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BOXING DEVICE

Abstract

A boxing device has a box-moving section that moves a box with flaps from a supply position to a boxing position; a flap support section; and a pushing section. At the boxing position, articles are boxed in the box's opening. The flap support section supports the flaps. A pushing section pushes a group of side-by-side aligned articles into the box in the boxing position. Before the pushing section pushes the articles into the box, the box-moving section moves the box so that the box changes from a first orientation, in which the opening of the box faces sideways in the box supply position, to a second orientation, in which the opening of the box faces upwards in the boxing position. The flap support section supports the flaps as the box is moved from the first orientation to the second orientation.

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Background/Summary

TECHNICAL FIELD

[0001] This disclosure relates to a boxing device.

BACKGROUND ART

[0002] Japanese Laid-open Patent Publication No. 2014-61904 describes a boxing device in which articles are boxed from the side into a cardboard box laid with an opening facing sideways, and the cardboard box is then rotated 90° and stood up so that the opening faces upwards.

SUMMARY OF THE INVENTION

[0003] In a boxing device such as the one disclosed in Japanese Laid-open Patent Publication No. 2014-61904, if articles are boxed after the cardboard box has been placed with the opening facing upwards, flaps of the cardboard box may fall inward. If the articles are boxed with the flaps laying inward, the boxing may not proceed smoothly and the contents may be damaged.

[0004] An object of the present disclosure is to provide a boxing device that can prevent box flaps from falling inward.

[0005] Thus, an embodiment of a boxing device in accordance with the claimed invention has a box-moving section, a flap support section, and a pushing section. The box-moving section moves a box from a box supply position to a boxing position. The box has flaps. The flaps are disposed continuously with respect to side walls that define an opening. At the box supply position, the box is supplied from the outside. At the boxing position, a plurality of articles are boxed in the opening. The flap support section supports the flaps. A pushing section pushes an article group, in which a plurality of the articles conveyed by an article-conveying section are aligned side-by-side, into the box in the boxing position. The box-moving section, before the pushing section pushes the article group into the box, moves the box so that the box changes in orientation from a first orientation, in which the opening of the box faces sideways in the box supply position, to a second orientation, in which the opening of the box faces upwards in the boxing position. The flap support section supports the flaps when the orientation of the box changes from the first orientation to the second orientation.

[0006] In this boxing device, the flaps of the box can be prevented from falling inward.

[0007] In a boxing device of a second aspect, the flap support section has a first part, a second part, and a third part. The first part extends along a vertical direction. The second part extends in a direction inclined in relation to the vertical direction. The third part extends along a horizontal direction.

[0008] In a boxing device of a third aspect, the box-moving section moves the box from the box supply position to the boxing position while keeping the box aligned with the flap support section.

[0009] In a boxing device of a fourth aspect, the pushing section has an opening/closing member. The opening/closing member includes protrusions on a surface that faces the box.

[0010] A boxing device of a fifth aspect further has a box-transferring section. The box-transferring section transfers the box in which the article group is boxed. The box-transferring section moves from a standby position to below the box after the box has been changed to the second orientation.

[0011] In a boxing device of a sixth aspect, the flap support section lays down a flap that is on a rear side of the box in a box movement direction to the outside of the box when the box moves from the box supply position to the boxing position.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 is a schematic diagram illustrating a packaging and boxing line including an

embodiment of a boxing device in accordance with the claimed invention;

[0013] FIG. 2 is a side view of the boxing device shown in FIG. 1;

[0014] FIG. 3 is a perspective view of a box;

[0015] FIG. 4 is a perspective view of the boxing device;

[0016] FIG. 5 is a perspective view from below of the boxing device;

[0017] FIG. 6 is a perspective view of a third flap support section;

[0018] FIG. 7 is a perspective view from below of an opening/closing member;

[0019] FIG. 8 is a schematic diagram illustrating a change in vertical position of a box-transferring section;

[0020] FIG. 9 is a block diagram of a control unit;

[0021] FIG. 10 is a side view illustrating movement of the box and a box-moving section; and

[0022] FIG. 11 is a side view illustrating movement of the box and the box-moving section.

DESCRIPTION OF EMBODIMENTS

[0023] Below is a description of an embodiment of a boxing device in accordance with the claimed invention, made with reference to the drawings. In the description of the drawings, the same elements are given the same reference numerals, and redundant description is omitted. In the following description, for convenience, front-rear, up-down, and left-right directions with respect to a boxing device **300** are used. In some drawings, orthogonal axes indicating these directions are displayed. The front-rear and left-right directions are all directions that extend horizontally. The up-down direction is equivalent to a vertical direction. In addition, expressions such as same, horizontal, parallel, etc., may be used; these include not only completely same, horizontal, parallel, etc., but also substantially same, horizontal, parallel, etc.

(1) Overall Configuration

[0024] FIG. 1 is a schematic diagram of a packaging and boxing line **1** including the boxing device **300** in accordance with the claimed invention. The packaging and boxing line **1** has a packaging machine **100**, an inspection device **200**, and the boxing device **300**. In FIG. 1, the boxing device **300** is shown as being covered by a cover.

[0025] The packaging machine **100** packages a predetermined amount of a product A manufactured by a manufacturing device (not shown) in packaging material. Articles in which product A is packaged in packaging material is hereinafter referred to as articles B. The packaging machine **100** has a combination weighing machine **101** and a bag-making and packaging machine **102**. The combination weighing machine **101** is disposed above the bag-making and packaging machine **102**. The combination weighing machine **101** weighs the amount of product A that can be contained in one article B, and drops this amount of product into the bag-making and packaging machine **102**. The bag-making and packaging machine **102** is a vertical pillow-type bag-making and packaging machine, and packages the product A weighed by the combination weighing machine **101** into articles B (vertical pillow bags) and supplies the articles to the inspection device **200**. This example is not provided by way of limitation; the product A may, for example, be a snack food or the like.

[0026] The inspection device **200** inspects the articles B supplied from the packaging machine **100** for weight and the presence of pinholes and/or foreign matter, and supplies the articles B to the boxing device **300** via an article-conveying section **201**.

[0027] The boxing device **300** combines the articles B supplied from the article-conveying section **201** into an article group B1, and executes a boxing operation of boxing the article group B1 into a box C. As shown in FIG. 2, the boxing device **300** has a box-moving section **10**, a flap support section **20**, a second flap support section **30** (see FIG. 5), a third flap support section **40**, a pushing section **50**, a box-transferring section **60**, a second box-transferring section **70** (see FIG. 4), and a control unit **80** (see FIG. 9). As shown in FIG. 4, a box supply position P1, a boxing position P2, and a scaling and sorting position P3 are present in the boxing device **300**.

[0028] As shown in FIG. 3, the box C has flaps C10 and side walls C20. The side walls C20 define an opening O. The flaps C10 are disposed continuously with respect to side walls C20. In the

present embodiment, the flaps C10 include main flaps C11 and minor flaps C12. In the present embodiment, there are two main flaps C11 and two minor flaps C12. The main flaps C11 are connected to the side walls C20 facing in the left-right direction. The minor flaps C12 are connected to the side wall C20s facing in the front-rear direction.

[0029] As shown in FIG. 4, the box C can be in a first orientation S1 and a second orientation S2. In the first orientation S1, the opening O of the box C faces sideways. More specifically, in the first orientation S1, the opening O faces backward. In the second orientation S2, the opening O of the box C faces upward.

[0030] During the boxing operation, the box C is moved sequentially to the box supply position P1, the boxing position P2, and the scaling and sorting position P3. At the box supply position P1, the box C is in the first orientation S1 and moves along the vertical direction. At the boxing position P2 and the scaling and sorting position P3, the box C is in the second orientation S2 and moves in the horizontal direction. The article group B1 is boxed into the opening O. Therefore, during the boxing operation, the flaps C10 need to be open to the outside of the box C until the loading of a predetermined number of article groups B1 is completed.

[0031] As shown in FIGS. 2 and 4, the box supply position P1 is located near the center in the front-rear direction of the boxing device 300. At the box supply position P1, a box C is supplied from outside the boxing device 300. More specifically, at the box supply position P1, a box C in the first orientation S1 is supplied from an upper part of the boxing device 300.

[0032] The boxing position P2 is located rearward of the box supply position P1. The boxing position P2 is disposed at a lower position than the box supply position P1. At the boxing position P2, the article group B1 is boxed into the box C through the opening O. At the boxing position P2, the box C is in the second orientation S2. Since the opening O of the box C faces upward, the article group B1 is boxed into the box C from above the opening O.

[0033] The scaling and sorting position P3 is located forward of the box supply position P1. The scaling and sorting position P3 is located lower than the box supply position P1 and at the same height as the boxing position P2. At the scaling and sorting position P3, the box C is scaled and sorted.

(2) Detailed Configuration

(2-1) Box-Moving Section

[0034] The box-moving section 10 moves the box C from the box supply position P1 to the boxing position P2. The box-moving section 10 is controlled by the control unit 80.

[0035] The box-moving section 10 has a box holder 11, a first cam 12, a second cam 13, a transmission member 13a, a first cam rail 14, and a second cam rail 15.

[0036] The first cam rail 14 is disposed spanning from the box supply position P1 to the boxing position P2. More specifically, the first cam rail 14 is disposed in a front part of the box supply position P1 of the boxing device 300. The first cam rail 14 includes a vertical part 14a extending in the vertical direction, an inclined part 14b inclined relative to the vertical direction, and a horizontal part 14c extending in the horizontal direction. The vertical part 14a extends along the vertical direction from the vicinity of a box loading port at the top of the boxing device 300. The vertical part 14a connects to the inclined part 14b, and the inclined part 14b connects to the horizontal part 14c.

[0037] The first cam 12 is connected near a suction part of the box holder 11. The first cam 12 is movable along the first cam rail 14 in order of the vertical direction, the direction inclined relative to the vertical direction, and the horizontal direction, and also in the opposite order. A detailed operation of the first cam 12, etc., shall be described in detail in the section on the boxing operation described later.

[0038] The second cam rail 15 is disposed at the boxing position P2. More specifically, the second cam rail 15 is disposed below the pushing section 50 so as to extend in the front-rear direction.

[0039] The transmission member 13a is disposed between the first cam 12 and the second cam 13.

[0040] The second cam **13** is connected to the box holder **11** via the transmission member **13a**. The second cam **13** moves along the second cam rail **15**. The second cam **13** is disposed in contact with the second cam rail **15** due to gravity.

[0041] The box holder **11** moves the box C. The box holder **11** has a suction part (not shown) in a central portion thereof. The suction part suctions a right side surface of the box C and holds the box C from the side surface. The box holder **11** holds the box C by clamping vertically opposing surfaces of the box C from the outside.

[0042] Following the movement of the first cam **12** and the second cam **13**, the box holder **11** moves in order in the vertical direction, in the direction inclined relative to the vertical direction, and in the horizontal direction, and moves the box C from the box supply position **P1** to the boxing position **P2**. When the box C is conveyed by the box-transferring section **60**, the box holder moves in the horizontal direction, in the direction inclined relative to the vertical direction, and in the vertical direction and returns to the upper part of the box supply position **P1**.

[0043] The box-moving section **10** moves the supplied box C, which is in the first orientation **S1**, downward along the vertical direction. Before the pushing section **50** pushes the article group **B1** into the box C, the box-moving section **10** moves the box C so that the orientation of the box C changes from the first orientation **S1** to the second orientation **S2**. The box-moving section **10** moves the box C from the box supply position **P1** to the boxing position **P2** while keeping the box C aligned with the flap support section **20** (described hereinafter). When it is moved from the box supply position **P1** to the boxing position **P2**, the box C moves in an arcuate trajectory in a side view.

(2-2) Flap Support Section

[0044] The flap support section **20** supports the flaps **C10**. The flap support section **20** supports the flaps **C10** when the orientation of the box C changes from the first orientation **S1** to the second orientation **S2**.

[0045] The flap support section **20** includes multiple rod-form members. The attachment location of the flap support section **20** is not particularly limited; for example, the flap support section **20** is attached to the box-moving section **10**. The flap support section **20** need not be in constant contact with the flaps **C10**.

[0046] In the present embodiment, the flap support section **20** includes three rod-form members, as shown in FIG. 5. More specifically, the flap support section **20** includes two major bars **21** and one sub bar **22**.

[0047] Each of the two major bars **21** lays down each main flap **C11** of the box C to the outside of the box C.

[0048] The two major bars **21** have the same shape. The two major bars **21** are disposed parallel to each other. The two major bars **21** are disposed adjacent to each other in the left-right direction with a gap therebetween, in positions where the major bars are in contact with different main flaps **C11** of the box C. A width between the major bars **21** is greater than a left-right width of the opening of the box C. This allows the major bars **21** to lay down the main flaps **C11** to the outside of the box C.

[0049] The major bars **21** each have a first part **21a**, a second part **21b**, and a third part **21c**. The first part **21a** connects to the second part **21b**, and the second part **21b** connects to the third part **21c**.

[0050] The first part **21a** is disposed in the box supply position **P1**. The first part **21a** extends along the vertical direction from the vicinity of the box loading port at the upper part of the boxing device **300**.

[0051] The second part **21b** is disposed spanning from the box supply position **P1** to the boxing position **P2**. The second part **21b** is a radius part extending in an arc from the front to the rear in a side view. Though not particularly limited, the bending **R** of the second part **21b** may be **R3** or greater (radius: >3 mm). In the present embodiment, for example, the bending **R** of the second part

21b may be R100 (radius: 100 mm). The second part **21b** extends in a direction inclined backward in relation to the vertical direction at the connecting part with the first part **21a**. The second part **21b** extends backward so as to approach the horizontal direction at the connecting part with the third part **21c**.

[0052] The third part **21c** is disposed in the boxing position **P2**. In a lower part of the pushing section **50**, the third part **21c** extends along the horizontal direction to a rear end of the pushing section **50**.

[0053] The sub bar **22** lays down a minor flap **C12** of the box **C** to the outside of the box **C**. In particular, when the box **C** moves from the box supply position **P1** to the boxing position **P2**, the sub bar **22** lays down the minor flap **C12**, which is on the rear side in the movement direction of the box **C**, to the outside of the box **C**.

[0054] The sub bar **22** is disposed between the two major bars **21** so as to be parallel to each of the major bars **21**. The sub bar **22** is disposed across a gap from each of the major bars **21**. The sub bar **22** is disposed at a position where contact is made with the minor flaps **C12** of the box **C**.

[0055] The sub bar **22** has a fourth part **22a**, a fifth part **22b**, and a sixth part **22c**. The fourth part **22a** connects to the fifth part **22b**, and the fifth part **22b** connects to the sixth part **22c**.

[0056] The fourth part **22a** extends parallel to the first part **21a** along the vertical direction from the vicinity of the box loading port at the upper part of the boxing device **300**. The fourth part **22a** is disposed to the rear of the first part **21a** in a side view.

[0057] The fifth part **22b** is a radius part extending in an arc from the front to the rear in a side view. Though not particularly limited, the bending **R** of the fifth part **22b** may be **R3** or greater (radius: >3 mm). In the present embodiment, for example, the bending **R** of the fifth part **22b** may be **R100** (radius: 100 mm). The bending **R** of the fifth part **22b** may be smaller or greater than the bending **R** of the second part **21b**. This allows the fifth part **22b** to easily push the minor flap **C12** without obstructing the movement of the box **C** when the box **C** changes from the first orientation **S1** to the second orientation **S2**. The fifth part **22b** extends in a direction inclined backward in relation to the vertical direction at the connecting part with the fourth part **22a**. The fifth part **22b** extends backward so as to approach the horizontal direction at the connecting part with the sixth part **22c**.

[0058] The sixth part **22c** extends parallel to the third part **21c**, along the horizontal direction up to a front end of the pushing section **50**. The sixth part **22c** is not disposed below the lower part of the pushing section **50**. The sixth part **22c** and the third part **21c** are of the same height.

(2-3) Second Flap Support Section

[0059] The second flap support section **30** is disposed rearward of an opening/closing member **51** so as to face the minor flap **C12** on the rear side of the box **C**. The second flap support section **30** is a plate-form member extending in the front-rear direction. The second flap support section **30** supports the minor flap **C12** on the rear side of the box **C** when the box **C** is in the boxing position **P2**.

(2-4) Third Flap Support Section

[0060] As shown in FIG. 2, the third flap support section **40** is disposed in front of the boxing device **300**, on the outside of the arcuate trajectory of the box **C** when the box **C** changes orientation. The third flap support section **40** prevents the flaps **C10** of the box **C** from falling to the inside of the box **C** when the box **C** moves from the boxing position **P2** to the sealing and sorting position **P3**. The third flap support section **40** is controlled by the control unit **80**.

[0061] As shown in FIG. 6, the third flap support part **40** includes two members. Each member includes a fixed part **41** and a movable part **42**. The attachment location of the fixed part **41** is not particularly limited; for example, the fixed part **41** is fixed to a lower part of a sealing section **71**. The movable part **42** has one end pivotally connected to the fixed part **41**, and the one end is disposed to be movable in the up-down direction. The movable part **42** pivots in the up-down direction due to an air cylinder. The two movable parts **42** are arranged parallel to each other with a

gap therebetween. A distance between opposing surfaces of the two movable parts **42** is smaller than a length of the opening O of the box C in the left-right direction. Therefore, the minor flaps C**12** of the box C can be held down. A distance between left and right outer surfaces of the two movable parts **42** is greater than the length of the opening O of the box C in the left-right direction. Therefore, the main flaps C**11** of the box C can be held down.

[0062] As shown in the left drawing of FIG. **6**, while the box C is moving from the box supply position P**1** to the boxing position P**2**, the ends of the movable parts **42** are lowered downward. As a result, the third flap support part **40** does not block the path along which the box C descends. On the other hand, as shown in the right drawing of FIG. **6**, while the box C is moving from the boxing position P**2** to the sealing and sorting position P**3**, the ends of the movable parts **42** rise upward and hold down the flaps C**10** of the box C from above. As a result, even if the box C is moved from the boxing position P**2** to the sealing and sorting position P**3** using part of the path along which the box C descends, the third flap support part **40** does not obstruct the movement of the box C.

(2-5) Pushing Section

[0063] The pushing section **50** pushes the article group B**1**, in which a plurality of articles conveyed by the article-conveying section **201** are aligned side-by-side, into a box C located at the boxing position P**2**. The pushing section **50** is controlled by the control unit **80**.

[0064] The pushing section **50** is disposed at a final end of the article-conveying section **201**. The pushing section **50** has the opening/closing member **51**. The opening/closing member **51** is positioned above the opening O of the box C when the box C is in the boxing position P**2**.

[0065] The opening/closing member **51** is positioned at the final end of the article-conveying section **201** and supports the article group B**1** that has been conveyed from the article-conveying section **201** and has been combined. The opening/closing member **51** places the article group B**1** into the box C. More specifically, the opening/closing member **51** opens all at once in the left-right direction from a center, and places the article group B**1** all together into the box C. The opening/closing member **51** opens to inner dimensions of the box C.

[0066] As shown in FIG. **7**, the opening/closing member **51** includes two protrusions **51a** on a surface that faces the box C. FIG. **7** shows a state in which the opening/closing member **51** is open to the left and right.

[0067] The protrusions **51a** are individually disposed at the end of the center of the opening/closing member **51**. The protrusions **51a** extend in the front-rear direction. The protrusions **51a** are of such height as to allow contact to be made thereby with upper ends of the side walls C**20** of the box C in the boxing position. The protrusions **51a** move together with the center of the opening/closing member **51**, and therefore move to a breadth nearly equal to the inner dimensions of the box C.

[0068] The protrusions **51a** reliably widen the opening O of the box C to the left and right while centering the box C. Front ends of the protrusions **51a** are inclined backward and downward. Therefore, even if the box C moves in the horizontal direction to be placed in the boxing position P**2**, the protrusions **51a** are prevented from getting caught on the flaps C**10** of the box C.

(2-6) Box-Transferring Section

[0069] The box-transferring section **60** transfers the box C into which the article group B**1** has been loaded. The box-transferring section **60** is controlled by the control unit **80**. The box-transferring section **60** is driven by a servo motor.

[0070] The box-transferring section **60** has a conveying mechanism and a box lifter mechanism (neither is shown).

[0071] The conveying mechanism includes a conveyor. The box-transferring section **60**, via the conveying mechanism, transfers the box C into which the article group B**1** has been boxed. The box-transferring section **60** is disposed at a standby position P**4** so as to be movable in the front-rear direction. The standby position P**4** is in a front part of the boxing device **300**. The standby position P**4** is adjacent to the sealing and sorting position P**3**.

[0072] After the box C has been changed to the second orientation S**2**, the box-transferring section

60 moves from the standby position **P4** to the boxing position **P2** below the box **C**. As a result, while the box **C** is being moved from the boxing position **P2** to the scaling and sorting position **P3**, the next box **C** can be lowered. Therefore, the time required to replace the box **C** can be reduced. When the loading of the article group **B1** into the box **C** is completed, the box-transferring section **60** transfers the box **C** forward. The box-transferring section **60** delivers the box to the second box-transferring section **70**.

[0073] The box lifter mechanism can move up and down according to the height of the box **C**. As shown in FIG. **8**, when the box **C** is moved to the boxing position **P2** and the box-transferring section **60** moves below the box **C**, the box-transferring section **60** is moved upward by the box lifter mechanism. This causes the flap support section **20** to come into contact with the flaps **C10**, allowing the flaps **C10** reliably to be opened outward. In addition, the box lifter mechanism at low height can handle even a box **C** at low height. When the loading of the article group **B1** into the box **C** is completed, the box-transferring section **60** is moved downward by the box lifter mechanism.

(2-7) Second Box-Transferring Section

[0074] The second box-transferring section **70** seals and sorts the box **C** transferred by the box-transferring section **60**. The second box-transferring section **70** is controlled by the control unit **80**.

[0075] The second box-transferring section **70** includes the sealing section **71** and a sorting section **72**. The sealing section **71** uses the flaps **C10** to cover the opening **O** of the box **C** and tapes the flaps closed. The sorting section **72** performs classification into acceptable boxes, for which the boxing is regarded as acceptable, and unacceptable boxes, for which the boxing is not regarded as acceptable, and separates and conveys the boxes **C** out of the boxing device **300**. The sorted boxes **C** are conveyed out from, for example, a front end of the boxing device **300**.

[0076] The sorting section **72** sorts the boxes into acceptable boxes and unacceptable boxes. There is no particular limitation on the method for determining whether a box is acceptable or unacceptable; for example, the control unit **80** determines whether or not the weight of the box **C** is within a predetermined range on the basis of an output signal from a load cell. When the weight is determined to be outside of the predetermined range, a failure signal indicating that the weight is determined to be outside of the predetermined range is sent to the sorting section **72**. The sorting section **72** sorts unacceptable boxes into an unacceptable-box-collection conveyor (not shown) in accordance with failure signals from the control unit **80**.

[0077] The sorting section **72** is a conveyor. The conveyor transfers the boxes **C** in the front-rear direction. The second box-transferring section **70** is disposed in front of the box-transferring section **60**. The second box-transferring section **70** is able to rotate. As a result, as soon as a box **C** can be transferred to the sealing position, the next cycle of boxing can be performed without waiting for sealing to have concluded. In the box-transferring section **60**, boxes can be transferred using flap folding surfaces as a reference, making it easier to control the flaps. When the boxes are conveyed out after sealing, conveyor height can be changed using the conveyor height of the next stage as a reference, and the boxes can be conveyed out, increasing the freedom of box transfer. Since the unit that performs sealing and the unit that sorts the boxes **C** can be disposed in the same position, the section occupied by these units in the boxing device **300** can be shortened.

[0078] A mechanical locking mechanism is disposed on a rotating lever that rotates the second box-transferring section **70**. The locking mechanism may, for example, be a leaf spring stopper. The second box-transferring section is disposed below the sealing section **71**. The second box-transferring section carries out the sorting of the boxes **C**. If a box **C** is acceptable, the second box-transferring section moves the box **C** forward. If a box **C** is unacceptable, the locking mechanism mechanically locks.

(2-8) Control Unit

[0079] The control unit **80** controls the parts of the boxing device **300** to implement the boxing operation. The boxing operation includes a box-moving process, a boxing process, a box-

transferring process, and a sealing and sorting process. The details of the boxing operation shall be described later. FIG. 9 is a block diagram of the control unit 80. The control unit 80 is electrically connected to the box-moving section 10, the third flap support section 40, the pushing section 50, the box-transferring section 60, and the second box-transferring section 70 so as to be able to transmit and receive control signals and detection signals.

[0080] The control unit 80 is implemented by a computer. The control unit 80 includes a control arithmetic device and a storage device. A processor such as a CPU or a GPU can be used as the control arithmetic device. The control arithmetic device reads a program stored in the storage device and performs a predetermined arithmetic process in accordance with the program. Furthermore, the control arithmetic device can write an arithmetic result to the storage device and read information stored in the storage device in accordance with the program.

(3) Boxing Operation

[0081] The boxing operation is an operation of repeatedly boxing a predetermined number N of articles B into a box C. The boxing operation includes a box-moving process, a boxing process, a box-transferring process, and a sealing and sorting process. The boxing operation is started, for example, when a packaging and boxing line (not shown) activates.

[0082] When the boxing operation is started, the control unit 80 starts the box-moving process. The box-moving process is a process of moving the box C from the box supply position P1 to the boxing position P2.

[0083] In the box-moving process, a box C is supplied from the outside of the boxing device 300 at the box supply position P1. The control unit 80 controls the box-moving section 10 to move the box C. More specifically, at the box supply position P1, the box holder 11 suctions side surfaces of the supplied box C to hold the box C from the side surfaces and top and bottom surfaces, and holds a first orientation of the box C. At this time, as shown in FIG. 2, the first cam 12 is located at the vertical part 14a of the first cam rail, and the second cam 13 is located at the second cam rail 15. The first cam 12 moves downward along the vertical part 14a, and the second cam 13 moves backward along the second cam rail 15. Following the movements of the first cam 12 and the second cam 13, the box holder 11 moves downward while holding the box C.

[0084] Next, as shown in FIG. 10, before the pushing section 50 pushes the article group B1 into the box C, the first cam 12 moves to the inclined part 14b of the first cam rail, and the second cam 13 moves further backward along the second cam rail 15. The box holder 11, while still holding the box C, becomes inclined in relation to the vertical direction.

[0085] Next, as shown in FIG. 11, the first cam 12 moves to the horizontal part 14c of the first cam rail, and the second cam 13 moves further backward along the second cam rail 15. The box holder 11, while still holding the box C, becomes extended in the horizontal direction. The orientation of the box C is thereby changed from the first orientation S1 to the second orientation S2. The first cam 12 moves backward along the horizontal part 14c, and the second cam 13 moves further backward along the second cam rail 15. The box holder 11, following the movements of the first cam 12 and the second cam 13, moves the box C in the second orientation S2 to the boxing position P2.

[0086] While the box C is being moved from the box supply position P1 to the boxing position P2, the flap support section 20 is always in a state of being able to be in contact with the flaps C10 of the box C. Therefore, the flaps C10 of the box C are reliably maintained in an open state toward the outside of the box C. When being moved from the box supply position P1 to the boxing position P2, the box C moves in an arcuate trajectory in a side view.

[0087] While the box C is in the box supply position P1, the box-transferring section 60 waits at the standby position P4. At the same time that the box C moves to the boxing position P2, the control unit 80 moves the box-transferring section 60 below the box C. The box-transferring section 60, upon arriving at the boxing position P2, moves upward due to the box lifter mechanism and raises the box C to the desired height for boxing. As a consequence thereof, the flaps C10 of

the box C come into contact with the flap support section **20** and the second flap support section **30**, and the flaps **C10** of the box C reliably open to the outside of the box C.

[0088] When the box C arrives at the boxing position **P2**, the control unit **80** starts the boxing process. The boxing process is a process of packing the article group **B1** into the opening **O** of the box C.

[0089] The control unit **80** controls the pushing section **50** and the opening/closing member **51** of the pushing section **50** opens left and right from the center. The pushing section **50** thereby loads the article group **B1** into the box C. When the opening/closing member **51** opens left and right, the protrusions **51a** also move left and right. The protrusions **51a** thereby reliably widen the opening **O** of the box C to the left and right.

[0090] When loading of the article group **B1** is completed, the control unit **80** starts the box-transferring process. The box-transferring process is a process of conveying out the box C into which the article group **B1** is packed.

[0091] The box-transferring section **60** is controlled by the control unit **80** and moved downward so that the height of the box C is put at a desired discharge height by the box lifter mechanism. The desired discharge height may, for example, be the height at which the box C is discharged. The box-transferring section **60** moves horizontally forward, which is the box discharge direction, while still carrying the box C, and moves to the standby position **P4**. Upon arriving at the standby position **P4**, the box-transferring section **60** delivers the box C to the second box-transferring section **70**. At the same time that the box-transferring section **60** finishes moving forward, the next box **C2** is conveyed in. At the same time that the next box **C2** becomes horizontal, the box-transferring section **60** passes under the box **C2** and moves below the box **C2**. The box-transferring section **60** moves upward due to the box lifter mechanism and raises the box **C2** to the desired position for boxing.

[0092] When the box C arrives at the sealing and sorting position **P3**, the control unit **80** starts the sealing and sorting process. Sealing and sorting is the process of closing the flaps **C10** of boxes C, applying tape, and sorting the boxes into acceptable boxes and unacceptable boxes.

[0093] The second box-transferring section **70** performs the sealing of boxes C. The second box-transferring section **70** sorts the boxes C that have finished being sealed and conveys the boxes C out of the boxing device **300**.

(4) Characteristics

4-1

[0094] A boxing device **300** of the disclosed, exemplary embodiment of the claimed invention has a box-moving section **10**, a flap support section **20**, and a pushing section **50**. The box-moving section **10** moves a box C from a box supply position **P1** to a boxing position **P2**. The box C has flaps **C10**. The flaps **C10** are disposed continuously with respect to side walls **C20** that define an opening **O**. At the box supply position **P1**, the box C is supplied from the outside. At the boxing position **P2**, a plurality of articles **B** are boxed in the opening **O**. The flap support section **20** supports the flaps **C10**. A pushing section **50** pushes an article group **B1**, in which a plurality of the articles **B** conveyed by an article-conveying section **201** are aligned side-by-side, into the box in the boxing position **P2**. The box-moving section **10**, before the pushing section **50** pushes the article group **B1** into the box C, moves the box C so that the box C changes in orientation from a first orientation **S1**, in which the opening **O** of the box C faces sideways in the box supply position **P1**, to a second orientation **S2**, in which the opening **O** of the box C faces upwards in the boxing position **P2**. The flap support section **20** supports the flaps **C10** when the orientation of the box C changes from the first orientation **S1** to the second orientation **S2**.

[0095] In the boxing device **300** of the present embodiment, the flaps **C10** of the box C can be prevented from falling inward.

4-2

[0096] In the boxing device **300** of the present embodiment, the flap support section **20** has a first

part **21a**, a second part **21b**, and a third part **21c**. The first part **21a** extends along a vertical direction. The second part **21b** extends in a direction inclined in relation to the vertical direction. The third part **21c** extends along a horizontal direction.

[0097] In the boxing device **300** of the present embodiment, the flaps **C10** of the box **C** can be prevented from falling inward while the box **C** is moving from the box supply position **P1** to the boxing position **P2**.

4-3

[0098] In the boxing device **300** of the present embodiment, the box-moving section **10** moves the box **C** from the box supply position **P1** to the boxing position **P2** while keeping the box aligned with the flap support section **20**.

[0099] In the boxing device **300** of the present embodiment, the flap support section **20** can support the flaps **C10** in accordance with a trajectory in which the box **C** moves.

4-4

[0100] In the boxing device **300** of the present embodiment, the pushing section **50** has an opening/closing member **51**. The opening/closing member **51** includes protrusions **51a** on a surface that faces the box **C**.

[0101] Since the protrusions **51a** open the box **C** to the left and right, a separate member is not required for accurate centering of the box **C**. In addition, the protrusions **51a** allow the opening/closing member to be opened to a breadth nearly equal to the inner dimensions of the box **C**, thereby increasing the allowance for boxing. Furthermore, even if a recycled box is used, the protrusions **51a** forcibly open the box **C** to predetermined inner dimensions, thereby suppressing the incidence of defects in the articles **B**, etc.

4-5

[0102] The boxing device **300** of the present embodiment further has a box-transferring section **60**. The box-transferring section **60** transfers the box **C** in which the article group **B1** is boxed. The box-transferring section **60** moves from a standby position **P4** to below the box **C** after the box **C** has been changed to the second orientation **S2**.

[0103] Since the next box **C2** can be lowered while the box-transferring section **60** is moving in the front-rear direction, the time required for replacing the box **C** can be shortened.

4-6

[0104] In the boxing device **300** of the present embodiment, the flap support section **20** lays down a minor flap **C12** that is on a rear side of the box **C** in a box movement direction to the outside of the box **C** when the box **C** moves from the box supply position **P1** to the boxing position **P2**.

[0105] In the boxing device **300** of the present embodiment, the minor flap **C12** that is on the rear side of the box **C** in the box movement direction can be prevented from falling inward while the box **C** is moving from the box supply position **P1** to the boxing position **P2**.

(5) Modifications

(5-1) Modification A

[0106] In the above embodiment, in the flap support section **20** of the boxing device **300**, the second part **21b** extends in a direction inclined rearward in relation to the vertical direction at the part of connection with the first part **21a**, but this example is not given by way of any particular limitation. The second part **21b** may extend in a direction inclined forward in relation to the vertical direction at the part of connection with the first part **21a**. That is, the second part **21b** may have a shape that bulges forward to describe a partial circle in a side view.

[0107] In the present modification, when the box **C** changes from the first orientation **S1** to the second orientation **S2**, the trajectory of the box **C** in a side view bulges outward slightly. That is, the trajectory of the box **C** has a shape that bulges forward to describe a partial circle in a side view. If the second part **21b** has a shape that bulges forward to describe an arc in a side view, the second part **21b** can come into contact with the flaps **C10** even when the box **C** changes from the first orientation to the second orientation, and the flaps can be supported more reliably.

(5-2) Modification B

[0108] In the above embodiment, the flap support section **20** has three bars, but this example is not given by way of any particular limitation. For example, the flap support section **20** may have two main bars and two sub bars for a total of four bars.

(5-3) Modification C

[0109] In the above embodiment, the box holder **11** is disposed only on the right side of the boxing device **300**, but this example is not given by way of any particular limitation. The box holder **11** may be disposed on both the left and right sides of the boxing device **300**.

(5-4) Modification D

[0110] In the above embodiment, the pushing section **50** loads the article group **B1** into the box **C**, but this example is not given by way of any particular limitation. The pushing section **50** may load the articles **B** into the box **C** individually.

(5-5) Modification E

[0111] In the above embodiment, a box **C** in the first orientation **S1** is supplied from the upper part of the boxing device **300** and conveyed out from the sealing and sorting position **P3**, but this example is not given by way of any particular limitation. The box **C** may be supplied from the boxing position **P2** or the sealing and sorting position **P3**. The box **C** may be conveyed out from the boxing position **P2**.

REFERENCE SIGNS LIST

[0112] **10** Box-moving section [0113] **20** Flap support section [0114] **21a** First part [0115] **21b** Second part [0116] **21c** Third part [0117] **30** Second flap support section [0118] **40** Third flap support section [0119] **50** Pushing section [0120] **51** Opening/closing member [0121] **51a** Protrusion [0122] **60** Box-transferring section [0123] **201** Article-conveying section [0124] **B** Articles [0125] **B1** Article group [0126] **C** Box [0127] **C10** Flap [0128] **C20** Side wall [0129] **O** Opening [0130] **P1** Box supply position [0131] **P2** Boxing position [0132] **S1** First orientation [0133] **S2** Second orientation

CITATION LIST

Patent Literature

[0134] [Patent Literature 1] Japanese Laid-open Patent Publication No. 2014-61904

Claims

1. A boxing device, comprising: a box-moving section configured to move a box from a box supply position to a boxing position, the box having a flap disposed continuously with respect to a side wall defining an opening, the box supply position to which the box is supplied from the outside, the boxing position at which a plurality of articles are boxed into the opening; a flap support section configured to support the flap; and a pushing section configured to push an article group, in which a plurality of the articles conveyed by an article-conveying section are aligned side-by-side, into the box in the boxing position, the box-moving section, before the pushing section pushes the article group into the box, moving the box so that the box changes in orientation from a first orientation, in which the opening of the box faces sideways in the box supply position, to a second orientation, in which the opening of the box faces upwards in the boxing position, and the flap support section supporting the flap when the orientation of the box changes from the first orientation to the second orientation.

2. The boxing device according to claim 1, wherein the flap support section has a first part extending along a vertical direction, a second part extending in a direction inclined in relation to the vertical direction, and a third part extending along a horizontal direction.

3. The boxing device according to claim 1, wherein the box-moving section moves the box from the box supply position to the boxing position while keeping the box aligned with the flap support section.

4. The boxing device according to claim 1, wherein the pushing section has an opening/closing member, and the opening/closing member includes a protrusion on a surface that faces the box.
 5. The boxing device according to claim 1, further including a box-transferring section that transfers the box in which the article group is boxed, the box-transferring section moving from a standby position to below the box after the box has been changed to the second orientation.
 6. The boxing device according to claim 1, wherein the flap support section lays down the flap that is on a rear side of the box in a box movement direction to the outside of the box when the box moves from the box supply position to the boxing position.
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