DESCRIPTION

Title of Invention

GRIPPING DEVICE AND METHOD

Technical Field

[0001]

The present disclosure relates to a gripping device and a method for gripping an article.

Background Art

[0002]

A transport device such as a palletizing device that loads articles on a tray such as a pallet is known. For example, PTL 1 discloses a gripping device that grips an article by suctioning an upper surface of the article in a transport device.

Citation List

Patent Literature

[0003]

[PTL 1] Japanese Patent No. 6793428

Summary of Invention

Technical Problem

[0004]

The gripping device of PTL 1 determines a method of gripping the article based on detection results of an imaging device, a position sensor, and a contact sensor. Thus, the number of processes for determining the method of gripping the article is increased. A control of the gripping device is complicated, and a processing time is increased.

When the method of gripping the article is insufficient, the article may fall.

[0005]

The present disclosure is conceived to solve the above problem, and an object thereof is to provide a gripping device and a method capable of improving transport performance.

Solution to Problem

[0006]

A gripping device of the present disclosure for achieving the above object includes an upper surface gripping part including a first suction surface capable of suctioning an upper surface of an article, a control unit that controls a motion of the upper surface gripping part by setting a transport parameter for operating the upper surface gripping part based on transport target data of the article, and a correction unit that corrects the transport parameter determined by the control unit based on characteristic data of the article.

[0007]

A gripping method of the present disclosure uses a gripping device including an upper surface gripping part including a first suction surface capable of suctioning an upper surface of an article, and includes a step of controlling a motion of the upper surface gripping part by setting a transport parameter for operating the upper surface gripping part based on transport target data of the article, and a step of correcting the transport parameter based on characteristic data of the article.

Advantageous Effects of Invention

[0008]

According to the gripping device and the method of the present disclosure, transport performance can be improved.

Brief Description of Drawings

[0009]

FIG. 1 is a schematic diagram of a gripping device according to a first embodiment.

FIG. 2 is a schematic diagram showing a 90° flip-up aspect of the gripping device shown in FIG. 1.

FIG. 3 is a schematic diagram showing a 180° flip-up aspect of the gripping device shown in FIG. 1.

FIG. 4 is a schematic block diagram of the gripping device shown in FIG. 1.

FIG. 5 is a flowchart showing a processing flow of a control device.

FIG. 6 is a plan view for schematically describing an unloading operation by the gripping device.

FIG. 7 is a cross-sectional view taken along line II-II shown in FIG. 6.

FIG. 8 is a cross-sectional view showing a state after FIG. 7.

FIG. 9 is a schematic block diagram of a gripping device according to a second embodiment.

FIG. 10 is a flowchart showing a processing flow of a control device.

FIG. 11 is a schematic block diagram of a gripping device according to a third embodiment.

FIG. 12 is a flowchart showing a processing flow of a control device.

Description of Embodiments

[0010]

Hereinafter, embodiments according to the present disclosure will be described in detail with reference to the drawings. It should be noted that these embodiments do not limit the invention. In addition, elements in the following embodiments include

elements replaceable or easily replaced by those skilled in the art, elements that are substantially identical, or equivalent elements. Furthermore, various omissions, replacements, or changes can be made to the elements in the following embodiments without departing from the concept of the present disclosure. In the following embodiments, elements necessary for illustrating the embodiments will be described, and other elements will be omitted. Identical elements will be designated by identical reference signs, and different elements will be designated by different reference signs.

[0011]

[First Embodiment]

<Configuration of Gripping Device>

FIG. 1 is a schematic diagram of a gripping device according to the present embodiment. FIG. 2 is a schematic diagram showing a 90° flip-up aspect of the gripping device shown in FIG. 1. FIG. 3 is a schematic diagram showing a 180° flip-up aspect of the gripping device shown in FIG. 1. FIG. 4 is a schematic block diagram of the gripping device shown in FIG. 1. A gripping device 1 shown in FIGS. 1 to 4 is a device that is attached to a palletizing device as a transport device and that loads articles on a pallet, unloads articles from the pallet, or reloads articles from any pallet to another pallet in a logistics management facility such as a warehouse.

[0012]

According to the Japan Pallet Association, a pallet is defined as a "structure that has a surface for placing goods bundled into one unit and that can be handled, transported, and stored manually or by a dedicated vehicle such as a forklift, including a superstructure". In the present embodiment, the pallet is a container or a platform on which an article R is loaded. That is, the pallet here is not limited to a so-called plate-shaped platform and includes a basket cart and the like and may have any shape. The

article R is loaded on the pallet and is, for example, a shipped product or the like. The article R also includes a corrugated box or the like for packaging a product or the like. The article R has a shape in which at least an upper surface Ra is flat. In the present embodiment, the article R is assumed to be a corrugated box having a rectangular parallelepiped shape or a cubic shape.

[0013]

As shown in FIGS. 1 to 3, the gripping device 1 includes a base part 10, an upper surface gripping part 20, a side surface gripping part 30, a first arm part 40, a second arm part 50, and a flip-up mechanism 60. In addition, as shown in FIG. 4, the gripping device 1 further includes an imaging device 70, an input/output device 80, and a control device 90 that controls an operation of each part of the gripping device 1. In the present embodiment, the fact that the gripping device 1 includes the imaging device 70, the input/output device 80, and the control device 90 also includes an aspect in which a function of each device is configured as part of functions of the palletizing device to which the gripping device 1 is attached, or a transport system provided with the palletizing device.

[0014]

In the present embodiment, the article R is loaded on the pallet. An upper side in a vertical direction is an upper surface Ra, and a side in a horizontal direction orthogonal to the vertical direction is a side surface Rb. A direction perpendicular to a second facing surface 30a that faces the side surface Rb when the side surface gripping part 30 supports the side surface Rb of the article R is defined as an X-axis direction. A direction parallel to a rotation axis A of the flip-up mechanism 60 is defined as a Y-axis direction. A direction orthogonal to the X-axis direction and the Y-axis direction and perpendicular to a first facing surface 20a that faces the upper surface Ra when the

upper surface gripping part 20 supports the upper surface Ra of the article R is defined as a Z-axis direction. At least during an operation of the gripping device 1, the X-axis direction and the Y-axis direction correspond to the horizontal direction, and the Z-axis direction corresponds to the vertical direction.

[0015]

The base part 10 shown in FIGS. 1 to 3 is connected to a tip of an arm of the palletizing device to which the gripping device 1 is attached, via a turning shaft part 12, a turning mechanism 14, and an elevating mechanism 16. The turning shaft part 12 is fixed to the base part 10 on an upper surface side such that an axis thereof is parallel to the Z-axis direction. The base part 10 and the turning shaft part 12 are supported to be rotatable about an axis of the turning shaft part 12 in a rotation direction φ with respect to the arm of the palletizing device.

[0016]

The turning mechanism 14 shown in FIG. 4 rotates the base part 10 and the turning shaft part 12 in the rotation direction φ. For example, when the palletizing device is a multi-joint robot, the rotation of the turning shaft part 12 by the turning mechanism 14 corresponds to an operation of a sixth shaft of the multi-joint robot. The turning mechanism 14 is implemented by a well-known mechanism such as a rotary actuator including a motor, a rack and pinion mechanism including an air cylinder, a wire, or a link mechanism. An operation of the turning mechanism 14 is controlled by a control unit 96 of the control device 90.

[0017]

The elevating mechanism 16 linearly moves the base part 10 and the turning shaft part 12 in a vertical direction V parallel to the Z-axis direction. For example, when the palletizing device is a multi-joint robot, the linear motion of the turning shaft

part 12 by the elevating mechanism 16 is implemented by cooperation between a plurality of shafts of the multi-joint robot. When the palletizing device is a Cartesian coordinate robot, the linear motion of the turning shaft part 12 by the elevating mechanism 16 corresponds to an operation of a linear motion joint of the Cartesian coordinate robot in the vertical direction. In this case, the elevating mechanism 16 is implemented by a well-known mechanism such as a linear motion actuator including a motor, an air cylinder, or the like, or a rack and pinion mechanism. An operation of the elevating mechanism 16 is controlled by the control unit 96 of the control device 90.

[0018]

The upper surface gripping part 20 is provided in a lower part of the base part 10. The upper surface gripping part 20 has the first facing surface 20a facing the upper surface Ra of the article R as a lower surface thereof. The upper surface gripping part 20 is fixed to the base part 10 such that the first facing surface 20a is perpendicular to the Z-axis direction. The upper surface gripping part 20 is elevated and turned in accordance with an elevating operation and a turning operation of the base part 10 and the turning shaft part 12. The upper surface gripping part 20 includes a first suction part 22 that can suction the article R on the first facing surface 20a.

[0019]

In the example shown in FIGS. 1 to 3, the first suction part 22 is illustrated as having a single block shape. However, for example, the first suction part 22 may be a plurality of suction pads protruding downward from the first facing surface 20a of the upper surface gripping part 20. The first suction part 22 has a first suction surface 22a at a lower end thereof. When a first suction mechanism 24 shown in FIG. 4 operates in a state where the first suction surface 22a abuts on the upper surface Ra of the article R, the first suction part 22 suctions the upper surface Ra of the article R on the first

suction surface 22a. The first suction mechanism 24 includes, for example, a vacuum generator that is connected to the first suction surface 22a via an air pipe, not shown, and that sucks air from the first suction surface 22a. For example, when the first suction part 22 is configured with a plurality of suction pads, each suction pad is connected to the first suction mechanism 24, which is the vacuum generator, via the air pipe. An operation of the first suction mechanism 24 is controlled by the control unit 96 of the control device 90.

[0020]

The side surface gripping part 30 is provided in a side part of the base part 10 in the X-axis direction via the first arm part 40, the second arm part 50, and the flip-up mechanism 60. The side surface gripping part 30 has the second facing surface 30a facing the side surface Rb of the article R. The side surface gripping part 30 can be moved in a longitudinal direction of the first arm part 40 with respect to the base part 10 by a first extending and retracting mechanism 44, described later. The side surface gripping part 30 can also be moved in a longitudinal direction of the second arm part 50 with respect to the base part 10 by a second extending and retracting mechanism 54, described later. The side surface gripping part 30 can be rotated in a rotation direction θ about the rotation axis A of the flip-up mechanism 60 with respect to the base part 10 by the flip-up mechanism 60. The rotation axis A is a horizontal axis parallel to both the first suction surface 22a of the upper surface gripping part 20 and a second suction surface 32a of the side surface gripping part 30.

[0021]

The side surface gripping part 30 can be moved relative to the upper surface gripping part 20 in an X-Z plane by the first extending and retracting mechanism 44, the second extending and retracting mechanism 54, and the flip-up mechanism 60. In

other words, the first extending and retracting mechanism 44 and the second extending and retracting mechanism 54 are moving mechanisms that move the side surface gripping part 30 relative to the upper surface gripping part 20. The side surface gripping part 30 of the present embodiment does not move relative to the upper surface gripping part 20 in the Y-axis direction. However, the side surface gripping part 30 may be configured to move relative to the upper surface gripping part 20 in the Y-axis direction. The side surface gripping part 30 has a second suction part 32 that can suction the article R on the second facing surface 30a.

[0022]

In the example shown in FIGS. 1 to 3, the second suction part 32 is illustrated as having a single block shape. However, for example, the second suction part 32 may be a plurality of suction pads protruding from the second facing surface 30a of the side surface gripping part 30. The second suction part 32 has the second suction surface 32a in an end part thereof on an opposite side to a side on which the second facing surface 30a is present. When a second suction mechanism 34 shown in FIG. 4 operates in a state where the second suction surface 32a abuts on the side surface Rb of the article R, the second suction part 32 suctions the side surface Rb of the article R on the second suction surface 32a. The second suction mechanism 34 includes, for example, a vacuum generator that is connected to the second suction surface 32a via an air pipe, not shown, and that sucks air from the second suction surface 32a. For example, when the second suction part 32 is configured with a plurality of suction pads, each suction pad is connected to the second suction mechanism 34, which is the vacuum generator, via the air pipe. An operation of the second suction mechanism 34 is controlled by the control unit 96 of the control device 90.

[0023]

In the aspect shown in FIG. 1, in which the longitudinal direction of the first arm part 40 is parallel to the X-axis direction and the longitudinal direction of the second arm part 50 is parallel to the Z-axis direction, the second facing surface 30a of the side surface gripping part 30 faces the side surface Rb of the article R. In this case, the second suction surface 32a of the second suction part 32 faces the side surface Rb of the article R. In addition, in this case, the whole surface of the second suction surface 32a is positioned below the first suction surface 22a. In the aspect shown in FIG. 2, in which the longitudinal direction of the first arm part 40 is parallel to the Z-axis direction and the longitudinal direction of the second arm part 50 is parallel to the X-axis direction, the second facing surface 30a of the side surface gripping part 30 faces vertically downward. In this case, the second suction surface 32a of the second suction part 32 faces vertically downward. In addition, in this case, the second suction surface 32a is positioned above the first suction surface 22a by a distance B.

[0024]

The first arm part 40 is provided in the side part of the base part 10 in the X-axis direction via the second arm part 50 and the flip-up mechanism 60. The first arm part 40 includes a first supporting part 42 and the first extending and retracting mechanism 44. The first supporting part 42 is positioned on one end side of the first arm part 40 in the longitudinal direction. The first supporting part 42 is connected to the second arm part 50. The first supporting part 42 supports the first extending and retracting mechanism 44 and is connected to the side surface gripping part 30 via the first extending and retracting mechanism 44. In the present embodiment, the first supporting part 42 has a frame shape that accommodates and supports a first fixed part 44a of the first extending and retracting mechanism 44. The first extending and retracting mechanism 44 extends along the longitudinal direction of the first arm part 40

and can extend and retract in a first extending and retracting direction F1 that is the longitudinal direction of the first arm part 40. In the aspect shown in FIG. 1, in which the longitudinal direction of the first arm part 40 is parallel to the X-axis direction and the longitudinal direction of the second arm part 50 is parallel to the Z-axis direction, the first extending and retracting mechanism 44 is extended and retracted in advance in accordance with a width dimension w of the article R such that the second suction surface 32a abuts on the side surface Rb of the article R.

[0025]

In the present embodiment, the first extending and retracting mechanism 44 includes the first fixed part 44a and a first movable part 44b. The first fixed part 44a is fixed to the first supporting part 42. The first fixed part 44a supports the first movable part 44b such that the first movable part 44b can linearly move in the first extending and retracting direction F1 within a predetermined range. The first movable part 44b can move in the first extending and retracting direction F1 with respect to the first fixed part 44a. The first movable part 44b is supported by the first fixed part 44a on one end side thereof in the longitudinal direction. The first movable part 44b is fixed to the side surface gripping part 30 on the other end side thereof in the longitudinal direction. For example, the first extending and retracting mechanism 44 is implemented by a well-known mechanism such as a cylinder including the first fixed part 44a having a cylindrical shape and the first movable part 44b having a rod shape, an electric actuator, a wire, or a link mechanism.

[0026]

The second arm part 50 is provided in the side part of the base part 10 in the X-axis direction via the flip-up mechanism 60. The second arm part 50 includes a second supporting part 52 and the second extending and retracting mechanism 54. The second

supporting part 52 is positioned on one end side of the second arm part 50 in the longitudinal direction. The second supporting part 52 is connected to the flip-up mechanism 60. The second supporting part 52 supports the second extending and retracting mechanism 54 and is connected to the first supporting part 42 of the first arm part 40 via the second extending and retracting mechanism 54. In the present embodiment, the second supporting part 52 has a frame shape that accommodates and supports a second fixed part 54a of the second extending and retracting mechanism 54. The second extending and retracting mechanism 54 extends along the longitudinal direction of the second arm part 50 and can extend and retract in a second extending and retracting direction F2 that is the longitudinal direction of the second arm part 50. In the aspect shown in FIG. 1, in which the longitudinal direction of the first arm part 40 is parallel to the X-axis direction and the longitudinal direction of the second arm part 50 is parallel to the Z-axis direction, the second extending and retracting mechanism 54 is extended and retracted in advance in accordance with a height dimension h of the article R such that the second suction surface 32a abuts at a suitable height position on the side surface Rb of the article R.

[0027]

In the present embodiment, the second extending and retracting mechanism 54 includes the second fixed part 54a and a second movable part 54b. The second fixed part 54a is fixed to the second supporting part 52. The second fixed part 54a supports the second movable part 54b such that the second movable part 54b can linearly move in the second extending and retracting direction F2 within a predetermined range. The second movable part 54b can move in the second extending and retracting direction F2 with respect to the second fixed part 54a. The second movable part 54b is supported by the second fixed part 54a on one end side thereof in the longitudinal direction. The

second movable part 54b is fixed to the first supporting part 42 of the first arm part 40 on the other end side thereof in the longitudinal direction. For example, the second extending and retracting mechanism 54 is implemented by a well-known mechanism such as a cylinder including the second fixed part 54a having a cylindrical shape and the second movable part 54b having a rod shape, an electric actuator, a wire, or a link mechanism.

[0028]

The flip-up mechanism 60 can switch between a first state (the state shown in FIG. 1) where the side surface gripping part 30 is positioned below a lower end of the upper surface gripping part 20 (in the present embodiment, the first suction surface 22a of the first suction part 22), and a second state (the state shown in FIGS. 2 and 3) where the side surface gripping part 30 is positioned above the lower end of the upper surface gripping part 20. The flip-up mechanism 60 is connected to the upper surface gripping part 20 via the base part 10. The flip-up mechanism 60 is connected to the side surface gripping part 30 via the first arm part 40 and the second arm part 50. The flip-up mechanism 60 of the present embodiment is provided in the side part of the base part 10 in the X-axis direction. The flip-up mechanism 60 rotates the second arm part 50, the first arm part 40, and the side surface gripping part 30 in the rotation direction θ about the rotation axis A parallel to the Y-axis direction with respect to the base part 10.

[0029]

In the present embodiment, the flip-up mechanism 60 includes a fixed part 62 and a rotating part 64. The fixed part 62 is fixed to a connection part 10a of the base part 10. That is, the fixed part 62 moves in an integrated manner with the base part 10 and the upper surface gripping part 20. The rotating part 64 can rotate in the rotation direction θ about the rotation axis A with respect to the fixed part 62. The rotating part

64 is fixed to the second supporting part 52 of the second arm part 50. For example, the flip-up mechanism 60 is implemented by a well-known mechanism such as a rotary actuator including a motor, a rack and pinion mechanism including an air cylinder, a wire, or a link mechanism. The flip-up mechanism 60 includes a lock mechanism, not shown, that can position the rotating part 64 at a position in the rotation direction θ with respect to the fixed part 62. The lock mechanism is implemented by a well-known mechanism such as an air lock using high-pressure air, a mechanical lock by driving a motor, or a solenoid lock using an electromagnetic solenoid.

[0030]

The side surface gripping part 30, the first arm part 40, and the second arm part 50 can be rotated in the rotation direction θ about the rotation axis A by the flip-up mechanism 60 among a 0° position shown in FIG. 1, a 90° position shown in FIG. 2, and a 180° position shown in FIG. 3. The side surface gripping part 30, the first arm part 40, and the second arm part 50 can be positioned at any position between the 0° position shown in FIG. 1 and the 180° position shown in FIG. 3 by the lock mechanism, not shown. At the 0° position shown in FIG. 1, the first arm part 40 is positioned below the second arm part 50, and the second suction surface 32a of the side surface gripping part 30 is positioned below the first suction surface 22a of the upper surface gripping part 20 and faces the side surface Rb of the article R. At the 90° position shown in FIG. 2, the second suction surface 32a of the side surface gripping part 30 faces vertically downward and is positioned above the first suction surface 22a of the upper surface gripping part 20 by the distance B. At the 180° position shown in FIG. 3, the second suction surface 32a of the side surface gripping part 30 faces the opposite side to the base part 10 in the X-axis direction, and the first arm part 40 is positioned above the second arm part 50.

[0031]

The imaging device 70 images a target pallet on which the article R is loaded or unloaded, the article R loaded on the pallet, and disposition of the stacked articles R and outputs image data from which a position or an individual object of an imaging target can be identified, to the control device 90. The imaging device 70 is disposed at a position at which the pallet or the article R loaded on the pallet can be observed. Here, the imaging device 70 images disposition of a plurality of stacked articles R, that is, a layout of the plurality of articles R, by imaging all (the plurality of) articles R loaded on the pallet. The imaging device 70 may be mounted on the gripping device 1 or disposed separately from the gripping device 1. The imaging device 70 includes one or a plurality of cameras.

[0032]

The input/output device 80 includes an input device with which an operator inputs various types of information for operating the gripping device 1, and an output device for presenting various types of information to the operator. The input device is implemented by, for example, a keyboard, a mouse, a physical switch, a button, or a touch panel. The output device is implemented by, for example, a display device including a liquid crystal display device, an organic EL (electro luminescence) display device, or the like, a light-emitting device including a light emitting diode (LED) or the like, or a speaker. The input/output device 80 may be an information terminal with which various types of information can be input and output.

[0033]

The control device 90 is a computer that controls the gripping device 1. The control device 90 includes a communication unit 92, a storage unit 94, the control unit 96, and a correction unit 97. The communication unit 92 is a module that is used in

the control unit 96 and that communicates with an external device such as a management device 100, and may include, for example, an antenna. In the present embodiment, a communication method of the communication unit 92 is assumed to be wireless communication. However, any communication method may be used. The storage unit 94 is a memory that stores contents of an operation of the control unit 96, a program, and various types of information acquired from the management device 100 via the communication unit 92, and includes, for example, at least one of a main storage device, such as a random-access memory (RAM) or a read-only memory (ROM), and an external storage device, such as a hard disk drive (HDD).

[0034]

The control unit 96 is an operation processing device and includes, for example, an operation circuit such as a central processing unit (CPU). The control unit 96 executes various processes by reading and executing the program (software) from the storage unit 94. The control unit 96 may execute the processes using one CPU or may include a plurality of CPUs and execute the processes using the plurality of CPUs.

[0035]

The control unit 96 acquires upstream data from the management device 100 via the communication unit 92. For example, the upstream data includes transport target data such as a type, a weight, and a dimension of the article R loaded on the pallet, a perforation line or a zipper part of a box, the number of gluing points, the number of articles R, disposition of each article R on the pallet or a position at which each article R is loaded on the pallet, and an order of unloading the articles R from the pallet or an order of loading the articles R on the pallet. The control unit 96 acquires the image data by executing imaging via the imaging device 70 at any timing. The control unit 96 recognizes the number, position, shape, and size of the articles R present in the image

data by performing image processing on the acquired image data.

[0036]

The control unit 96 determines a transport parameter for the upper surface gripping part 20 and the side surface gripping part 30 based on the image data and the transport target data. In this case, the image data may not be used. Here, the transport parameter includes turning speeds and turning accelerations of the upper surface gripping part 20 and the side surface gripping part 30 by the turning mechanism 14, rising speeds and rising accelerations of the upper surface gripping part 20 and the side surface gripping part 30 by the elevating mechanism 16, a suction pressure and a suction time of the article R by the first suction mechanism 24, and a suction pressure and a suction time of the article R by the second suction mechanism 34. The control unit 96 also determines a transport parameter for the side surface gripping part 30 based on the image data and the transport target data. Here, the transport parameter includes whether side surface gripping by the side surface gripping part 30 is necessary, and a flip-up direction and a flip-up angle of the side surface gripping part 30. In this case, the image data is used. That is, the transport parameter includes whether the first extending and retracting mechanism 44, the second extending and retracting mechanism 54, and the flip-up mechanism 60 need to operate, and extending and retracting speeds and extending and retracting accelerations thereof.

[0037]

The control unit 96 sets the transport parameter based on the transport target data. In this case, a reference value of the transport parameter for the transport target data is set in advance. The control unit 96 controls the turning mechanism 14, the elevating mechanism 16, the first suction mechanism 24, the second suction mechanism 34, the first extending and retracting mechanism 44, the second extending and retracting

mechanism 54, and the flip-up mechanism 60 based on the set transport parameter. The control unit 96 executes a control for moving the gripping device 1 itself in the horizontal direction in the palletizing device to which the gripping device 1 is attached. When the palletizing device is a multi-joint robot, the motion of the gripping device 1 in the horizontal direction is implemented by cooperation between a plurality of shafts of the multi-joint robot.

[0038]

The correction unit 97 is an operation processing device like the control unit 96 and includes, for example, an operation circuit such as a central processing unit (CPU). The correction unit 97 executes various processes by reading and executing the program (software) from the storage unit 94. The correction unit 97 may be integrated with the control unit 96 and provided as one function of the control unit 96.

[0039]

The correction unit 97 corrects the transport parameter determined by the control unit 96 based on characteristic data of the article R. In the first embodiment, the characteristic data of the article R is transport record data of the article R. The gripping device 1 includes an accumulation unit 110. The accumulation unit 110 is connected to the control device 90 and transmits and receives various types of data to and from the control device 90. Here, for example, the transport record data is set in accordance with the transport target data. For example, operation condition items of the gripping device 1 include the type of the article R (a type of the corrugated box: paper quality, a basis weight, and a thickness), the weight and the dimension (an aspect ratio), a side surface opening ratio, whether a perforation line or a zipper part is present in the corrugated box and a length thereof, the number of gluing points and an amount of adhesive, packaging (whether shrink wrap is present), other items (whether an upper

surface tape is present, and whether an address label is present), and the number of years of operation of the gripping device 1. The transport record data is a transport parameter of the gripping device 1 for preventing the article R from falling when the gripping device 1 grips the article R with respect to the operating condition items. As described above, the transport parameter of the gripping device 1 includes the turning speeds and the turning accelerations of the upper surface gripping part 20 and the side surface gripping part 30 by the turning mechanism 14, the rising speeds and the rising accelerations of the upper surface gripping part 20 and the side surface gripping part 30 by the elevating mechanism 16, the suction pressure and the suction time of the article R by the first suction mechanism 24, the suction pressure and the suction time of the article R by the second suction mechanism 34, and the extending and retracting speeds and the extending and retracting accelerations of the first extending and retracting mechanism 44, the second extending and retracting mechanism 54, and the flip-up mechanism 60.

[0040]

The transport record data is set based on verification data of a manufacturer of the gripping device 1 and an operation record (including issues) when a user (customer) uses the gripping device 1. That is, the transport record data is a transport parameter (minimum operating condition) of the gripping device 1 with which the gripping device 1 can transport the article R without dropping it, based on the verification data of the gripping device 1 and the operation record in the past. In the accumulation unit 110, the transport parameter (the minimum operation condition) with respect to the operation condition items is accumulated as the transport record data. The control device 90 receives the transport record data from the input/output device 80 or the management device 100 and rewrites the transport record data of the accumulation unit 110, as

necessary.

[0041]

The transport record data is not limited to the above configuration. For example, reference values of the turning speed and the turning acceleration of the turning mechanism 14, the rising speed and the rising acceleration of the elevating mechanism 16, the suction pressure and the suction time of the first suction mechanism 24, the suction pressure and the suction time of the second suction mechanism 34, and the extending and retracting speeds and the extending and retracting accelerations of the first extending and retracting mechanism 44, the second extending and retracting mechanism 54, and the flip-up mechanism 60 are set as the transport parameters of the gripping device 1. Levels (functions) 1 to 5 of a degree of falling with respect to each transport parameter are set as the transport record data. For example, when the actual weight of the article is greater than Level 3 as a reference weight for preventing falling, the weight of the article R is determined to be Level 4 as a determined weight, and the transport parameter is corrected to a safe side, that is, a side on which the article R is unlikely to fall. Even when the side surface opening ratio of the article R is large, the perforation line or the zipper part of the corrugated box is long, or the number of gluing points and the amount of adhesive are small, the transport parameter is corrected to the safe side, that is, the side on which the article R is unlikely to fall. The transport record data may be set by machine-learning the verification data of the manufacturer of the gripping device 1 and the operation record (including issues) when the user (customer) uses the gripping device 1.

[0042]

The correction unit 97 corrects the transport parameter determined by the control unit 96 based on the transport record data accumulated in the accumulation unit

110. The control unit 96 controls motions of the upper surface gripping part 20 and the side surface gripping part 30 based on the corrected transport parameter corrected by the correction unit 97.

[0043]

The management device 100 is a system that manages an operation of each device in the logistics management facility in which the gripping device 1 of the present embodiment is provided. The management device 100 is, for example, a warehouse control system (WCS) or a warehouse management system (WMS). However, the management device 100 is not limited to a WCS and a WMS and may be any system. For example, the management device 100 may be other back-end systems such as a production management system. The management device 100 may be provided at any position. The management device 100 may be provided in the facility in which the gripping device 1 is provided, or may be provided at a position remote from the facility such that the facility is managed at the remote position.

[0044]

<Process of Control Device>

Next, a processing flow of determining whether the side surface gripping by the side surface gripping part 30 is necessary in the transport by the gripping device 1 will be described. Here, unloading a plurality of articles R loaded on the pallet will be described. FIG. 5 is a flowchart showing the processing flow of the control device. The process shown in FIG. 5 is executed by the control unit 96 of the control device 90 based on the program and data stored in advance in the storage unit 94. For example, the control device 90 receives a predetermined control signal for providing an instruction to drive the gripping device 1 from the management device 100 and transitions to step S10 shown in FIG. 5 to start the process.

[0045]

The control device 90 acquires the transport target data (step S10). In the present embodiment, the control device 90 acquires the transport target data from the management device 100 via the communication unit 92. In the present process, the transport target data includes at least data as a determination criterion for determining whether the upper surface gripping part 20 can suction the plurality of articles R and rise, and data as a determination criterion for determining whether the side surface gripping by the side surface gripping part 30 is necessary, when each article R as an unloading target is lifted by the gripping device 1. For example, when the article R is small and light, the side surface gripping is not necessary. The transport target data also includes data indicating the number, position (coordinates on the pallet), and unloading order of each of the articles R as the unloading target.

[0046]

The control device 90 sets the number of executions i to i = 1 and starts a loop process (step S12). In the loop process, a process from step S14 to step S20 is repeatedly executed n times while $i \leq n$ is established. Here, n is the number of articles R loaded on the pallet, and i indicates the unloading order of the articles R from the pallet.

[0047]

The control device 90 acquires the captured image data (step S14). In the present embodiment, the control device 90 causes the imaging device 70 to image a predetermined region including the i-th article R as the unloading target. In this case, the imaging device 70 outputs the captured image data indicating data of a captured image to the control device 90. For example, the captured image data may be associated with coordinate data in a coordinate system with reference to a predetermined

position of the gripping device 1 or the facility in which the gripping device 1 is provided. The control device 90 recognizes the position, shape, size, and disposition (layout) of the i-th article R as the unloading target by performing image processing on the captured image data.

[0048]

The control device 90 determines the transport parameter (step S16). The transport parameter includes the turning speed and the turning acceleration of the turning mechanism 14, the rising speed and the rising acceleration of the elevating mechanism 16, the suction pressure and the suction time of the first suction mechanism 24, the suction pressure and the suction time of the second suction mechanism 34, and the extending and retracting speeds and the extending and retracting accelerations of the first extending and retracting mechanism 44, the second extending and retracting mechanism 54, and the flip-up mechanism 60, and is set based on the transport target data acquired in step S10.

[0049]

The control device 90 acquires the transport record data (step S18). The transport record data is accumulated in the accumulation unit 110, and the control device 90 acquires the transport record data from the accumulation unit 110. The control device 90 corrects the transport parameter in accordance with the transport record data (step S20).

[0050]

The control device 90 determines whether the side surface gripping is necessary (step S22). In the present embodiment, the control device 90 determines whether the side surface gripping is necessary based on the transport target data acquired in step S10. For example, when the i-th article R to be unloaded can be sufficiently lifted by only the

upper surface gripping part 20, it is determined that the side surface grip is not necessary. When the control device 90 determines that the side surface gripping is necessary (step S22; Yes), the control device 90 transitions to step S26. When the control device 90 determines that the side surface gripping is not necessary (step S22; No), the control device 90 transitions to step S24.

[0051]

When it is determined that the side surface gripping is not necessary (step S22; No), the control device 90 determines the flip-up direction and the flip-up angle of the side surface gripping part 30 based on the captured image data acquired in step S14 (step S24). The flip-up direction indicates a position of the side surface gripping part 30 in the φ rotation direction. The flip-up angle indicates a position of the side surface gripping part 30 in the θ rotation direction. When an obstacle is present around the i-th article R to be unloaded, the side surface gripping part 30 may interfere with the obstacle. Specifically, when another article R is loaded adjacent to the article R on a side (the right side shown in FIG. 1) on which the side surface gripping part 30 is present, the side surface gripping part 30 may interfere with the adjacent article R when the upper surface gripping part 20 abuts on the upper surface Ra of the article R.

[0052]

The position of the side surface gripping part 30 in the θ rotation direction and the position thereof in the φ rotation direction when step S24 starts are, for example, the position of the side surface gripping part 30 when the (i-1)-th article R is unloaded. In step S24, the control device 90 first acquires the position of the side surface gripping part 30 in the φ rotation direction. Next, the control device 90 determines whether another article R as an obstacle is present in a direction of the side surface gripping part 30 with respect to the i-th article R, based on the captured image data acquired in step

S14. When it is determined that another article R as an obstacle is not present, the control device 90 determines to maintain the flip-up direction and the flip-up angle of the side surface gripping part 30 and transitions to step S26.

[0053]

When it is determined that another article R as an obstacle is present, the control device 90 determines the flip-up angle of the side surface gripping part 30 at which the side surface gripping part 30 can avoid the obstacle. For example, when it is determined that the height dimension h of the other article R as the obstacle is less than or equal to the height dimension h of the i-th article R based on at least one of the transport target data or the captured image data, the control device 90 determines that the flip-up angle is 90° (the position shown in FIG. 2). For example, when it is determined that the height dimension h of the other article R as the obstacle is greater than the height dimension h of the i-th article R and less than a predetermined threshold value based on at least one of the transport target data or the captured image data, the control device 90 determines that the flip-up angle is 180° (the position shown in FIG. 3). The predetermined threshold value is set in advance by a configuration of the gripping device 1 other than the side surface gripping part 30. For example, in the configuration of the present embodiment, the predetermined threshold value is set within a range in which the second supporting part 52 does not interfere at the position of 180° shown in FIG. 3.

[0054]

For example, when it is determined that the height dimension h of the other article R as the obstacle is greater than or equal to the predetermined threshold value based on at least one of the transport target data or the captured image data, the control device 90 determines to move the side surface gripping part 30 in the φ rotation direction.

In a state where the side surface gripping part 30 is moved in the φ rotation direction by 90°, 180°, or 270°, the control device 90 determines the flip-up angle at which the side surface gripping part 30 can avoid the other article R as the obstacle in the above procedure. When the control device 90 determines the flip-up direction and the flip-up angle of the side surface gripping part 30, the control device 90 transitions to step S26.

[0055]

The control device 90 transports (unloads) the i-th article R (step S26). First, the control device 90 controls the turning mechanism 14 and the flip-up mechanism 60 to position the side surface gripping part 30 in a predetermined posture in accordance with the flip-up direction and the flip-up angle determined in step S24. When the side surface gripping by the side surface gripping part 30 is performed, the control device 90 controls the first extending and retracting mechanism 44 and the second extending and retracting mechanism 54 to extend and retract the first arm part 40 and the second arm part 50 such that the side surface gripping part 30 is positioned at a suitable position on the side surface Rb of the article R, based on the width dimension w (see FIG. 1) of the i-th article R.

[0056]

Next, the control device 90 controls the gripping device 1 to move horizontally to a position at which the first suction part 22 of the upper surface gripping part 20 faces the upper surface Ra of the article R. Next, the control device 90 controls the elevating mechanism 16 to lower the base part 10 and the upper surface gripping part 20 to a position at which the first suction surface 22a of the first suction part 22 abuts on the upper surface Ra of the article R. Next, the control device 90 operates the first suction mechanism 24 to suction the upper surface Ra of the article R on the first suction surface

22a. When it is determined that the side surface gripping is necessary in step S22, the control device 90 operates the second suction mechanism 34 to suction the side surface Rb of the article R on the second suction surface 32a. Accordingly, the gripping device 1 supports the article R. The control device 90 raises the gripping device 1 gripping the article R via the elevating mechanism 16 and then transports the gripping device 1 to a predetermined position and unloads the i-th article R from the pallet.

[0057]

The control device 90 resets the number of executions i to i = i + 1 in the loop process and returns to step S14 (step S28). When the process from step S14 to step S26 is executed n times and the unloading of n articles R on the pallet is completed, the loop process is finished.

[0058]

In the process of the present embodiment shown in FIG. 5, step S14 is performed for each article R. However, for example, when the articles R are arranged in a plane on the pallet, that is, when the plurality of articles R are not loaded in a top-to-bottom direction, step S14 of imaging all articles R on the pallet may be performed only once for the first time. In the process of the present embodiment, data of the number and position (coordinates) of each of the articles R is included in the transport target data. However, the number and position of the articles R may be acquired based on captured image data obtained by imaging all articles R on the pallet.

[0059]

While the process when the articles R are unloaded from the pallet on which the plurality of articles R are loaded has been described above, the process of the present embodiment shown in FIG. 5 is also applicable to loading the plurality of articles R on the pallet. In this case, a predetermined region including a region in which the articles

R are scheduled to be loaded on the pallet is imaged in step S14. In step S20, when the i-th article R is loaded at a predetermined position on the pallet, the flip-up direction and the flip-up angle are determined based on whether an obstacle is present in a region adjacent to the region in which loading is scheduled, and on a dimension thereof. In this case, the obstacles are the first to (i-1)-th loaded articles R.

[0060]

<Unloading Operation>

FIG. 6 is a plan view for schematically describing an unloading operation by the gripping device. FIG. 7 is a cross-sectional view taken along line II-II shown in FIG. 6. FIG. 8 is a cross-sectional view showing a state after FIG. 7. FIGS. 6 to 8 show an operation of unloading an article R4 among articles R1, R2, R3, and R4 arranged on a pallet P. All of the articles R1, R2, R3, and R4 have the same dimension. In the plan view shown in FIG. 6, the article R3 is disposed adjacent to the article R4 on the left. In FIGS. 6 to 8, only the upper surface gripping part 20 and the side surface gripping parts 30 of the gripping device 1 are shown. The side surface gripping part 30 is assumed to be at the 90° position shown in FIG. 2.

[0061]

As shown in FIGS. 6 and 7, in a state where the first suction part 22 of the upper surface gripping part 20 abuts on the upper surface Ra of the article R4, the side surface gripping part 30 is positioned above the article R3. In this case, a lower end of the second suction part 32 of the side surface gripping part 30 is positioned above a lower end of the first suction part 22 by the distance B (see FIG. 2). Accordingly, the second suction part 32 of the side surface gripping part 30 does not come into contact with the article R3. As shown in FIG. 8, the gripping device 1 of the present embodiment can unload the article R4 by only the suction of the first suction part 22 of the upper surface

gripping part 20.

[0062]

[Second Embodiment]

FIG. 9 is a schematic block diagram of a gripping device according to a second embodiment, and FIG. 10 is a flowchart for describing a processing flow of a control device. A basic configuration of the second embodiment is the same as that of the above first embodiment and will be described with reference to FIG. 1. Members having the same functions as those of the above first embodiment will be designated by identical reference signs and will not be described in detail.

[0063]

As shown in FIGS. 1 and 9, the gripping device 1 includes the base part 10, the upper surface gripping part 20, the side surface gripping part 30, the first arm part 40, the second arm part 50, and the flip-up mechanism 60. In addition, the gripping device 1 further includes the imaging device 70, the input/output device 80, and the control device 90 that controls the operation of each part of the gripping device 1.

[0064]

The control device 90 includes the communication unit 92, the storage unit 94, the control unit 96, and the correction unit 97. The communication unit 92, the storage unit 94, and the control unit 96 are substantially the same as those in the first embodiment and will not be described.

[0065]

The correction unit 97 corrects the transport parameter determined by the control unit 96 based on the characteristic data of the article R. In the second embodiment, the characteristic data of the article R is a moisture content and a deformation amount of the corrugated box constituting the article R. The gripping

device 1 includes a moisture detector 121 and a shape detector 122. The moisture detector 121 and the shape detector 122 are provided in the gripping device 1 or separately from the gripping device 1. The moisture detector 121 acquires moisture content data of the corrugated box constituting the article R. The shape detector 122 acquires deformation amount data of the corrugated box constituting the article R. The moisture detector 121 is, for example, a contact or non-contact moisture sensor and detects a water content of the corrugated box. The shape detector 122 is, for example, a contact displacement sensor or a non-contact laser displacement sensor and detects the deformation amount (deformation ratio) from a corrugated box shape.

[0066]

The correction unit 97 corrects the transport parameter determined by the control unit 96 based on the moisture content data. The correction unit 97 also corrects the transport parameter determined by the control unit 96 based on the deformation amount data. The reference values of the turning speed and the turning acceleration of the turning mechanism 14, the rising speed and the rising acceleration of the elevating mechanism 16, the suction pressure and the suction time of the first suction mechanism 24, the suction pressure and the suction time of the second suction mechanism 34, and the extending and retracting speeds and the extending and retracting accelerations of the first extending and retracting mechanism 44, the second extending and retracting mechanism 54, and the flip-up mechanism 60 as the transport parameters of the gripping device 1 are set. The reference values of the transport parameter are set with respect to reference values of the moisture content data and the deformation amount data of the corrugated box constituting the article R. Thus, the correction unit 97 corrects the transport parameter by comparing the reference value with the detected moisture content data. The correction unit 97 also corrects the transport parameter by comparing the

reference value with the detected deformation amount data.

[0067]

That is, when the detected moisture content data is greater than the reference value, the correction unit 97 corrects the transport parameter to the safe side, that is, the side on which the article R is unlikely to fall. When the detected deformation amount data is greater than the reference value, the correction unit 97 corrects the transport parameter to the safe side, that is, the side on which the article R is unlikely to fall.

[0068]

The correction unit 97 corrects the transport parameter determined by the control unit 96 based on the moisture content data of the corrugated box detected by the moisture detector 121 and the deformation amount data of the corrugated box detected by the shape detector 122. The control unit 96 controls the motions of the upper surface gripping part 20 and the side surface gripping part 30 based on the corrected transport parameter corrected by the correction unit 97.

[0069]

As shown in FIG. 10, the control device 90 acquires the transport target data (step S10). The control device 90 sets the number of executions i to i = 1 and starts a loop process (step S12). In the loop process, a process from step S14 to step S20 is repeatedly executed n times while $i \leq n$ is established. Here, n is the number of articles R loaded on the pallet, and i indicates the unloading order of the articles R from the pallet.

[0070]

The control device 90 acquires the captured image data (step S14). The control device 90 determines the transport parameter (step S16). The transport parameter includes the turning speed and the turning acceleration of the turning

mechanism 14, the rising speed and the rising acceleration of the elevating mechanism 16, the suction pressure and the suction time of the first suction mechanism 24, the suction pressure and the suction time of the second suction mechanism 34, and the extending and retracting speeds and the extending and retracting accelerations of the first extending and retracting mechanism 44, the second extending and retracting mechanism 54, and the flip-up mechanism 60, and is set based on the transport target data acquired in step S10.

[0071]

The control device 90 acquires detection data (step S30). The detection data is the moisture content data of the article R detected by the moisture detector 121 and the deformation amount data of the article R detected by the shape detector 122. The control device 90 acquires the moisture content data of the article R detected by the moisture detector 121 and the deformation amount data of the article R detected by the shape detector 122. The control device 90 corrects the transport parameter in accordance with the moisture content data and the deformation amount data (step S20).

[0072]

The control device 90 determines whether the side surface gripping is necessary (step S22). When the control device 90 determines that the side surface gripping is necessary (step S22; Yes), the control device 90 transitions to step S26. When the control device 90 determines that the side surface gripping is not necessary (step S22; No), the control device 90 transitions to step S24. When it is determined that the side surface gripping is not necessary (step S22; No), the control device 90 determines the flip-up direction and the flip-up angle of the side surface gripping part 30 based on the captured image data acquired in step S14 (step S24). When the control device 90 determines the flip-up direction and the flip-up angle of the side surface gripping part

30, the control device 90 transitions to step S26.

[0073]

The control device 90 transports (unloads) the i-th article R (step S26). The control device 90 resets the number of executions i to i = i + 1 in the loop process and returns to step S14 (step S28). When the process from step S14 to step S26 is executed n times and the unloading of n articles R on the pallet is completed, the loop process is finished.

[0074]

[Third Embodiment]

FIG. 11 is a schematic block diagram of a gripping device according to a third embodiment, and FIG. 12 is a flowchart for describing a processing flow of a control device. A basic configuration of the third embodiment is the same as that of the above second embodiment and will be described with reference to FIG. 1. Members having the same functions as those of the above first embodiment will be designated by identical reference signs and will not be described in detail.

[0075]

As shown in FIGS. 1 and 11, the gripping device 1 includes the base part 10, the upper surface gripping part 20, the side surface gripping part 30, the first arm part 40, the second arm part 50, and the flip-up mechanism 60. In addition, the gripping device 1 further includes the imaging device 70, the input/output device 80, and the control device 90 that controls the operation of each part of the gripping device 1.

[0076]

The control device 90 includes the communication unit 92, the storage unit 94, the control unit 96, and the correction unit 97. The communication unit 92, the storage unit 94, and the control unit 96 are substantially the same as those in the first

embodiment and will not be described. The correction unit 97 has the function thereof in the first embodiment and the function thereof in the second embodiment.

[0077]

That is, the correction unit 97 corrects the transport parameter determined by the control unit 96 based on the characteristic data of the article R. In the third embodiment, the characteristic data of the article R is the transport record data of the article R and the moisture content and the deformation amount of the corrugated box constituting the article R. The gripping device 1 includes the accumulation unit 110. The accumulation unit 110 is connected to the control device 90 and transmits and receives various types of data to and from the control device 90. The correction unit 97 corrects the transport parameter determined by the control unit 96 based on the transport record data accumulated in the accumulation unit 110. The gripping device 1 also includes the moisture detector 121 and the shape detector 122. The correction unit 97 corrects the transport parameter determined by the control unit 96 based on the moisture content data. The correction unit 97 also corrects the transport parameter determined by the control unit 96 based on the deformation amount data.

[0078]

As shown in FIG. 12, the control device 90 acquires the transport target data (step S10). The control device 90 sets the number of executions i to i = 1 and starts a loop process (step S12). In the loop process, a process from step S14 to step S20 is repeatedly executed n times while $i \leq n$ is established. Here, n is the number of articles R loaded on the pallet, and i indicates the unloading order of the articles R from the pallet.

[0079]

The control device 90 acquires the captured image data (step S14). The

control device 90 determines the transport parameter (step S16). The transport parameter includes the turning speed and the turning acceleration of the turning mechanism 14, the rising speed and the rising acceleration of the elevating mechanism 16, the suction pressure and the suction time of the first suction mechanism 24, the suction pressure and the suction time of the second suction mechanism 34, and the extending and retracting speeds and the extending and retracting accelerations of the first extending and retracting mechanism 44, the second extending and retracting mechanism 54, and the flip-up mechanism 60, and is set based on the transport target data acquired in step S10.

[0080]

The control device 90 acquires the transport record data (step S18). The transport record data is accumulated in the accumulation unit 110, and the control device 90 acquires the transport record data from the accumulation unit 110. The control device 90 acquires detection data (step S30). The detection data is the moisture content data of the article R detected by the moisture detector 121 and the deformation amount data of the article R detected by the shape detector 122. The control device 90 corrects the transport parameter in accordance with the transport record data (step S20). The control device 90 also corrects the transport parameter in accordance with the moisture content data and the deformation amount data (step S20).

[0081]

The control device 90 determines whether the side surface gripping is necessary (step S22). When the control device 90 determines that the side surface gripping is necessary (step S22; Yes), the control device 90 transitions to step S26. When the control device 90 determines that the side surface gripping is not necessary (step S22; No), the control device 90 transitions to step S24. When it is determined that the side

surface gripping is not necessary (step S22; No), the control device 90 determines the flip-up direction and the flip-up angle of the side surface gripping part 30 based on the captured image data acquired in step S14 (step S24). When the control device 90 determines the flip-up direction and the flip-up angle of the side surface gripping part 30, the control device 90 transitions to step S26.

[0082]

The control device 90 transports (unloads) the i-th article R (step S26). The control device 90 resets the number of executions i to i = i + 1 in the loop process and returns to step S14 (step S28). When the process from step S14 to step S26 is executed n times and the unloading of n articles R on the pallet is completed, the loop process is finished.

[0083]

[Operations and Effects of Present Embodiment]

A gripping device according to a first aspect includes the upper surface gripping part 20 including the first suction surface 22a capable of suctioning the upper surface Ra of the article R, the control unit 96 that controls the motion of the upper surface gripping part 20 by setting the transport parameter for operating the upper surface gripping part 20 based on the transport target data of the article R, and the correction unit 97 that corrects the transport parameter determined by the control unit 96 based on the characteristic data of the article R.

[0084]

According to the gripping device according to the first aspect, the transport parameter for operating the upper surface gripping part 20 is set based on the transport target data of the article R. The transport parameter is corrected based on the characteristic data of the article R. The motion of the upper surface gripping part 20 is

controlled based on the corrected transport parameter. Thus, the transport parameter is suitable for a state of the article R. The article can be stably transported without falling, and transport performance can be improved.

[0085]

According to a second aspect of the gripping device, the gripping device according to the first aspect further includes the accumulation unit 110 that accumulates the transport record data as the characteristic data of the article R, in which the correction unit 97 corrects the transport parameter determined by the control unit 96 based on the transport record data. Accordingly, by using the characteristic data of the article R as the transport record data, a sensor that detects the shape and the like of the article R is not necessary, and controls can be simplified.

[0086]

According to a third aspect of the gripping device, the gripping device according to the first aspect or the second aspect further includes the moisture detector 121 that acquires the moisture content data as the characteristic data of the article R, in which the correction unit 97 corrects the transport parameter determined by the control unit 96 based on the moisture content data. Accordingly, a degree of deformation of the article R can be estimated using the moisture content of the corrugated box constituting the article R, and the transport parameter can be appropriately corrected.

[0087]

According to a fourth aspect of the gripping device, the gripping device according to any one of the first aspect to the third aspect further includes the shape detector 122 that acquires the deformation amount data as the characteristic data of the article R, in which the correction unit 97 corrects the transport parameter determined by the control unit 96 based on the deformation amount data. Accordingly, by detecting

the deformation amount of the corrugated box constituting the article R, the transport parameter can be appropriately corrected.

[0088]

According to a fifth aspect of the gripping device, the gripping device according to the first aspect or the fourth aspect further includes the side surface gripping part 30 including the second suction surface 32a capable of suctioning the side surface Rb of the article R, and the flip-up mechanism 60 that can switch between the first state where the side surface gripping part 30 is positioned below the lower end of the upper surface gripping part 20, and the second state where the side surface gripping part 30 is positioned above the lower end of the upper surface gripping part 20, in which the control unit 96 controls the motion of the side surface gripping part 30 by setting the transport parameter for operating the side surface gripping part 30 based on the transport target data of the article R, and the correction unit 97 corrects the transport parameter determined by the control unit 96 based on the characteristic data of the article R. Accordingly, the transport parameter of the side surface gripping part 30 is suitable for the state of the article R, and the article can be stably transported without falling.

[0089]

A gripping method according to a sixth aspect uses a gripping device 1 including the upper surface gripping part 20 including the first suction surface 22a capable of suctioning the upper surface Ra of the article R, and includes a step of controlling the motion of the upper surface gripping part 20 by setting the transport parameter for operating the upper surface gripping part 20 based on the transport target data of the article R, and a step of correcting the transport parameter based on the characteristic data of the article R. Accordingly, the transport parameter is suitable for the state of the article R. The article can be stably transported without falling, and transport

performance can be improved.

[0090]

While the embodiments of the present disclosure have been described above, the embodiments are not limited by the contents described in the embodiments.

[0091]

For example, in the present embodiment, the side surface gripping part 30 is moved to a position below and a position above the lower end of the upper surface gripping part 20 by rotating the side surface gripping part 30, the first arm part 40, and the second arm part 50 about the rotation axis A of the flip-up mechanism 60. However, this motion may be implemented by a translational motion in the Z-axis direction.

Reference Signs List

[0092]

1: gripping device

10: base part

10a: connection part

12: turning shaft part

14: turning mechanism

16: elevating mechanism

20: upper surface gripping part

20a: first facing surface

22: first suction part

22a: first suction surface

24: first suction mechanism

30: side surface gripping part

30a: second facing surface

32: second suction part

32a: second suction surface

34: second suction mechanism

40: first arm part

42: first supporting part

44: first extending and retracting mechanism

44a: first fixed part

44b: first movable part

50: second arm part

52: second supporting part

54: second extending and retracting mechanism

54a: second fixed part

54b: second movable part

60: flip-up mechanism

62: fixed part

64: rotating part

70: imaging device

80: input/output device

90: control device

92: communication unit

94: storage unit

96: control unit

97: correction unit

100: management device

110: accumulation unit

121: moisture detector

122: shape detector

R: article

Ra: upper surface

Rb: side surface