

DESCRIPTION

TITLE

ARTICLE CONVEYANCE SORTING APPARATUS, ARTICLE SORTING
SYSTEM, AND CONTROL SERVER

5

FIELD

Embodiments described herein relate generally to an
article conveyance sorting apparatus, an article sorting
system, and a control server.

10

BACKGROUND

Sorting systems for automating the sorting of
articles, such as packages or paper sheets, have become
widespread. For example, the sorting system includes a main
conveyance path section and a sorter, reads an image of an
15 article conveyed by a main conveyance section, recognizes
destination information included in the image, and
designates a sorting destination according to a destination
recognition result. Further, the sorting system feeds an
article from the main conveyance section to the sorter, and
20 sorts the article by the sorter to a designated sorting
destination according to the destination recognition result
of the article circulated and conveyed.

The above-described sorter circulates and conveys a
plurality of trays, and the main conveyance section
25 delivers each article toward a tray that is circulated and
conveyed. The sorter discharges the article contained in
the tray toward the designated sorting destination at a

timing when the tray reaches a position corresponding to the designated sorting destination.

CITATION LIST

PATENT LITERATURE

- 5 Patent Literature 1: Jpn. Pat. Appln. KOKAI
Publication No. H08-198436

SUMMARY

TECHNICAL PROBLEM

For example, the sorter circulates and conveys a
10 plurality of openable trays. The openable tray includes a partition on its periphery and further includes a mechanism for opening a part (for example, a bottom) thereof. A part of the openable tray is opened by driving an opening member at a position corresponding to the sorting destination, and
15 the package contained in the openable tray freely falls from the opening part. The package is sorted to the sorting destination by using free fall. Alternatively, the sorter circulates a plurality of sliding trays. There is no complete partition in the sliding tray. A package is sorted
20 to a sorting destination through a slope or the like by sliding the package on a sliding tray at a position corresponding to the sorting destination.

Sorters utilizing openable trays are suitable for handling lightweight articles because they allow the
25 articles to fall freely. Further, since the periphery of the openable tray is partitioned, it is suitable for handling articles having a shape which easily rolls.

Sorters utilizing sliding trays are suitable for handling heavyweight articles and fragile articles because they do not utilize free fall. Further, since the periphery of the sliding tray is not completely partitioned, it is suitable for handling articles having a shape which does not easily roll. Thus, since articles that can be handled are limited depending on the type of the sorter, there is a demand for a sorting system having a high degree of freedom in handling articles from physical distribution sites.

A problem to be solved by the present invention is to provide an article conveyance sorting apparatus, an article sorting system, and a control server that can deal with various articles.

SOLUTION TO PROBLEM

According to an embodiment, an article conveyance sorting apparatus includes a distributing section, a first conveyance section, a second conveyance section, and a conveyance sorting section. The distributing section distributes an article in a first direction or a second direction based on a first distribution control signal or a second distribution control signal corresponding to a distinguishing result of the article distinguished based on article information. The first conveyance section receives the article distributed in the first direction, and conveys the article based on a first conveyance control signal toward a tray of a first type among a plurality of trays sequentially conveyed. The second conveyance section

receives the article distributed in the second direction,
and conveys the article based on a second conveyance
control signal toward a tray of a second type among the
plurality of trays sequentially conveyed. The conveyance
5 sorting section conveys the plurality of trays including
the tray of the first type and the tray of the second type,
and sorts each of articles conveyed by the plurality of
trays to a designated sorting destination based on a
sorting control signal.

10 BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagram illustrating an example of a
schematic configuration of an article sorting system
according to an embodiment.

15 FIG. 2 is a block diagram illustrating an example of a
schematic configuration of a control server included in the
article sorting system according to the embodiment.

FIG. 3 is a flowchart illustrating an example of an
article sorting process performed by the article sorting
system according to the embodiment.

20 FIG. 4 is a flowchart illustrating an example of
conveyance control of an article (for example, a
lightweight article) to a tray of a first type by the
control server of the article sorting system according to
the embodiment.

25 FIG. 5 is a flowchart illustrating an example of
conveyance control of an article (for example, a
heavyweight article) to a tray of a second type by the

control server of the article sorting system according to the embodiment.

DETAILED DESCRIPTION

Hereinafter, an embodiment will be described with
5 reference to the drawings.

FIG. 1 is a diagram illustrating an example of a schematic configuration of an article sorting system according to an embodiment.

As illustrated in FIG. 1, the article sorting system
10 includes an article conveyance sorting apparatus 1, a network 2, and a control server 3.

The article conveyance sorting apparatus 1 conveys a plurality of articles 4 in order, distributes the articles 4 in midstream based on a distinguishing result of the
15 articles 4, and sorts the articles 4 to designated sorting destinations based on a sorting destination determination result of the articles 4. The article conveyance sorting apparatus 1 includes a plurality of article detection sensors along a conveyance path of the articles 4, and a
20 plurality of tray detection sensors along a conveyance path of trays 107 for circulating and conveying the articles 4. The article conveyance sorting apparatus 1 outputs detection signals from the article detection sensors and the tray detection sensors to the control server 3 via the
25 network 2. Further, the article conveyance sorting apparatus 1 executes conveyance (including delivery timing), distributing, sorting, and the like of the article

4 based on a control signal transmitted from the control
server 3 via the network 2. The network 2 functions to
transmit and receive signals between the article conveyance
sorting apparatus 1 and the control server 3. The control
5 server 3 receives an article detection signal and a tray
detection signal from the article conveyance sorting
apparatus 1, receives article information, and outputs a
control signal for controlling article processing
(conveyance, distributing, sorting, and the like) by the
10 article conveyance sorting apparatus 1.

The article conveyance sorting apparatus 1 includes a
take-in section 101, a first conveyance section 102, a
second conveyance section 103, a conveyance sorting section
104, a reading section 105, a distributing section 106, and
15 trays 107. The take-in section 101 takes in the article 4
introduced by an operator 5 or the article 4 fed by a
conveyance belt or the like, conveys the taken-in article 4
toward the reading section 105, and further conveys the
article 4 having passed through the reading section 105
20 toward the distributing section 106.

The reading section 105 reads or measures various
kinds of information on the article 4 and outputs article
information. For example, the reading section 105 captures
images of the article 4 from an upper surface, a side
25 surface, and a lower surface of the article 4, and outputs
the captured images. The reading section 105 also measures
the size, shape, weight, and the like of the conveyed

article 4, and outputs measurement information. Further,
the reading section 105 reads an article ID from the
article 4 and outputs the read article ID. When the article
ID is a QR code (registered trademark), the reading section
5 105 functions as a QR code reader. When the article ID is
information stored in a wireless tag, the reading section
105 functions as a wireless reader and reads the article ID
from the wireless tag by wireless communication.

The distributing section 106 distributes the article 4
10 in a first direction (that is, to the first conveyance
section 102) based on a first distribution control signal
corresponding to the distinguishing result of the article 4
distinguished based on the article information, and
distributes the article 4 in a second direction (that is,
15 to the second conveyance section 103) based on a second
distribution control signal corresponding to the
distinguishing result. For example, an article 4 (article
4a) having a weight equal to or less than a weight
reference value is distinguished as a lightweight article,
20 and an article 4 (article 4b) heavier than the weight
reference value is distinguished as a heavyweight article.
The distributing section 106 distributes the article 4a to
the first conveyance section 102 based on the first
distribution control signal corresponding to the
25 distinguishing of the lightweight article, and distributes
the article 4b to the second conveyance section 103 based
on the second distribution control signal corresponding to

the distinguishing of the heavyweight article.

5 The first conveyance section 102 conveys articles by
an article conveyor. The first conveyance section 102
receives the article 4a distributed in the first direction
by the distributing section 106, and conveys the article 4a
toward a tray of a first type 107a (a tray for conveying
the article 4a to a designated sorting destination) among
the plurality of trays 107 conveyed by the conveyance
sorting section 104 based on a first conveyance control
10 signal. The first conveyance section 102 may convey the
article 4a toward the tray 107b depending on the setting of
the conveyance control. The first conveyance section 102
includes a first conveyance speed adjustment section 102a.
The first conveyance speed adjustment section 102a
15 functions as a buffer that variably adjusts the conveyance
speed of the article 4a, and includes a stopper that
adjusts the delivery timing of the article 4a to, for
example, the sorting conveyance section 104. The first
conveyance speed adjustment section 102a variably controls
20 the conveyance speed of the article 4a based on the first
conveyance control signal. The timing at which the article
4a is delivered from the first conveyance section 102 to
the conveyance sorting section 104 (tray 107a or 107b) is
adjusted by the variable adjustment of the conveyance speed
25 of the article 4a by the first conveyance speed adjustment
section 102a and the timing at which the stopper is opened.

 The second conveyance section 103 conveys articles by

a transfer conveyor. The second conveyance section 103 receives the article 4b distributed in the second direction by the distributing section 106, and conveys the article 4b toward a tray of a second type 107b (a tray for conveying the article 4b to a designated sorting destination) among the plurality of trays 107 conveyed by the conveyance sorting section 104 based on a second conveyance control signal. The second conveyance section 103 includes a second conveyance speed adjustment section 103a. The second conveyance speed adjustment section 103a functions as a buffer that variably adjusts the conveyance speed of the article 4b, and includes a stopper that adjusts the delivery timing of the article 4b to, for example, the sorting conveyance section 104. The second conveyance speed adjustment section 103a variably controls the conveyance speed of the article 4b based on the second conveyance control signal. The timing at which the article 4b is delivered from the second conveyance section 103 to the conveyance sorting section 104 (tray 107b) is adjusted by the variable adjustment of the conveyance speed of the article 4b by the second conveyance speed adjustment section 103a and the timing at which the stopper is opened.

The conveyance sorting section 104 conveys the plurality of trays 107 by a circulation conveyor, and sorts the articles 4 conveyed by the plurality of trays 107 to the designated sorting destinations based on sorting control signals. The plurality of trays 107 include the

trays of the first type 107a and the trays of the second type 107b. For example, the tray 107a is an openable tray, including a partition on its periphery, and further includes a mechanism for opening a part (for example, a bottom) thereof. A part of the openable tray is opened by driving an opening member at a position corresponding to the sorting destination, and the package contained in the openable tray freely falls from the opening part. The package is sorted to the sorting destination by using free fall. For example, the tray 107b is a sliding tray and does not have a complete partition. A package is sorted to a sorting destination through a slope or the like by sliding the package on a sliding tray at a position corresponding to the sorting destination.

The network 2 receives signals and information from each section of the article conveyance sorting apparatus 1, and transmits them to the control server 3. In addition, the network 2 receives various control signals from the control server 3, and transmits the control signals to each section of the article conveyance sorting apparatus 1.

The control server 3 can be realized by one computer or a combination of a plurality of computers. The control server 3 communicates with an external apparatus, such as the article conveyance sorting apparatus 1, receives and stores a signal from the external apparatus, and transmits a control signal or the like to the external apparatus to control the external apparatus. For example, the control

server 3 monitors article detection signals from the article detection sensors, traces conveyance (movement) of each article 4, and detects or estimates where each article 4 is located. Similarly, the control server 3 monitors tray detection signals from the tray detection sensors, traces conveyance (movement) of each tray, and detects or estimates where each tray is located. Furthermore, the control server 3 may allocate article detection identification information (hereinafter referred to as the article detection ID (identification information)) to each article 4 detected by the article detection sensors and manage each article 4 based on the article detection ID. Similarly, the control server 3 may allocate tray detection identification information (hereinafter referred to as the tray detection ID) to each tray detected by the tray detection sensors and manage each tray based on the tray detection ID.

The articles 4 processed by the article sorting system include packages of various sizes, shapes, and weights. Destination information (article sorting information) may be recorded in each article 4, and article identification information (hereinafter referred to as an article ID) may be allocated to each article in advance. For example, the destination information is directly or indirectly recorded for each article, and the article ID is directly or indirectly recorded for each article. The article ID may be an article ID recorded by a recording method of either

visible printing or invisible printing with ink that absorbs infrared rays or the like. Alternatively, an electronic tag or a wireless tag storing the article ID may be attached to the article.

5 The article ID at a minimum includes unique information and is constituted by one or a combination of two or more of a number, a character, a symbol, a bar code, a two-dimensional code, and a QR code (registered trademark). The control server 3 stores an article
10 management table for managing the article ID allocated to each article 4 and the destination information read and recognized from each article 4 in association with each other. Further, the control server 3 stores a sorting management table that associates the destination
15 information with each sorting destination.

FIG. 2 is a block diagram illustrating an example of a schematic configuration of a control server included in the article sorting system according to the embodiment.

As illustrated in FIG. 2, the control server 3
20 includes a processor 31, a read-only memory (ROM) 32, a random-access memory (RAM) 33, an auxiliary storage device 34, a communication interface 35, and an input/output section 36.

The processor 31 corresponds to a central portion of a
25 computer that performs processing such as calculation and control necessary for article processing. The processor 31 executes control to realize various functions based on a

program such as system software, application software, or
firmware stored in at least one of the ROM 32 and the
auxiliary storage device 34. The processor 31 is, for
example, a central processing unit (CPU), a micro
5 processing unit (MPU), or a digital signal processor (DSP).
Alternatively, the processor 31 is a combination of two or
more of these.

The processor 31 allocates an article detection ID to
each of the articles 4a and 4b to be detected based on
10 article detection signals from the article detection
sensors, traces the conveyance (movement) of each of the
articles 4a and 4b, and detects or estimates where each of
the articles 4a and 4b is located. The processor 31
allocates an article detection ID to each of the trays 107a
15 and 107b to be detected based on tray detection signals
from the tray detection sensors, traces the conveyance
(movement) of each of the trays 107a and 107b, and detects
or estimates where each of the trays 107a and 107b is
located.

20 The processor 31 monitors the movement amount of each
of the transfer conveyor and the circulation conveyor based
on a signal from a rotary encoder that detects the movement
amount of the transfer conveyor of the first conveyance
section 102, a signal from a rotary encoder that detects
25 the movement amount of the transfer conveyor of the second
conveyance section 103, and a signal from a rotary encoder
that detects the movement amount of the circulation

conveyor of the conveyance sorting section 104. For example, the processor 31 can correct the positions of the articles 4 and the positions of the trays 107 based on the amounts of movement of the transfer conveyors and the circulation conveyor.

The ROM 32 is a computer-readable storage medium, and corresponds to a main storage device of the computer including the processor 31 as a center. The ROM 32 is a non-volatile memory (non-transitory storage medium) that is exclusively used for reading data. The ROM 32 may store at least a portion of the program described above. In addition, the ROM 32 stores data or various setting values and the like used when the processor 31 performs various processes.

The RAM 33 is a computer-readable storage medium, and corresponds to a main storage device of the computer including the processor 31 as a center. The RAM 33 is a memory used for reading and writing data. The RAM 33 is utilized as a so-called work area for storing data to be temporarily used when the processor 31 performs various processes.

The auxiliary storage device 34 is a computer-readable storage medium, and corresponds to an auxiliary storage device of the computer including the processor 31 as a center. The auxiliary storage device 34 is a non-transitory storage medium, such as an electric erasable programmable read-only memory (EEPROM) (registered trademark), a hard

disk drive (HDD), or a solid state drive (SSD). The auxiliary storage device 34 may store at least a portion of the program described above. In addition, the auxiliary storage device 34 stores data to be used by the processor 5 31 when performing various types of processing, data generated by the processing performed by the processor 31, or various setting values, and the like. For example, the auxiliary storage device 34 stores an article management table for managing the article ID allocated to each article 10 4 and the destination information read and recognized from each article in association with each other. Further, the auxiliary storage device 34 stores a sorting management table that associates the destination information with each sorting destination.

15 The program stored in at least one of the ROM32 and the auxiliary storage device 34 includes a program for article processing. As an example, the control server 3 is transferred to a business entity which has installed the article sorting system with the program being stored in at 20 least one of the ROM 32 and the auxiliary storage device 34. Alternatively, the program may be transferred to the business entity or the like by a non-transitory computer-readable storage medium storing the program. In this case, the program stored in the non-transitory computer-readable 25 storage medium is written to at least one of the ROM 32 and the auxiliary storage device 34 under an operation by the administrator, a service person, or the like. The non-

transitory computer-readable storage medium storing the program is, for example, a removable storage medium, such as a magnetic disk, a magneto-optical disk, an optical disk, or a semiconductor memory. Alternatively, the program
5 may be downloaded via a network or the like and written to at least one of the ROM 32 and the auxiliary storage device 34.

The communication interface 35 is an interface for performing wired or wireless communication with another
10 apparatus via a network or the like, receiving various types of information transmitted from another apparatus, and transmitting these various types of information to another apparatus. For example, the communication interface 35 receives the article ID from the server before the start
15 of article processing. Further, the communication interface 35 receives an article detection signal from the article detection sensor, a tray detection signal from the tray detection sensor, and article information from the reading section 105. Further, the communication interface 35
20 transmits the first or second distribution control signal to the distributing section 106, transmits the first conveyance control signal to the first conveyance section 103, transmits the second conveyance control signal to the second conveyance section 104, and transmits the sorting
25 control signal to the conveyance sorting section 104.

The input/output section 36 includes a keyboard, a numeric keypad, a mouse, a touch panel display, and the

like. The input/output section 36 receives an instruction input from the operator and notifies the processor 31 of the instruction input. The touch panel display displays various types of information for the operator.

5 FIG. 3 is a flowchart illustrating an example of an article sorting process performed by the article sorting system according to the embodiment.

 The take-in section 101 of the article conveyance sorting apparatus 1 sequentially takes in the articles 4
10 and conveys the taken-in articles 4 (ST11). The article conveyance sorting apparatus 1 detects the conveyed article 4 (ST12) and outputs an article detection signal (ST13).

 Based on the article detection signal received via the communication interface 35, the processor 31 of the control
15 server 3 starts tracing the article 4 (ST21). The processor 31 starts tracing of each of the articles 4 based on the article detection signals corresponding to the articles 4 sequentially taken in by the take-in section 101 (ST21).

 The reading section 105 captures an image of the
20 article 4 sequentially conveyed by the take-in section 101 (ST14), measures the size, shape, weight, and the like of the article 4 (ST15), and outputs article information including the captured image and measurement information (ST16).

25 The processor 31 determines the sorting destination of the article based on the article information received via the communication interface 35, and designates the sorting

destination according to the sorting destination
determination result (ST22). For example, the processor 31
recognizes the destination information from the captured
image included in the article information, and designates
5 the sorting destination according to the destination
recognition result. Alternatively, the processor 31 may
designate the sorting destination based on the article ID
included in the article information.

Further, the processor 31 distinguishes the article
10 based on the article information received via the
communication interface 35 (ST23). For example, based on
the weight information included in the article information,
the processor 31 distinguishes an article 4 (article 4a)
having a weight equal to or less than the weight reference
15 value as a lightweight article, and determines an article 4
(article 4b) heavier than the weight reference value as a
heavyweight article (ST23).

When the processor 31 distinguishes the article 4 as a
lightweight article, the processor 31 selects the first
20 distribution control signal for distributing the article 4a
in the first direction, and the communication interface 35
outputs the selected first distribution control signal
(ST24). When the processor 31 distinguishes the article 4
as a heavyweight article, the processor 31 selects the
25 second distribution control signal for distributing the
article 4b in the second direction, and the communication
interface 35 outputs the selected second distribution

control signal (ST24).

Further, the processor 31 traces each article 4a, and can detect the state of conveyance of each article 4a. That is, the processor 31 can detect the position of each
5 article 4a, the conveyance interval of each article 4a, and the like. In addition, the processor 31 traces each tray 107a which is circularly conveyed by the conveyance sorting section 104, and can detect the state of conveyance of each tray 107a. That is, the processor 31 can detect the
10 position of each tray 107a, the conveyance interval of each tray 107a, and the like. The processor 31 selects the first conveyance control signal corresponding to the state of conveyance of each article 4a and the state of conveyance of each tray 107a, and the communication interface 35
15 outputs the selected first conveyance control signal (ST25). The number of times of selection and output of the first conveyance control signal is not limited to 1; the first conveyance control signal is appropriately selected and output according to the state of conveyance.

20 Similarly, the processor 31 traces each article 4b, and can detect the state of conveyance of each article 4b. That is, the processor 31 can detect the position of each article 4b, the conveyance interval of each article 4b, and the like. In addition, the processor 31 traces each tray
25 107b which is circularly conveyed by the conveyance sorting section 104, and can detect the state of conveyance of each tray 107b. That is, the processor 31 can detect the

position of each tray 107b, the conveyance interval of each
tray 107b, and the like. The processor 31 selects the
second conveyance control signal corresponding to the state
of conveyance of each article 4b and the state of
5 conveyance of each tray 107b, and the communication
interface 35 outputs the selected second conveyance control
signal (ST25). The number of times of selection and output
of the second conveyance control signal is not limited to
1; the second conveyance control signal is appropriately
10 selected and output according to the state of conveyance.

Further, the processor 31 selects a sorting control
signal corresponding to the designated sorting destination
of each article 4, and the communication interface 35
outputs the selected sorting control signal (ST26).

15 The distributing section 106 distributes the article
4a distinguished as the lightweight article in the first
direction based on the first distribution control signal
(ST17), and the first conveyance section 102 conveys the
article 4a to be distributed in the first direction.
20 Furthermore, the distributing section 106 distributes the
article 4b distinguished as the heavyweight article in the
second direction based on the second distribution control
signal (ST17), and the second conveyance section 103
conveys the article 4b to be distributed in the second
25 direction.

The first conveyance section 102 controls conveyance
of each article 4a based on the first conveyance control

signal, and conveys and delivers the article 4a toward a tray 107a (target tray) among the plurality of trays 107 conveyed by the conveyance sorting section 104 (ST18). The first conveyance speed adjustment section 102a variably
5 controls the conveyance speed of the article 4a based on the first conveyance control signal designating a first speed (standard speed), a second speed (high speed) faster than the first speed, or a third speed (low speed) slower than the first speed, and opens the stopper at a
10 predetermined timing to adjust the timing at which the article 4a is delivered to the tray 107a conveyed by the conveyance sorting section 104.

Furthermore, the second conveyance section 103 controls conveyance of each article 4b based on the second
15 conveyance control signal, and conveys and delivers the article 4b toward a tray 107b (target tray) among the plurality of trays 107 conveyed by the conveyance sorting section 104 (ST18). The first conveyance speed adjustment section 102a variably controls the conveyance speed of the
20 article 4b based on the second conveyance control signal designating a first speed (standard speed), a second speed (high speed) faster than the first speed, or a third speed (low speed) slower than the first speed, and opens the stopper at a predetermined timing to adjust the timing at
25 which the article 4b is delivered to the tray 107b conveyed by the conveyance sorting section 104.

Further, the conveyance sorting section 104 discharges

the article 4a from the tray 107a at a predetermined timing based on the sorting control signal, and sorts the article 4a to a designated sorting destination (ST19). Similarly, the conveyance sorting section 104 discharges the article 4b from the tray 107b at a predetermined timing based on the sorting control signal, and sorts the article 4b to a designated sorting destination (ST19).

For example, the conveyance sorting section 104 includes the opening member that opens a part of the tray 107a, and by driving the opening member based on the sorting control signal, the part of the tray 107a that is being conveyed opens at the predetermined timing, and the article 4a in the tray 107a falls toward the designated sorting destination (ST19). Further, the conveyance sorting section 104 includes a mechanism for inclining the tray 107b, and by driving the inclining mechanism based on the sorting control signal, the tray 107b that is being conveyed is inclined at the predetermined timing, and the article 4b (or the article 4a) in the tray 107b slides down toward the designated sorting destination (ST19).

Alternatively, the conveyance sorting section 104 includes a mechanism for pushing out the article 4b (or the article 4a) in the tray 107b, and by driving the pushing-out mechanism based on the sorting control signal, the article 4b (or the article 4a) in the tray 107b that is being conveyed is pushed out at the predetermined timing, and the article 4b (or the article 4a) slides down toward the

designated sorting destination (ST19).

FIG. 4 is a flowchart illustrating an example of conveyance control of an article (for example, a lightweight article) to a tray of the first type by the control server of the article sorting system according to the embodiment.

The processor 31 selects the first conveyance control signal according to an initial setting. For example, the processor 31 selects the first conveyance control signal designating the standard speed (ST25101). The first conveyance speed adjustment section 102a conveys the article 4a at the standard speed based on the first conveyance control signal designating the standard speed.

When the distance to the article 4a in front becomes longer than a first distance based on the state of conveyance of the article 4a in the first conveyance section 102, the processor 31 determines that there is an empty space in front (ST25102, YES), and selects the first conveyance control signal designating high speed (acceleration) (ST25103). The first conveyance speed adjustment section 102a conveys the article 4a at the high speed based on the first conveyance control signal designating the high speed. As a result, the distance to the article 4a in front is reduced.

Furthermore, when the distance to the article 4a in front becomes shorter than a second distance (the second distance < the first distance) based on the state of

conveyance of the article 4a in the first conveyance
section 102, the processor 31 determines that there is an
article in front (ST25104, YES), and selects the first
conveyance control signal designating low speed
5 (deceleration) (ST25105). The first conveyance speed
adjustment section 102a conveys the article 4a at the low
speed based on the first conveyance control signal
designating the low speed. Thus, collision with the article
4a in front is avoided.

10 By the stopper of the first conveyance speed
adjustment section 102a, the article 4a is held at a
position immediately before the conveyance sorting section
104 (standby place of the first conveyance speed adjustment
section 102a) (completion of standby of the article 4a).

15 When the processor 31 detects a standby state in which the
article 4a is held by the stopper (ST25106, YES) and
detects that the tray 107a circulated and conveyed by the
conveyance sorting section 104 has reached a predetermined
position (that is, at a timing of receiving the article 4a)
20 (ST25107, YES), the processor 31 selects a first conveyance
control signal instructing opening of the stopper in order
to deliver the article 4a toward the tray 107a circulated
and conveyed by the conveyance sorting section 104

(ST25110). The first conveyance speed adjustment section
25 102a opens the stopper based on the first conveyance
control signal that instructs opening of the stopper, and
delivers the article 4a toward the tray 107a that is

circulated and conveyed by the conveyance sorting section 104. The article 4a is delivered to the tray 107a included in the plurality of trays 107 circulated and conveyed by the conveyance sorting section 104 at an appropriate timing by the aforementioned first conveyance control signal.

Even if the processor 31 does not detect that the tray 107a circulated and conveyed by the conveyance sorting section 104 has reached the predetermined position (ST25107, NO), the processor 31 may select the first conveyance control signal for instructing the stopper to open (ST25110), when the processor 31 detects that the article 4b is not held in the standby place of the second conveyance speed adjustment section 103a (ST25108, YES) and that the tray 107b circulated and conveyed by the conveyance sorting section 104 has reached the predetermined position (that is, at a timing of receiving the article 4) (ST25109, YES). The first conveyance speed adjustment section 102a opens the stopper based on the first conveyance control signal that instructs opening of the stopper, and delivers the article 4a to the tray 107b circulated and conveyed by the conveyance sorting section 104. As a result, the waiting time of the article 4a can be reduced, and the throughput can be improved.

FIG. 5 is a flowchart illustrating an example of conveyance control of an article (for example, a heavyweight article) to a tray of the second type by the control server of the article sorting system according to

the embodiment.

The processor 31 selects the second conveyance control signal according to the initial setting. For example, the processor 31 selects the second conveyance control signal designating the standard speed (ST25201). The second conveyance speed adjustment section 103a conveys the article 4b at the standard speed based on the second conveyance control signal designating the standard speed.

When the distance to the article 4b in front becomes longer than the first distance based on the state of conveyance of the article 4b in the second conveyance section 103, the processor 31 determines that there is an empty space in front (ST25202, YES), and selects the second conveyance control signal designating high speed (acceleration) (ST25203). The second conveyance speed adjustment section 103a conveys the article 4b at the high speed based on the second conveyance control signal designating the high speed. As a result, the distance to the article 4b in front is reduced.

Furthermore, when the distance to the article 4b in front becomes shorter than the second distance (the second distance < the first distance) based on the state of conveyance of the article 4b in the second conveyance section 103, the processor 31 determines that there is an article in front (ST25204, YES), and selects the second conveyance control signal designating the low speed (deceleration) (ST25202). The second conveyance speed

adjustment section 103a conveys the article 4b at the low speed based on the second conveyance control signal designating the low speed. Thus, collision with the article 4b in front is avoided.

5 By the stopper of the second conveyance speed adjustment section 103a, the article 4b is held at a position immediately before the conveyance sorting section 104 (standby place of the second conveyance speed adjustment section 103a) (completion of standby of the article 4b). When the processor 31 detects a standby state in which the article 4b is held by the stopper (ST25206, YES) and detects that the tray 107b circulated and conveyed by the conveyance sorting section 104 has reached a predetermined position (that is, at a timing of receiving the article 4b) (ST25207, YES), the processor 31 selects a second conveyance control signal instructing opening of the stopper in order to deliver the article 4b toward the tray 107b circulated and conveyed by the conveyance sorting section 104 (ST25210). The second conveyance speed adjustment section 103a opens the stopper based on the second conveyance control signal that instructs opening of the stopper, and delivers the article 4b toward the tray 107b that is circulated and conveyed by the conveyance sorting section 104. The article 4b is delivered to the tray 107b included in the plurality of trays 107 circulated and transported by the conveyance sorting section 104 at an appropriate timing by the aforementioned second conveyance

control signal.

Although the present embodiment is limited to the case where the article 4b is delivered to the tray 107b, the article 4a may be delivered to the tray 107b depending on the situation and the article 4b may be delivered to the tray 107a depending on the situation.

As described above, according to the present embodiment, it is possible to provide an article conveyance sorting apparatus, an article sorting system, and a control server that can deal with various articles. For example, various articles having different weights can be conveyed and sorted by the article conveyance sorting apparatus in a limited space. In a case where the article information includes information indicating whether or not the article is fragile, a fragile article may be determined as an article 4a and sorted by a sliding tray, and an article difficult to break may be determined as an article 4b and sorted by an openable tray. In a case where the article information includes information indicating whether or not a shape is easy to roll, an article that is difficult to roll may be determined as an article 4a and sorted by a sliding tray, and an article that is easy to roll may be determined as an article 4b and sorted by an openable tray.

Although the articles 4 taken in by the single take-in section 101 are distributed to a plurality of paths in midstream, the articles 4 are conveyed with the conveyance intervals appropriately shortened by providing the first

conveyance speed adjustment section 102a and the second conveyance speed adjustment section 103a. Therefore, it is possible to prevent a decrease in conveyance sorting efficiencies.

5 When there is no article 4b in the standby state and the tray 107a arrives earlier than the tray 107b, the article 4a in the standby state conveyed by the first conveyance section 102 is delivered toward the tray 107b, so that it is also possible to prevent a decrease in
10 conveyance sorting efficiencies.

 Further, the ratio between the trays 107a and the trays 107b included in the plurality of trays 107 circulated and conveyed by the conveyance sorting section 104 may be set to an arbitrary ratio. In addition, the
15 arrangement order of the trays 107a and the trays 107b may be set arbitrarily. By monitoring the state of conveyance of the tray 107a and the tray 107b, the processor 31 can feed the article 4a at an appropriate timing to the tray 107b (or the tray 107a) that is circulated and conveyed at
20 an arbitrary ratio and in an arbitrary order, and can similarly feed the article 4b at an appropriate timing to the tray 107b that is circulated and conveyed at an arbitrary ratio and in an arbitrary order.

 While certain embodiments have been described, these
25 embodiments have been presented by way of example only, and are not intended to limit the scope of the invention. The novel embodiments described herein can be implemented in a

variety of other forms; furthermore, various omissions,
substitutions, and changes can be made without departing
from the spirit of the invention. The embodiments and their
modifications are covered by the accompanying claims and
5 their equivalents, as would fall within the scope and gist
of the inventions.

CLAIMS

1. An article conveyance sorting apparatus comprising:
a distributing section that distributes an article in
a first direction or a second direction based on a first
5 distribution control signal or a second distribution
control signal corresponding to a distinguishing result of
the article distinguished based on article information;

a first conveyance section that receives the article
distributed in the first direction, and conveys the article
10 based on a first conveyance control signal toward a tray of
a first type among a plurality of trays sequentially
conveyed;

a second conveyance section that receives the article
distributed in the second direction, and conveys the
15 article based on a second conveyance control signal toward
a tray of a second type among the plurality of trays
sequentially conveyed; and

a conveyance sorting section that conveys the
plurality of trays including the tray of the first type and
20 the tray of the second type, and sorts each of articles
conveyed by the plurality of trays to a designated sorting
destination based on a sorting control signal.

2. The article conveyance sorting apparatus according
to claim 1, wherein the conveyance sorting section conveys
25 the plurality of trays including an openable tray, which is
the tray of the first type, and a sliding tray, which is
the tray of the second type, and discharges the article

from the openable tray or the sliding tray based on the sorting control signal to sort the article to the designated sorting destination.

3. The article conveyance sorting apparatus according to claim 1 or 2, wherein

the first conveyance section includes a first conveyance speed adjustment section,

the second conveyance section includes a second conveyance speed adjustment section,

the first conveyance speed adjustment section variably controls a conveyance speed of the article based on the first conveyance control signal, and

the second conveyance speed adjustment section variably controls the conveyance speed of the article based on the second conveyance control signal.

4. An article sorting system comprising:

the article conveyance sorting apparatus according to any one of claims 1 to 3; and

a control server, wherein

the control server distinguishes the article based on an article weight included in the article information, and outputs the first distribution control signal or the second distribution control signal according to the distinguishing result of the article.

5. The article sorting system according to claim 4, wherein the control server designates a sorting destination of the article based on article sorting information

included in the article information, and outputs the sorting control signal corresponding to the designated sorting destination.

5 6. The article sorting system according to claim 4 or 5, wherein the control server detects a state of conveyance of the tray of the first type and the tray of the second type by the conveyance sorting section, and outputs, based on the state of conveyance, the first conveyance control signal for controlling a timing of delivery of the article
10 toward the tray of the first type by the first conveyance section, and the second conveyance control signal for controlling a timing of delivery of the article toward the tray of the second type by the second conveyance section.

7. A control server comprising:

15 a processor configured to select a first distribution control signal or a second distribution control signal for distributing an article to a first conveyance section or a second conveyance section based on a distinguishing result of the article distinguished based on article information,
20 select a first conveyance control signal for conveying the article from the first conveyance section toward a tray of a first type included in a plurality of trays conveyed by a conveyance sorting section, select a second conveyance control signal for conveying the article from the second
25 conveyance section toward a tray of a second type included in the plurality of trays conveyed by the conveyance sorting section, and select a sorting control signal for

sorting the article conveyed by the plurality of trays to a designated sorting destination; and

an interface that outputs a first distribution control signal or a second distribution control signal to a
5 distributing section that distributes an article to the first conveyance section or the second conveyance section, outputs the first conveyance control signal or the second conveyance control signal to the first conveyance section or the second conveyance section, and outputs the sorting
10 control signal to the conveyance sorting section.