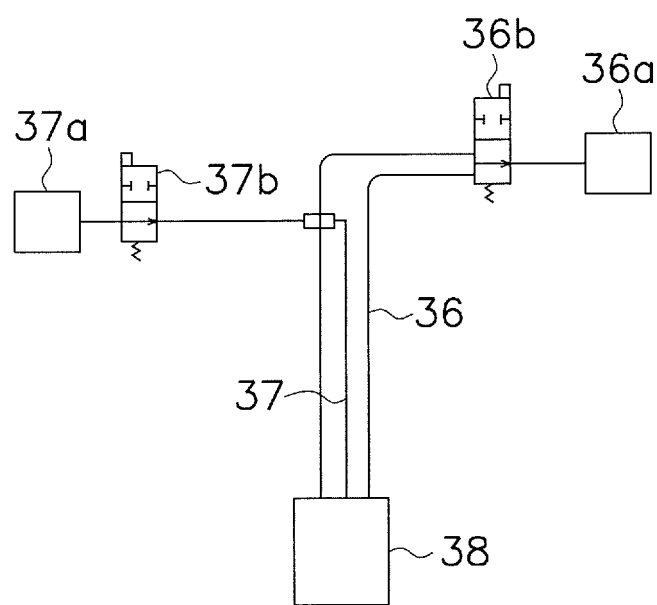


FIG. 4



F I G. 5

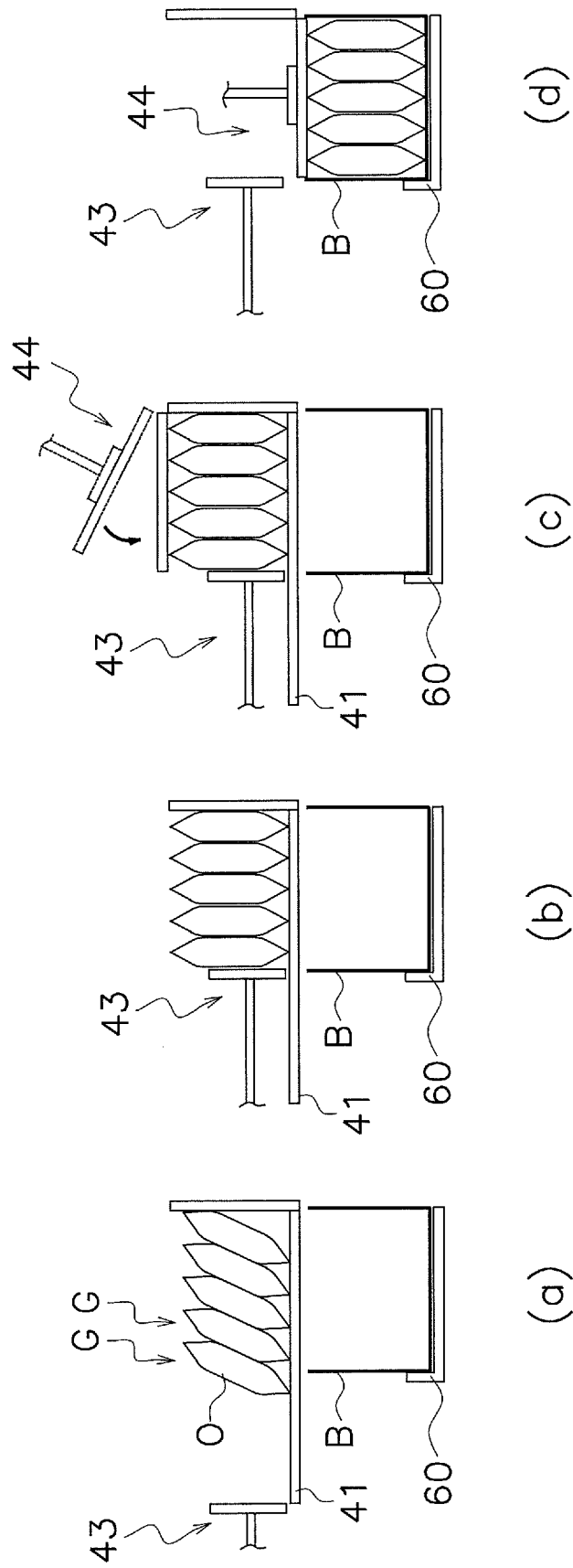


FIG. 6

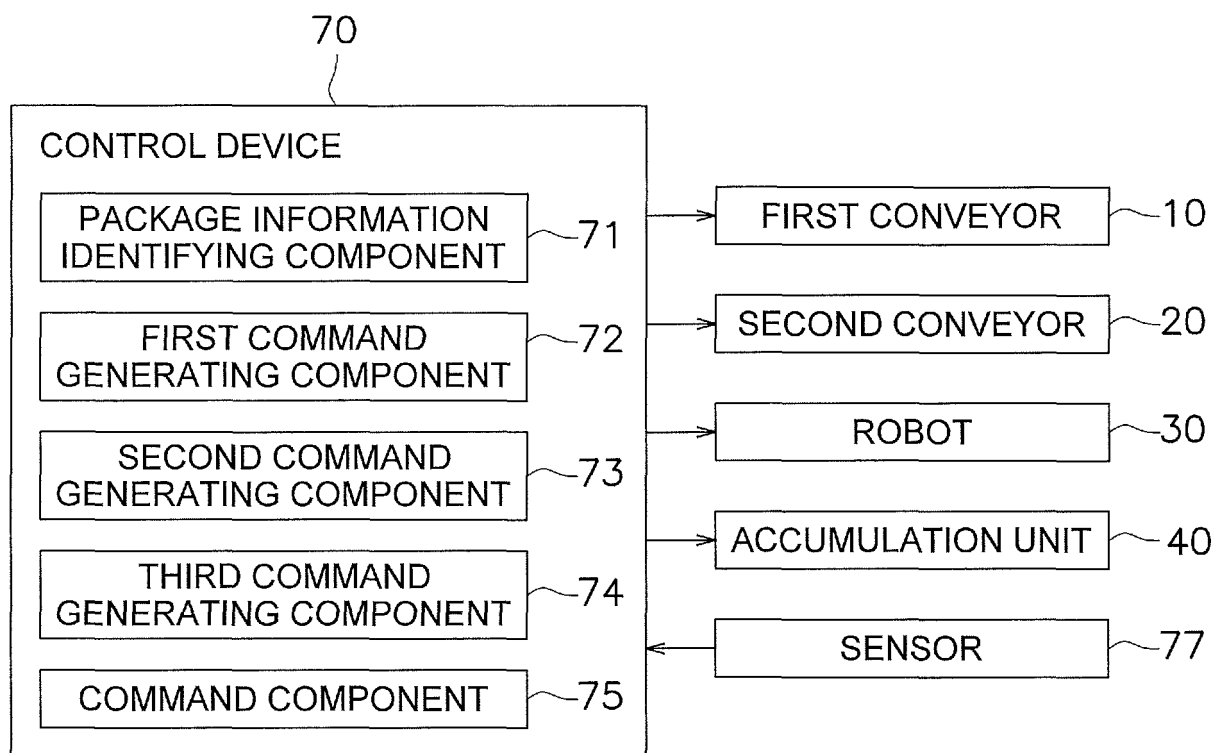


FIG. 7

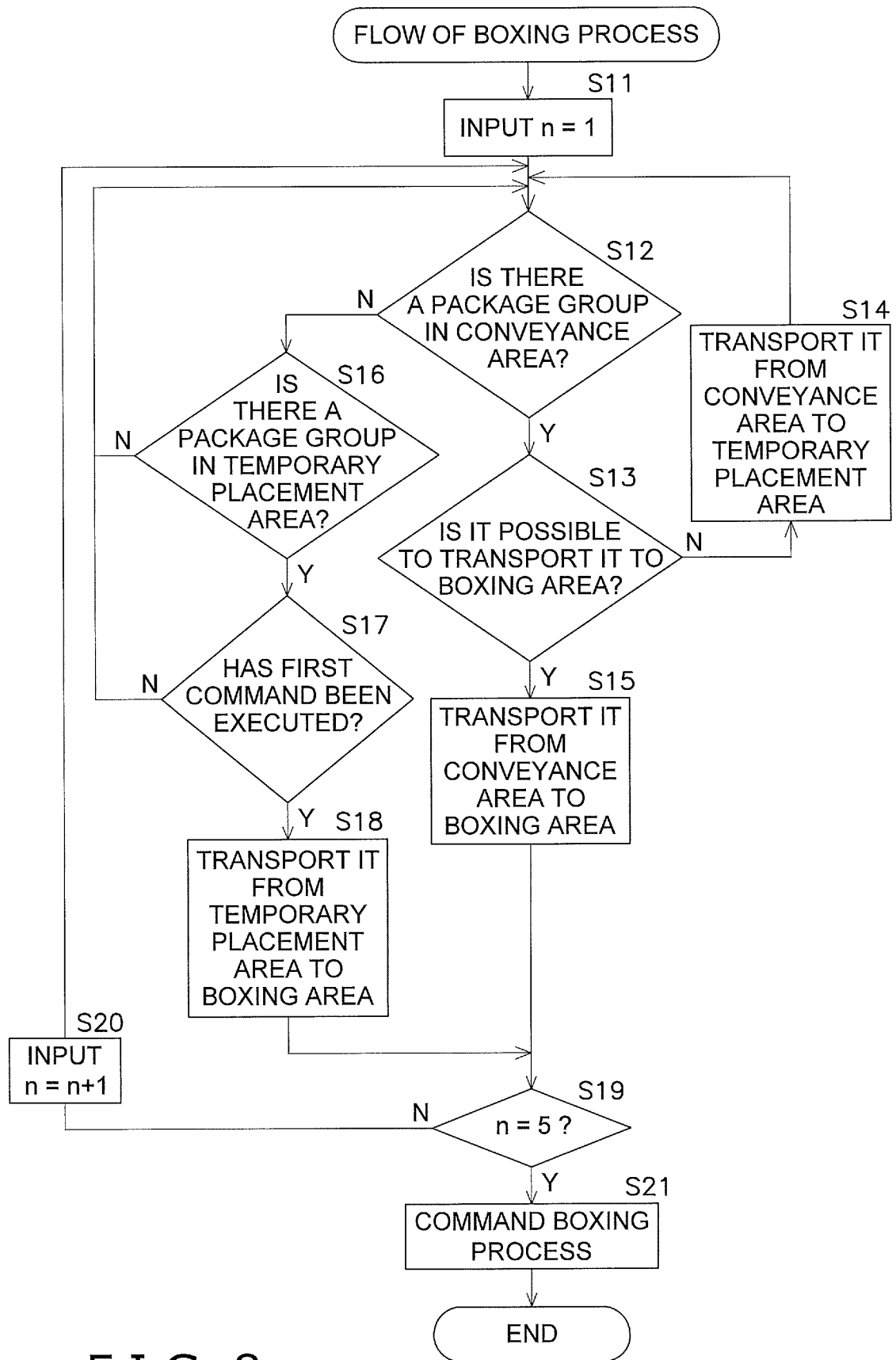


FIG. 8

FIG. 9 A

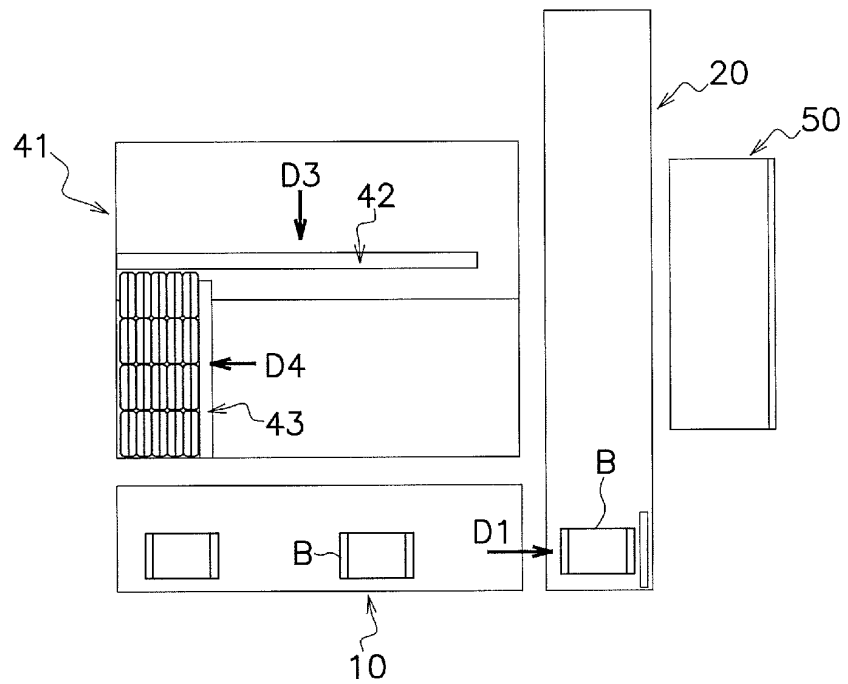


FIG. 9 B

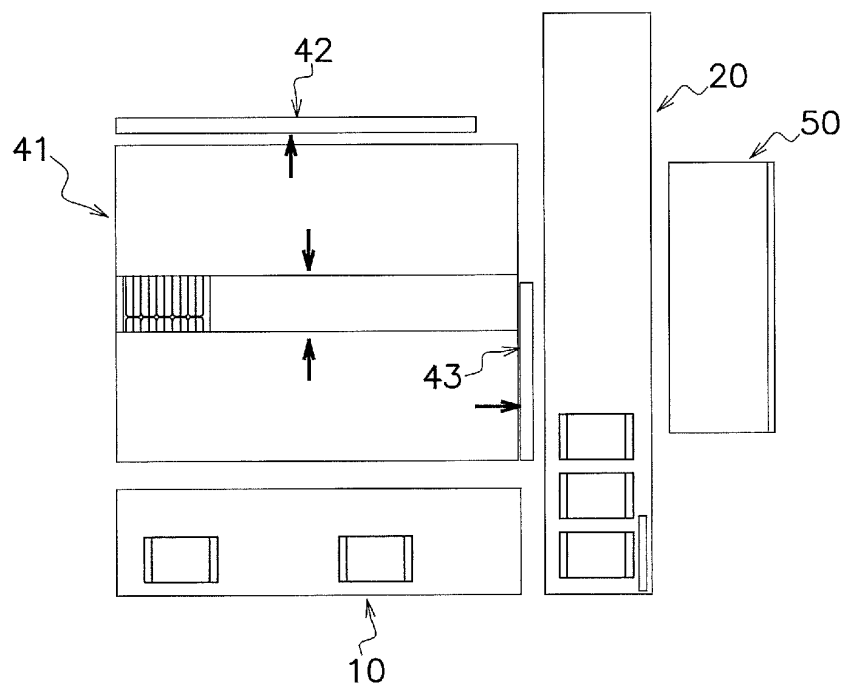


FIG. 9 C

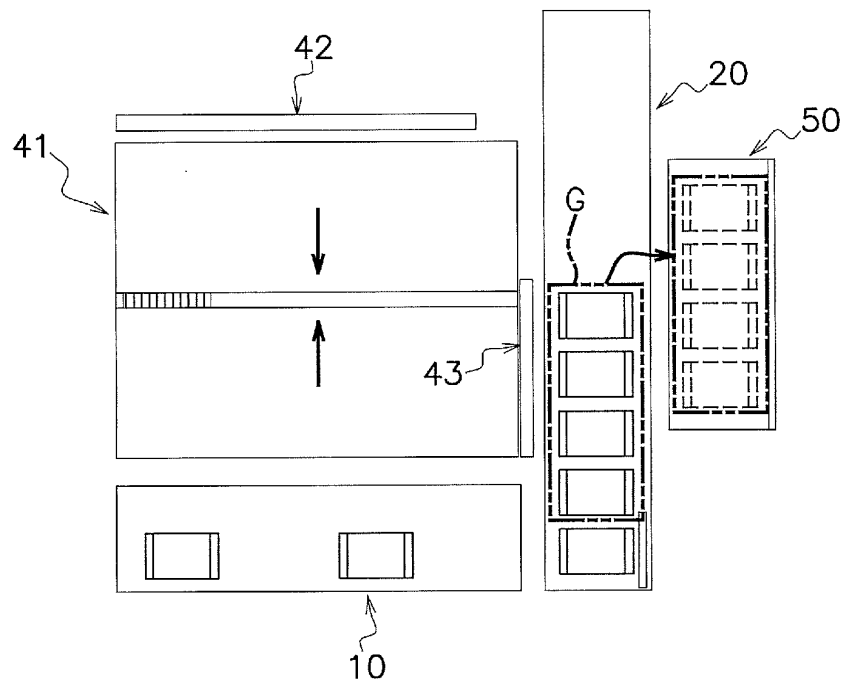


FIG. 9 D

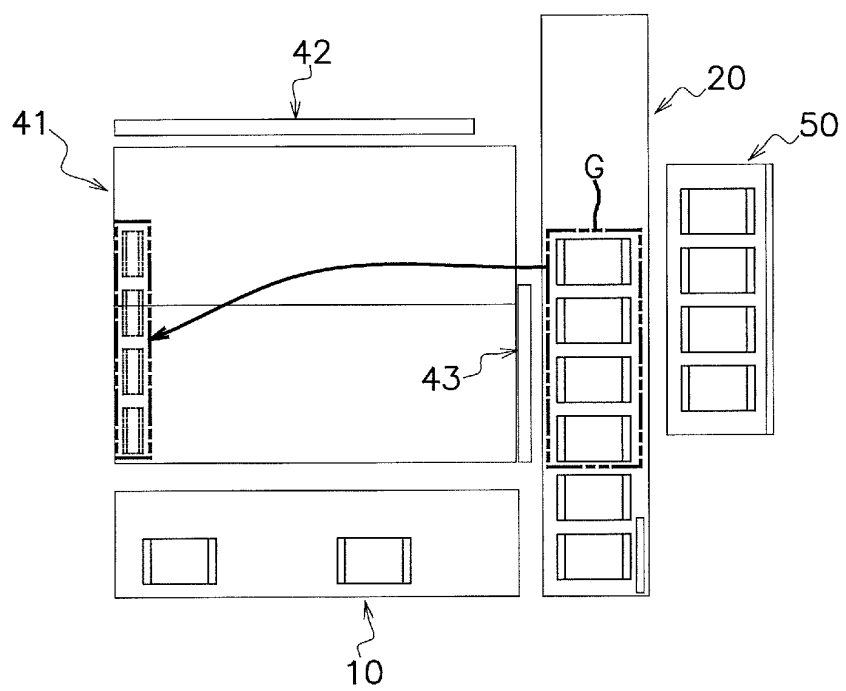


FIG. 9 E

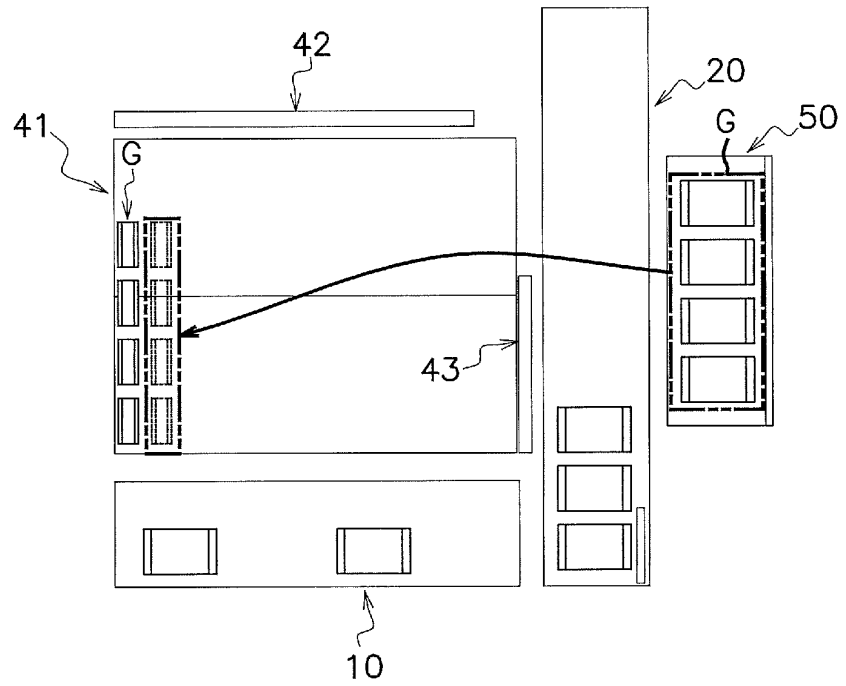
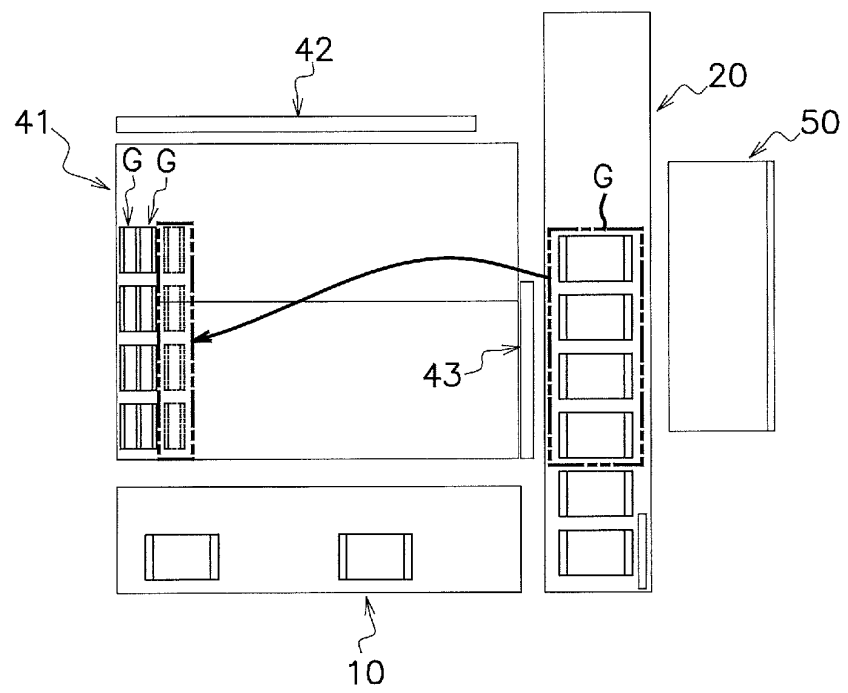


FIG. 9 F



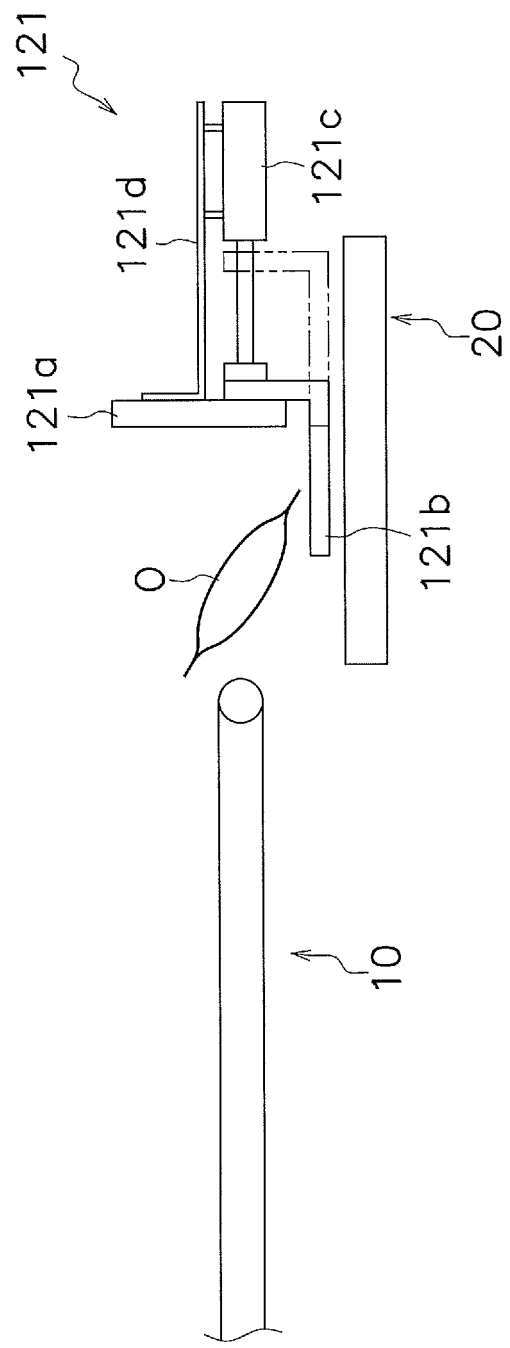


FIG. 10

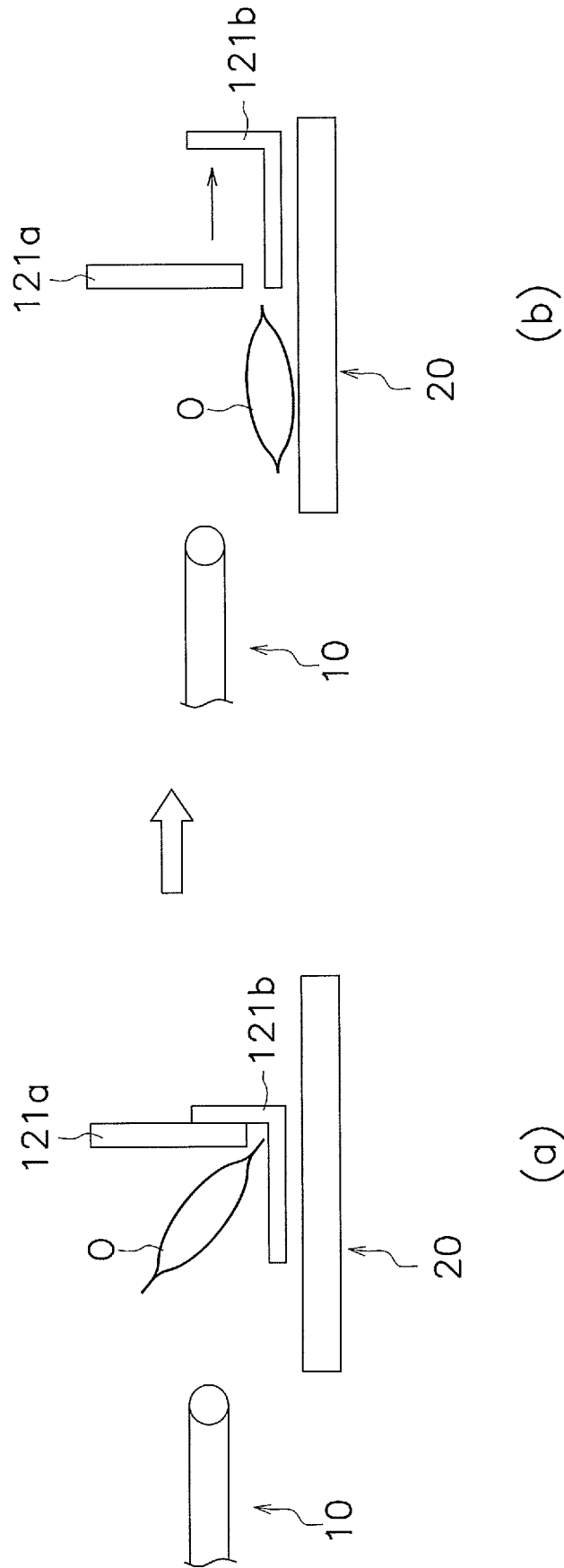


FIG. 11

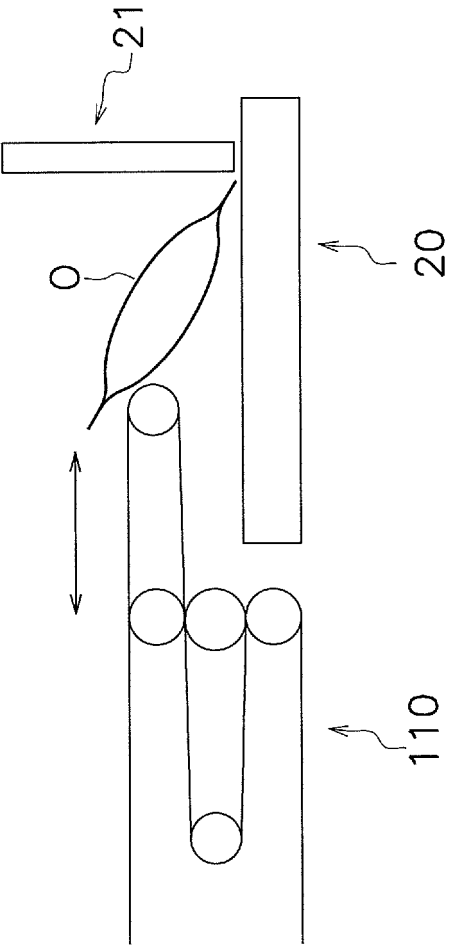


FIG. 12

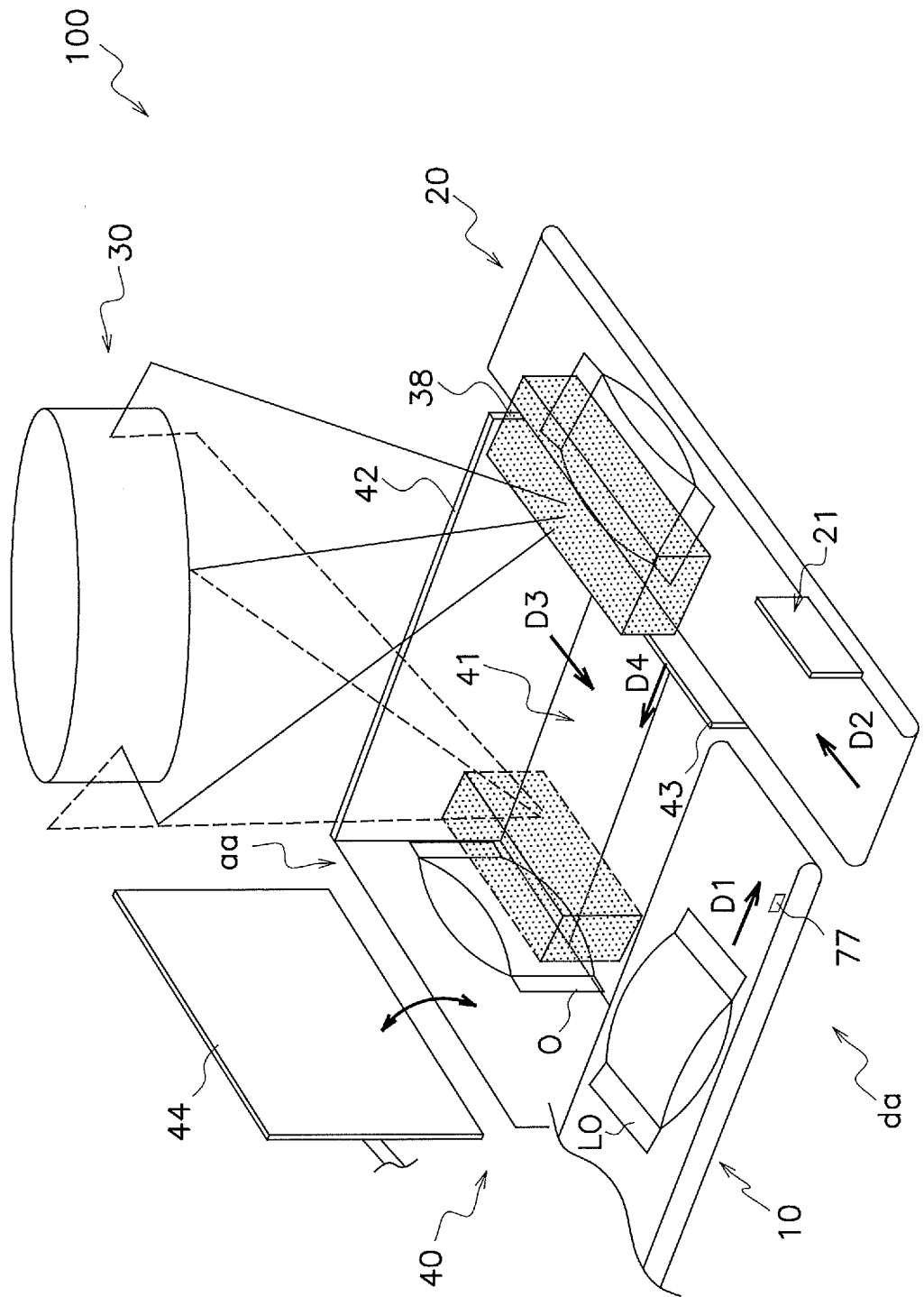


FIG. 13

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/052738

A. CLASSIFICATION OF SUBJECT MATTER

B65B5/06(2006.01)i, B65B35/38(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B65B5/06, B65B35/38

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2015

Kokai Jitsuyo Shinan Koho 1971-2015 Toroku Jitsuyo Shinan Koho 1994-2015

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2002-265039 A (Ishida Co., Ltd.), 18 September 2002 (18.09.2002), entire text; all drawings (Family: none)	1-6
A	JP 2011-225244 A (Kawashima Packaging Machinery Ltd.), 10 November 2011 (10.11.2011), entire text; all drawings (Family: none)	1-6
A	JP 2013-86837 A (Omori Machinery Co., Ltd.), 13 May 2013 (13.05.2013), entire text; all drawings (Family: none)	1-6

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

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"&"

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Date of the actual completion of the international search
16 April 2015 (16.04.15)Date of mailing of the international search report
28 April 2015 (28.04.15)Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/052738

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 4134711 B2 (Denso Corp.), 20 August 2008 (20.08.2008), entire text; all drawings (Family: none)	1-6
A	JP 11-90343 A (Kubota Corp.), 06 April 1999 (06.04.1999), entire text; all drawings (Family: none)	1-6

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2011213412 A [0002] [0003]