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ARTICLE SORTING SYSTEM

Field of the Invention

The present invention relates to an article sorting system that stores articles with two or more different numbers, takes out articles with specified numbers based on the shipping plan, and sends them to the subsequent process. An article can be a single piece or a box containing two or more pieces.

Background of the Invention

The previously proposed article sorting system uses flow racks for each article number, which are three- or four-tiered storage shelves made of flow conveyors with a slight slope at their fronts. With this system, articles are manually removed from the storage shelves on the basis of the shipping plan, and placed on the output conveyor.

Because the conventional article sorting system requires articles to be manually removed from the storage shelves, there is a limit to the number of layers in each storage shelf from the point of view of workability. For this reason, the conventional article sorting system does not allow the number of layers in each storage shelf to be increased in order to augment the storage capacity. Consequently, the throughput per unit floor area of the system is low.

Accordingly, the present invention provides a article sorting system that

allows an increase in the storage capacity per unit floor area, which results in an increase in the throughput of the system.

Summary of the Invention

The means adopted by the present invention in order to improve throughput of the system by increasing the storage capacity per unit floor area of the system are the installation of multiple storage apparatuses between the main input line and the main output line, with each storage apparatus installed in such a manner that an input/output line that passes through the said storage apparatus in order to allow articles to be received from the main input line and delivered onto the main output line automatically, installation of a multi-tiered article storage section, installation of a transfer apparatus that travels between the input/output line and the article storage section, and installation of a sorter in such a manner that it can freely move along the main input line in order to allow the main input line to connect to the input/output line of a selected storage apparatus for input purposes.

With the present invention, the number of layers in the article storage section of the storage apparatus can be increased by installing a transfer apparatus, and the storage capacity per unit floor area of the system can also be increased by increasing the height of the storage apparatus. Furthermore, with the present invention, articles with multiple numbers can be processed using only one main input line by installing a sorter that can freely move

along the main input line. Moreover, the storage apparatus becomes compact, enabling the throughput per unit floor area of the system to be increased by passing the input/output line through the storage apparatus.

The means adopted by the present invention for reducing the installation area in order to reduce the overall size of the system is that of making the aforesaid sorter move at the upper part of the aforesaid main input line in the article sorting system described in Claim 1.

With the present invention, because the main input line and the sorter are positioned so as to overlap each other on the same plane, the size of the required installation area is decreased.

The means adopted by the present invention for improving both the storage and output throughputs is the installation of a command system that determines the input/output line of a storage apparatus to be selected based on the number of the articles on the aforesaid main input line and sends commands to the sorter so that articles with numbers that are frequently discharged onto the main output line are stored in the aforesaid storage apparatus located at the lower part of the main output line in the article sorting system.

With the present invention, because the sorter moves automatically in accordance with the number of the article on the main input line and delivers that article to a specified storage apparatus for storage, the storage throughput can be improved. Furthermore, because articles with numbers that are frequently discharged are delivered to the lower part of the main output line,

the time required for articles to reach the subsequent process is shortened, enabling the output throughput to be improved.

Brief Description of the Drawings

Figure 1 is a general plan view, with the middle part omitted, illustrating the mode of operation of the present invention system.

Figure 2 is a front view along line Ⅱ-Ⅱ in Figure 1, with the middle part omitted.

Figure 3 is a front view along line Ⅲ-Ⅲ in Figure 1, with the middle part omitted.

Figure 4 is a right side view, with the middle part omitted, of the storage apparatus installed in the present invention system.

Datailed Description of the Preferred Embodiments

The article sorting system relating to the present invention (hereinafter referred to as the present invention system) is described based on the embodiment shown in Figures 1 to 4. Figure 1 is a general plan view, with the middle part omitted, of the present invention system, Figure 2 is a front view along line Ⅱ-Ⅱ in Figure 1, with the middle part omitted, Figure 3 is a front view along line Ⅲ-Ⅲ in Figure 1, with the middle part omitted, and Figure 4 is a right side view, with the middle part omitted, of the storage apparatus.

The present invention system 1, as shown in Figure 1, is equipped with a main input line 2 that extends from front to rear, a main output line 3 that also extends from front to rear, two or more storage apparatuses 4 that are positioned in the horizontal direction between the main input line 2 and the main output line 3, and a sorter 5 that can freely move from front to rear between the main input line 2 and an input/output line 7 of each storage apparatus 4.

For the aforesaid main input line 2, a roller line with forced-driven carrier rollers or a belt line with a forced-driven carrier belt is selected, as appropriate. The main input line 2 is structured to receive the article C, which is removed from a pallet (not shown in the drawings) in the previous process, and load the article C toward the front. For the main output line 3, a roller line with forced-driven carrier rollers or a belt line with a forced-driven carrier belt is selected, as appropriate. The main output line 3 is structured to receive the article C, which is transferred from the input/output line 7 of each storage apparatus 4, and to output the article C toward the rear in order to send it to the subsequent process.

Each of the aforesaid storage apparatuses 4 is equipped with two input/output lines 7, 7 that automatically accept the articles from the main input line 2 and transfer them to the main output line 3, multi-tiered article storage sections 8, 8 located in front and rear, and a transfer apparatus 9 that is positioned between the article storage sections 8, 8 located in the front

and rear and that moves between the input/output lines 7, 7 and each tier of the article storage sections 8, 8.

Each input/output line 7, as shown in Figure 2, consists of, from left to right, a cross-over conveyor on the input side 11, an aligning conveyor 12 that lines up the article C output from the cross-over conveyor on the input side 11, a cross-over conveyor on the output side 13 that accepts the article C output from the aligning conveyor 12, and an accelerating conveyor 14 that accepts the article C transferred from the cross-over conveyor on the output side 13, all of which are positioned in a line. For each conveyor, a roller conveyor with forced-driven carrier rollers or a belt conveyor with a forced-driven carrier belt is selected, as appropriate.

A stopper 15 that can freely move up and down is provided between the aforesaid cross-over conveyor on the output side 13 and the accelerating conveyor 14 to allow the articles C to be transferred onto the accelerating conveyor 4 individually. The accelerating conveyor 14 has an accelerating device 16 on its output side. The accelerating device 16 is structured in such a manner that multiple forced-driven accelerating rollers 17 freely move from the standby position at the bottom (see Figure 3) to the lifting position at the top (see Figure 2) to automatically raise the article C, which is sent to the output side of the accelerating conveyor 14, to further accelerate the article C in the direction D shown by the arrow (see Figure 1) from right front to left rear, and to transfer the article C to the main output line 3.

Each of the aforesaid storage apparatuses 4 has a frame body 18 to keep articles lined up. The frame body 18 remains at the standby position (see Figure 2) outside the aligning conveyor 12 and below the carrier side 12a of the aligning conveyor 12. The overhangs 18a, 18a, ... at the four corners of each frame body 18 are constructed so as to be raised with a frame body elevator 19. The frame body 18 moves up to the ascent position (see Figure 3) above the carrier side 12a of the aligning conveyor 12 to receive the articles lined up on the aligning conveyor 12. Each of the aforesaid article storage sections 8 has brackets 20, 20, that support the overhangs 18a, 18a, ... at the four corners of the frame body 18 on both sides of each tier, in order to allow the multiple frame bodies holding the article C to be stacked.

The aforesaid transfer apparatus 9, as shown in Figures 1 and 4, comprises a slinging section 23 with rollers 22, 22, ... attached, which is guided by guide rails 21 installed on its sides, slide forks 24, 24 located on both sides of the slinging section 23, and a winch or elevator (not shown in the drawings) that moves the slinging section 23 up and down. The transfer apparatus 9, as shown in Figure 3, is constructed in such a manner that the frame body 18 that is raised by the frame body elevator 19 is picked up with slide forks 24, 24 that move back and forth, drawn into the inner area of the slinging section 23, raised up to a specified tier of the article storage section 8 by the elevator, and finally transferred onto the brackets 20, 20 of the article storage section 8 by the slide forks 24, 24. By installing the transfer apparatus 9 that moves

up and down in each storage apparatus 4, the number of tiers in each article storage section can be increased, enabling the storage capacity per unit floor area of the system to be improved.

The aforesaid sorter 5, as shown in Figures 1 and 2, is equipped with a transfer frame 26 that can freely move back and forth guided by a rail (not shown in the drawings) that is connected to fixed frames 2a, 2a of the main input line 2 and positioned in the longitudinal direction, a pickup conveyor 27 that picks up the article C on the main input line 2, a roller conveyor 28 that changes the direction of the article C by 90 degrees and then automatically discharges it onto the cross-over conveyor on the input side 11, and a driving unit (not shown in the drawings) to move the transfer frame 26. In order to ensure that the number of the article carried by the main input line 2 matches the number of the article that the storage apparatus 4 is to store, the sorter 5 moves upon receipt of a command from a command system, which will be described later, and is connected to the specified cross-over conveyor on the input side 11. Because the sorter 5 is positioned so as to overlap the main input line 2 on the same plane, the size of the required installation area is decreased.

The aforesaid main output line 3 receives the articles with specific numbers from the storage apparatus 4 on the basis of the shipping plan and delivers them to the subsequent process, such as the stacking process. If the articles with numbers that are frequently shipped are stored in the storage apparatus 4 located upstream of the main output line 3, these the articles must

travel all the way to downstream of the main output line 3. As a result, the main output line 3 is occupied most of the time by the articles with higher shipping frequencies, making the output operation less efficient. For this reason, it becomes necessary to store articles with higher shipping frequencies in the storage apparatus 4 located nearer to the downstream end of the main output line 3 if we assume that the storage apparatuses are placed next to each other. In order to comply with this necessity, an electronic command system (not shown in the drawings) that issues transfer commands to the sorter 5 is configured to determine the input/output line 7 of a storage apparatus 4 to be selected on the basis of information on the numbers of the articles on the main input line 2, and moves the sorter 5 to the determined input/output line 7, so that the articles with numbers that are frequently discharged onto the main output line 3 (i.e., articles with higher shipping frequencies) are stored in the storage apparatuses 4 located closer to the bottom of the main output line 3. The electronic command system is also configured to stop the main input line 2 while the sorter 5 is moving. Information on the numbers of the articles on the main input line 2 can be obtained either by transmission from a depalletizer in the process before the main input line 2, or by reading the bar code on articles on the main input line 2.

The operation of the present invention system 1 as the article C passes through the system will be explained.

The article C, which is taken down from a pallet (not shown in the

drawings) in the previous process, is received by the main input line 2 and brought up to the stop position of the sorter 5. The article C is then picked up by the sorter 5, rotated 90 degrees, and then unloaded onto the input/output line 7 automatically. At this time, because the sorter 5 moves in accordance with article numbers, the article C is loaded onto the input/output line 7 of the storage apparatus 4 predetermined for that specific article number. The articles C, C,... that are loaded onto the input/output line 7 one after another are lined up on the aligning conveyor 12.

At the same time that the frame body 18, which stands by at the bottom of the aligning conveyor 12, is raised by the frame body elevator 19, a group of articles arranged in a line on the aligning conveyor 12 are accepted and loaded onto the frame body 18. The frame body 18 is then picked up by the transfer apparatus 9 and transferred onto the brackets 20, 20 of the article storage section 8 for storage. When returning from the article storage section 8, the transfer apparatus 9 moves with the frame body 18 that remains on the tier without any articles, up to the standby position. By repeating alignment on the aligning conveyor 12 and transfer by the transfer apparatus 9, the articles with specific numbers are brought into the specific article storage sections 8 for storage. In this manner, the articles with specific numbers are stored in the article storage sections 8 in accordance with shipping frequencies. The article storage operation is performed during time periods when the articles are not transferred onto the main output line 3. However, because each storage

apparatus 4 has two input/output lines 7, 7, it is possible to store the articles and transfer them onto the main output line 3 simultaneously.

To take out the articles, the transfer apparatus 9 draws out the articles that have been stored on the tier of the article storage section 8, together with the frame body 18, and transfers those articles onto the aligning conveyor 12 of the input/output line 7 on which no articles are placed. The article C transferred to the aligning conveyor 12 is then unloaded onto the cross-over conveyor on the output side 13 and stopped by the stopper 15. To take out the article C from the cross-over conveyor on the output side 13 of the specific article storage section 8 on the basis of the shipping plan, the stopper 15 is released and one item of the article C is sent to the accelerating device 16. Upon reaching the output side of the accelerating device 16, the article C is raised by the accelerating rollers 17, 17, ..., further accelerated in the direction of the arrow D (see Figure 1), and finally released onto the main output line 3. The articles C are released onto the main output line 3 in such a manner that the articles C with the same number are lined up on the basis of the shipping plan and discharged to the subsequent process.

The present invention is not limited to the transfer of the articles through the use of the frame body 18. It is possible to structure the system in such a manner that the articles are transferred from the aligning conveyor 12 to shelves on each tier of the article storage section 8 while they are being held with a gripper or suction cup attached to the transfer machine, instead of

using the frame body 18.

With the present invention system, the storage capacity per unit floor area of the system can be increased by increasing the height of the storage apparatus. In addition, the throughput per unit floor area of the system can be improved by reducing the size of the system.

With the present invention system, the throughput per unit floor area of the system can be further improved by positioning the main input line and the sorter so as to overlap with each other in order to reduce the overall size of the system.

With the present invention system, the storage capacity can be improved by means of the sorter that moves automatically according to the number of the article on the main input line and, additionally, the output throughput can be improved by making articles that are frequently unloaded reach the downstream end of the main output line in a shorter time.

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Claims;

1. A article sorting system characterized in that multiple storage apparatuses are positioned between a main input line and a main output line, each storage apparatus has an input/output line that passes through said storage apparatus to automatically receive articles from the main input line and deliver them to the main output line, a multi-tiered article storage section, and a transfer apparatus that travels between the input/output line and the article storage section, and a sorter is installed in such a manner that it can move freely along the main input line in order to allow the main input line to connect to the input/output line of a selected storage apparatus for input purposes.

2. A article sorting system as in claim 1 in which the said sorter moves at the upper part of the said main input line.

3. A article sorting system as in claim 1 or claim 2 that comprises a command system that not only determines the input/output line of a storage apparatus to be selected based on the number of the articles on the said main input line, but also sends commands to the sorter so that the articles with numbers that are more frequently discharged onto the main output line are stored in the said storage apparatus located closer to the bottom of the main output line.