ARTICLE TRANSPORT FACILITY

FIELD

[0001] The present invention relates to an article transport facility including layer transport devices aligned in the vertical direction in multiple layers, a lifting transport device that transports, in the vertical direction, articles received from the layer transport devices, and an unloading device that unloads the articles received from the lifting transport device.

BACKGROUND

[0002] An example of such an article transport facility is described in Japanese Unexamined Patent Application Publication No. 2022-94209 (Patent Literature 1). In the background described below, reference signs in parentheses are the reference signs in Patent Literature 1. Patent Literature 1 describes an automated warehouse (100) including outgoing conveyors (25) as layer transport devices, outgoing lifters (13) as lifting transport devices, and outgoing stations (9) as unloading devices. Each outgoing lifter (13) includes a lifting platform (63) on which a load (W) as an article is placed and a lifting assembly (65) that lifts and lowers the lifting platform (63).

[0003] When a load (W) is retrieved from the automated warehouse (100), the corresponding outgoing lifter (13) lifts or lowers the lifting platform (63) to a shelf tier (21) on which the load (W) to be received is disposed, and receives the load (W) from the outgoing conveyor (25) disposed on the shelf tier (21). The outgoing lifter (13) then lifts or lowers the lifting platform (63) to the position of the corresponding outgoing station (9), and transfers the load (W) to the outgoing station (9). In the automated warehouse (100) described in Patent Literature 1, once multiple loads (W) included in one order are ready, the loads (W) included in the order are retrieved from the automated warehouse (100). When loads (W) are received in the automated warehouse (100) described in Patent Literature 1, the receiving positions of multiple loads (W) included in one order are determined to be distributed on multiple shelf tiers (21) less than or equal to an upper limit value, thus improving the article retrieval efficiency.

CITATION LIST

PATENT LITERATURE

[0004] Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2022-94209

BRIEF SUMMARY

TECHNICAL PROBLEM

[0005] The lifting transport devices may each include two lifters, or specifically, an upper

lifter and a lower lifter. In this structure as well, the efficiency of transporting articles (the article retrieval efficiency in Patent Literature 1) with the lifting transport devices is to be improved when multiple articles (multiple loads included in one order in Patent Literature 1) are transported from the layer transport devices to the unloading devices by the lifting transport devices. However, Patent Literature 1 does not describe such a structure in which the lifting transport devices each include two lifters, or specifically, the upper lifter and the lower lifter.

[0006] Techniques are thus awaited for easily increasing the efficiency of transporting articles with the lifting transport devices when multiple articles are transported from the layer transport devices to the unloading devices by the lifting transport devices in the structure in which the lifting transport devices each include two lifters, or specifically, the upper lifter and the lower lifter.

SOLUTION TO PROBLEM

[0007] An article transport facility includes layer transport devices aligned in a vertical direction in a plurality of layers, a lifting transport device that transports, in the vertical direction, articles received from the layer transport devices, an unloading device that unloads the articles received from the lifting transport device, and a control system that controls the layer transport devices and the lifting transport device. The lifting transport device includes an upper lifter movable in the vertical direction along a lifting path, and a lower lifter movable, on a lower side relative to the upper lifter, in the vertical direction along the lifting path. Each of the upper lifter and the lower lifter holds a plurality of articles. The control system performs, as a selection process to select articles to be received by each of the upper lifter and the lower lifter, a first selection process to cause, among the layer transport devices on which the articles to be received by the upper lifter are arranged, a lowermost layer transport device to be on an upper side relative to an uppermost layer transport device among the layer transport devices on which the articles to be received by the lower lifter are arranged.

[0008] In this structure, when multiple articles are transported from the layer transport devices to the unloading device by the lifting transport device, the first selection process can be performed to avoid an overlap between a range in the vertical direction within which the upper lifter receives the articles from the layer transport devices and a range in the vertical direction within which the lower lifter receives the articles from the layer transport devices. This allows an overlap between the period of a receiving operation in which the upper lifter receives the articles from the layer transport devices and the period of a receiving operation in which the lower lifter receives the articles from the layer transport devices. This easily increases the efficiency of transporting articles with the lifting transport device.

[0009] Further features and advantageous effects of the article transport facility will be

apparent from embodiments described below with reference to the drawings.

BRIEF DESCRIPTION OF DRAWINGS

[0010] FIG. 1 is a partial perspective view of an article transport facility.

FIG. 2 is a control block diagram.

FIG. 3 is a diagram showing holding patterns to hold articles on an upper lifter and a lower lifter.

FIG. 4 is a diagram illustrating a receiving operation performed by a lifting transport device to receive the articles from layer transport devices.

FIG. 5 is a diagram illustrating a transfer operation performed by the lifting transport device to transfer the articles to an unloading device.

FIG. 6 is a diagram illustrating an example receiving operation performed by the lifting transport device to receive the articles.

FIG. 7 is a diagram illustrating an example receiving operation performed by the lifting transport device to receive the articles.

FIG. 8 is a diagram showing arrangement patterns of the articles on the layer transport devices corresponding to pattern 1.

FIG. 9 is a diagram showing arrangement patterns of the articles on the layer transport devices corresponding to pattern 2.

FIG. 10 is a diagram showing arrangement patterns of the articles on the layer transport devices corresponding to pattern 3.

FIG. 11 is a diagram showing arrangement patterns of the articles on the layer transport devices corresponding to pattern 4.

FIG. 12 is a diagram showing arrangement patterns of the articles on the layer transport devices corresponding to pattern 5.

FIG. 13 is a diagram showing arrangement patterns of the articles on the layer transport devices corresponding to pattern 6.

FIG. 14 is a diagram illustrating an example receiving operation performed by the lifting transport device to receive the articles.

FIG. 15 is a diagram illustrating an example receiving operation performed by the lifting transport device to receive the articles.

FIG. 16 is a diagram illustrating an example receiving operation performed by the lifting transport device to receive the articles.

FIG. 17 is a diagram illustrating an example receiving operation performed by the lifting transport device to receive the articles.

DETAILED DESCRIPTION

[0011] An article transport facility according to an embodiment will be described with reference to the drawings. As shown in the example in FIGs. 1 and 2, an article transport facility 100 includes layer transport devices 4, lifting transport devices 6, an unloading device 2, and a control system C. The article transport facility 100 further includes storage racks 1, a loading device 3, and transport vehicles 5. The various technical features of the control system C described below are also applicable to a method for transporting articles in the article transport facility and an article transport program for controlling the article transport facility (a program for causing a computer to function as the control system C). The method, the program, and a storage medium (e.g., a computer-readable storage medium such as a flash memory of an optical disc) storing such a program are also described herein.

[0012] As shown in FIG. 2, the control system C controls the layer transport devices 4 and the lifting transport devices 6. The control system C further controls the unloading device 2, the loading device 3, and the transport vehicles 5. The control system C controls driving of a driving power source (e.g., an electric motor) installed on a control target device to control the operation of the device. The functions of the control system C are implemented by, for example, hardware such as an arithmetic processor cooperating with a program executed on the hardware. The control system C may be a set of multiple pieces of hardware (multiple separate pieces of hardware) that can communicate with one another, rather than a single piece of hardware. A device (e.g., a controller included in the device) to be controlled by the control system C may serve as at least part of the control system C.

[0013] As shown in FIG. 1, two horizontal directions perpendicular to each other are referred to as an X-direction and a Y-direction, and the storage racks 1 are arranged with their rack width direction aligned with the X-direction and their rack depth direction aligned with the Y-direction. The transport vehicles 5 travel in the X-direction to transport articles W. In the example shown in FIG. 1, a pair of storage racks 1 are arranged to face each other in the Y-direction. Each transport vehicle 5 travels, in the X-direction, in a space defined between the pair of storage racks 1 in the Y-direction. Although each transport vehicle 5 transports articles W one by one in the example shown in FIG. 1, the transport vehicle 5 may transport multiple articles W (e.g., two articles W) together. Each transport vehicle 5 may include two carts, or specifically, a first cart that travels in the X-direction and a second cart that is mountable on the first cart and separable from the first cart to travel in the Y-direction and transport articles W.

[0014] Each storage rack 1 includes shelves 10 that support articles W. The articles W are supported on the shelves 10 and stored in the storage rack 1. The shelves 10 are aligned in a Z-direction, which is the vertical direction, in multiple layers. The storage rack 1 can store the articles W in each of the multiple layers (tiers). The articles W are, for example,

receptacles (e.g., containers or cardboard boxes) that store loads (e.g., products). Travel paths for the transport vehicles 5 are defined to correspond to the respective shelves 10 arranged in multiple layers. In this example, the travel paths for the transport vehicles 5 are each defined by a pair of rails 50 spaced from each other in the Y-direction.

[0015] Although some of the articles W are shown in FIG. 1, each shelf 10 can support articles W at multiple positions in the X-direction. In other words, each shelf 10 can support multiple articles W aligned in the X-direction. Each shelf 10 may support, at each position in the X-direction, multiple articles W (e.g., two articles W) aligned in the Y-direction.

[0016] As shown in FIG. 1, the layer transport devices 4 are aligned in the Z-direction in multiple layers. In the example shown in FIG. 1, the layer transport devices 4 are arranged to correspond to the respective shelves 10 arranged in multiple layers. A group of the layer transport devices 4 arranged in multiple layers is referred to as a layer transport device group. In the example shown in FIG. 1, a pair of layer transport device groups are arranged on opposite sides in the Y-direction with the travel paths for the transport vehicles 5 between the pair of layer transport device groups. FIG. 1 shows the shelves 10 arranged in six layers in the storage racks 1 and the layer transport devices 4 arranged in the six layers. FIG. 1 also shows the transport vehicle 5 disposed in the uppermost layer of the six layers.

[0017] An article W is transported by each transport vehicle 5 between a shelf 10 and a layer transport device 4 that are disposed in the same layer. The article W is transferred between the transport vehicle 5 and a transfer area (the shelf 10 or the layer transport device 4) of the article W by, for example, a transferrer included in the transport vehicle 5.

[0018] The layer transport devices 4 transport articles W in the horizontal direction (the X-direction in this example). Each layer transport device 4 includes a conveyor (e.g., a roller conveyor or a conveyor belt; the same applies hereafter) that transports articles W in the X-direction. The layer transport device 4 transfers or receives articles W to or from the corresponding lifting transport device 6 through an operation of transporting the articles W performed by the conveyor (in cooperation with an operation of transporting the articles W performed by a conveyor included in the lifting transport device 6 in this example). The layer transport device 4 can support multiple articles W aligned in the horizontal direction (the X-direction in this example). In the example shown in FIG. 1, each layer transport device 4 can support three articles W aligned in the X-direction.

[0019] The lifting transport devices 6 transport articles W in the Z-direction. In the example shown in FIG. 1, a pair of lifting transport devices 6 are aligned in the Y-direction. The lifting transport devices 6 transport articles W received from the layer transport devices 4 in the Z-direction. The lifting transport devices 6 transport articles W received from the loading device 3 in the Z-direction.

[0020] Each lifting transport device 6 includes an upper lifter 6U that moves in the Z-direction along a lifting path 60, and a lower lifter 6L that moves, on a lower side Z1 relative to the upper lifter 6U, in the Z-direction along the lifting path 60. The lifting path 60 is defined by, for example, a mast or a rail. The upper lifter 6U and the lower lifter 6L move in the Z-direction along the same lifting path 60. The upper lifter 6U is thus movable in the Z-direction within a range with a lower limit defined at a position at which the upper lifter 6U interferes with the lower lifter 6L, and the lower lifter 6L is movable in the Z-direction within a range with an upper limit defined at the position at which the lower lifter 6L interferes with the upper lifter 6U.

[0021] An article W is transferred between the upper lifter 6U and a transfer area (each layer transport device 4, the unloading device 2, or the loading device 3; the same applies hereafter) of the article W with the upper lifter 6U at a level corresponding to the transfer area after the upper lifter 6U moves to the level in the Z-direction. An article W is transferred between the lower lifter 6L and the transfer area of the article W with the lower lifter 6L at the level corresponding to the transfer area after the lower lifter 6L moves to the level in the Z-direction. Each of the upper lifter 6U and the lower lifter 6L includes the conveyor that transports articles W in the horizontal direction (the X-direction in this example), and receives or transfers articles W from or to the transfer area through the operation of transporting the articles W performed by the conveyor (in cooperation with an operation of transporting the articles W performed by a conveyor included in the transfer area in this example).

[0022] Each of the upper lifter 6U and the lower lifter 6L can hold multiple articles W. The multiple articles W are held to be aligned in the horizontal direction (the X-direction in this example) on each of the upper lifter 6U and the lower lifter 6L. As shown in FIG. 1, the upper lifter 6U and the lower lifter 6L can hold the same number of articles W. More specifically, each of the upper lifter 6U and the lower lifter 6L can hold two articles W.

[0023] Each of the upper lifter 6U and the lower lifter 6L holds one or more articles W received from the layer transport devices 4 or the loading device 3. To receive multiple articles W (two articles W in this example; the same applies hereafter) from the layer transport devices 4, each of the upper lifter 6U and the lower lifter 6L may receive the multiple articles W from one layer transport device 4, or may receive the multiple articles W in total from multiple layer transport devices 4. Each of the upper lifter 6U and the lower lifter 6L is controlled by the control system C to receive articles W selected in a selection process (described later).

[0024] The unloading device 2 unloads articles W received from the lifting transport devices 6 to, for example, an outgoing line. The loading device 3 transfers articles W loaded from, for example, an incoming line to the lifting transport devices 6. The unloading device 2 and the loading device 3 each include the conveyor that transports articles W in the horizontal

direction (the X-direction in this example).

[0025] The X-direction includes one side referred to as a first side X1 in the X-direction and the other side referred to as a second side X2 in the X-direction. In the example shown in FIG. 1, the pair of lifting transport devices 6 are arranged on the first side X1 in the X-direction relative to the storage racks 1. The Y-direction includes one side referred to as a first side Y1 in the Y-direction and the other side referred to as a second side Y2 in the Y-direction. In the example shown in FIG. 1, of the pair of lifting transport devices 6, the lifting transport device 6 disposed on the first side Y1 in the Y-direction is used for article retrieval, and the lifting transport device 6 disposed on the second side Y2 in the Y-direction is used for article receipt. Of the pair of layer transport device groups (the groups of layer transport devices 4 arranged in multiple layers), the layer transport device group disposed on the first side Y1 in the Y-direction is used for article retrieval, and the layer transport device group disposed on the second side Y2 in the Y-direction is used for article receipt.

[0026] The lifting transport device 6 for article retrieval is, in the Y-direction, at a position at which the lifting transport device 6 for article retrieval can receive articles W from the layer transport device group for article retrieval. The lifting transport device 6 for article receipt is, in the Y-direction, at a position at which the lifting transport device 6 for article receipt can transfer articles W to the layer transport device group for article receipt. The unloading device 2 is, in the Y-direction, at a position at which the unloading device 2 can receive articles W from the lifting transport device 6 for article retrieval. The loading device 3 is, in the Y-direction, at a position at which the loading device 3 can transfer articles W to the lifting transport device 6 for article receipt. Unlike in the example shown in FIG. 1, the loading device 3 may be disposed on the second side X2 in the X-direction relative to the storage racks 1, and a lifting transport device 6 disposed on the second side X2 in the X-direction relative to the storage racks 1 may be used for article receipt.

[0027] An article W to be received in the article transport facility 100 (specifically, the storage racks 1) is transferred to the lifting transport device 6 for article receipt from the loading device 3. The lifting transport device 6 (specifically, each of the upper lifter 6U and the lower lifter 6L) transports the article W received from the loading device 3 in the Z-direction, and transfers the article W to a layer transport device 4 included in the layer transport device group for article receipt and disposed in the same layer as the shelf 10 serving as a storage destination of the article W. The article W transferred to the layer transport device 4 is then transported to a storage position of the article W on the shelf 10 by a transport vehicle 5 and stored at the storage position.

[0028] An article W retrieved from the article transport facility 100 (specifically, the storage racks 1) is transported by a transport vehicle 5 from the storage position of the article

W on the shelf 10 to a layer transport device 4 included in the layer transport device group for article retrieval. The layer transport device 4 transfers the article W received from the transport vehicle 5 to the lifting transport device 6 for article retrieval. The lifting transport device 6 (specifically, each of the upper lifter 6U and the lower lifter 6L) transports the article W received from the layer transport device 4 in the Z-direction and transfers the article W to the unloading device 2.

[0029] As shown in FIG. 5, the unloading device 2 receives articles W from each of the upper lifter 6U and the lower lifter 6L at a predetermined position in the Z-direction. As shown in FIGs. 1 and 5, the position in the Z-direction at which the unloading device 2 receives articles W from each of the upper lifter 6U and the lower lifter 6L is offset to the lower side Z1, which is a first side in the Z-direction, in the overall area of the lifting path 60 in the Z-direction. In the present embodiment, the lower side Z1 corresponds to a first side in the vertical direction.

[0030] An article retrieval process of articles W performed by the control system C will be described in detail. Thus, the layer transport devices 4 described below refer to the layer transport devices 4 used for article retrieval, and the lifting transport device 6 refers to the lifting transport device 6 used for article retrieval.

[0031] A series of article retrieval operations in which the lifting transport device 6 receives articles W from the layer transport devices 4 and unloads the articles W to the unloading device 2 is defined as one cycle. The control system C repeatedly performs this cycle to perform the article retrieval process of articles W. In each cycle, the same number of articles W (four articles W in this example) as a maximum number of articles W holdable by the upper lifter 6U and the lower lifter 6L are to be retrieved in the article retrieval process. In each cycle, articles W selected in the selection process (described later) are to be retrieved in the article retrieval process. As described below, in response to the lifting transport device 6 not receiving the same number of articles W as the above maximum number of articles W from the layer transport devices 4 in each cycle, the control system C determines that the articles W that cannot be received in the cycle are to be retrieved in the next cycle. In each cycle, the operation of each of the upper lifter 6U and the lower lifter 6L is controlled to allow, on condition that the upper lifter 6U and the lower lifter 6L do not interfere with each other, an overlap between the period of a receiving operation in which the upper lifter 6U receives articles W from the layer transport devices 4 and the period of a receiving operation in which the lower lifter 6L receives articles W from the layer transport devices 4 as long as possible.

[0032] When multiple articles W are transported from the layer transport devices 4 to the unloading device 2 by the lifting transport device 6, the control system C performs the selection process to select articles W to be received by each of the upper lifter 6U and the lower lifter 6L. The control system C performs a first selection process as the selection process.

[0033] The first selection process is a selection process to cause, among the layer transport devices 4 on which the articles W to be received by the upper lifter 6U are arranged, a layer transport device 4 at the lowermost position on the lower side Z1 to be on an upper side Z2 relative to a layer transport device 4 at the uppermost position on the upper side Z2 among the layer transport devices 4 on which the articles W to be received by the lower lifter 6L are arranged. When all the articles W to be received by the upper lifter 6U are arranged on one layer transport device 4, this layer transport device 4 is the layer transport device 4 at the lowermost position on the lower side Z1 described above. When all the articles W to be received by the lower lifter 6L are arranged on one layer transport device 4, this layer transport device 4 is the layer transport device 4 at the uppermost position on the upper side Z2 described above. In the first selection process, basically, the articles W to be received by each of the upper lifter 6U and the lower lifter 6L are selected to cause the upper lifter 6U and the lower lifter 6L to receive the maximum number of articles W holdable by the upper lifter 6U and the lower lifter 6L (to receive a total of four articles W in this example).

[0034] FIG. 4 shows each of the upper lifter 6U and the lower lifter 6L receiving the articles W selected in the first selection process. In FIGs. 3 to 17, including FIG. 4, the numbers indicating a transfer order (described later) are each shown in a quadrangle representing an article W. An N-th article W in the transfer order is hereafter referred to as an article W[N]. In FIG. 4, an article W[1] and an article W[2] are selected as the articles W to be received by the upper lifter 6U, and an article W[3] and an article W[4] are selected as the articles W to be received by the lower lifter 6L. In this case, a range in the Z-direction (hereafter referred to as a first range) within which the upper lifter 6U receives the articles W from the layer transport devices 4 is a range in the Z-direction between the layer transport device 4 on which the article W[1] is disposed and the layer transport device 4 on which the article W[2] is disposed. A range in the Z-direction (hereafter referred to as a second range) within which the lower lifter 6L receives the articles W from the layer transport devices 4 is a range in the Z-direction between the layer transport device 4 on which the article W[3] is disposed and the layer transport device 4 on which the article W[4] is disposed. The first selection process can avoid an overlap between the first range and the second range. In FIG. 4 and in FIGs. 5 to 7 and 14 to 17 (referred to later), FIGs. 4(b), 5(b), 6(b), 7(b), 14(b), 15(b), 16(b), and 17(b) respectively show the states at time points after the time points in FIGs. 4(a), 5(a), 6(a), 7(a), 14(a), 15(a), 16(a), and 17(a).

[0035] In response to the first selection process being unperformable as the selection process (specifically, in response to the upper lifter 6U and the lower lifter 6L not receiving the maximum number of articles W holdable by the upper lifter 6U and the lower lifter 6L in the first selection process), the control system C performs a second selection process as the

selection process. In this manner, the control system C preferentially performs the first selection process. In response to the upper lifter 6U and the lower lifter 6L not receiving the maximum number of articles W holdable by the upper lifter 6U and the lower lifter 6L in the first selection process, the control system C prioritizes receiving the maximum number of articles W holdable by the upper lifter 6U and the lower lifter 6L and performs another selection process (the second selection process in this example).

[0036] The second selection process is a selection process to cause, among the layer transport devices 4 on which the articles W to be received by the upper lifter 6U are arranged, the layer transport device 4 at the lowermost position on the lower side Z1 to be the layer transport device 4 at the uppermost position on the upper side Z2 among the layer transport devices 4 on which the articles W to be received by the lower lifter 6L are arranged. In the second selection process, basically, the articles W to be received by each of the upper lifter 6U and the lower lifter 6L are selected to cause the upper lifter 6U and the lower lifter 6L to receive the maximum number of articles W holdable by the upper lifter 6U and the lower lifter 6L. FIGs. 6, 7, and 14 show each of the upper lifter 6U and the lower lifter 6L receiving the articles W selected in the second selection process. In these figures, the article W[1] and the article W[2] are selected as the articles W to be received by the upper lifter 6U, and the article W[3] and the article W[4] are selected as the articles W to be received by the lower lifter 6L.

[0037] As shown in FIG. 5, the control system C performs a transfer process to transfer multiple articles W from the upper lifter 6U and the lower lifter 6L to the unloading device 2 in a predetermined transfer order. The transfer order is determined based on, for example, an order (e.g., a shipping order generated based on an order from the shipping destination of the articles W). The order is generated by the control system C or another control device (e.g., a host management device of the control system C) that can communicate with the control system C.

[0038] In the transfer process, the upper lifter 6U or the lower lifter 6L moves to a level corresponding to the unloading device 2 in the Z-direction in an order of the lifter holding the article W[1], the lifter holding the article W[2], the lifter holding the article W[3], and the lifter holding the article W[4], and transfers the article W to the unloading device 2. When two articles W that are consecutive in the transfer order are held by the same lifter, the two articles W are transferred to the unloading device 2 based on the transfer order, with the lifter at the level corresponding to the unloading device 2. In the example shown in FIG. 5, the upper lifter 6U holding the article W[1] and the article W[2] moves to the level corresponding to the unloading device 2 in the Z-direction and transfers the article W[1] and the article W[2] to the unloading device 2 (refer to FIG. 5(a)), and then the lower lifter 6L holding the article W[3] and the article W[4] moves to the level corresponding to the unloading device 2 and transfers

the article W[3] and the article W[4] to the unloading device 2 (refer to FIG. 5(b)). When all of the article W[1], the article W[2], the article W[3], and the article W[4] are transferred to the unloading device 2, the transfer order of the other articles W advances by four. An article W[5], an article W[6], an article W[7], and an article W[8] thus respectively become the new article W[1], article W[2], article W[3], and article W[4].

[0039] The four articles W that are the article W[1], the article W[2], the article W[3], and the article W[4] are hereafter simply referred to as four articles W. FIG. 3 shows holding patterns to hold the four articles W on the upper lifter 6U and the lower lifter 6L. Each of the upper lifter 6U and the lower lifter 6L sequentially transfers the articles W to the unloading device 2, starting from the article W held on the first side X1 (the side on which the unloading device 2 is disposed) in the X-direction. Thus, when the four articles W are held by the upper lifter 6U and the lower lifter 6L in one of the six holding patterns (patterns 1 to 6) shown in FIG. 3, the four articles W can be transferred from the upper lifter 6U and the lower lifter 6L to the unloading device 2 in a predetermined transfer order.

[0040] FIGs. 4, 6, and 7 show situations in which the four articles W are held by the upper lifter 6U and the lower lifter 6L in pattern 1 shown in FIG. 3. In FIG. 4, the first selection process is performed as the selection process, and each of the upper lifter 6U and the lower lifter 6L receives the articles W selected in the first selection process. In FIGs. 6 and 7, the second selection process is performed as the selection process, and each of the upper lifter 6U and the lower lifter 6L receives the articles W selected in the second selection process. Each of the upper lifter 6U and the lower lifter 6L receives the multiple articles W to cause an article W at an earlier position in the transfer order to be disposed on the first side X1 (the side on which the unloading device 2 is disposed) in the X-direction. More specifically, each of the upper lifter 6U and the lower lifter 6L sequentially receives the multiple articles W, starting from an article W at an earlier position in the transfer order.

[0041] Articles W are sequentially transferred from the layer transport devices 4 to the lifting transport device 6, starting from an article W disposed on the first side X1 (the side on which the lifting transport device 6 is disposed) in the X-direction. Thus, when multiple articles W (two articles W in FIG. 6, and three articles W in FIG. 7) of the four articles W are arranged on the layer transport device 4 in the same layer as shown in FIGs. 6 and 7, the transport vehicle 5 transports the multiple articles W from the shelf 10 to the layer transport device 4 to cause an article W at an earlier position in the transfer order to be disposed on the first side X1 in the X-direction on the layer transport device 4.

[0042] A first condition is that articles W are held consecutively in the transfer order by each of the upper lifter 6U and the lower lifter 6L as in patterns 1 and 2 shown in FIG. 3. A second condition is that articles W are held consecutively in the transfer order by one of the

upper lifter 6U or the lower lifter 6L (the lower lifter 6L in pattern 3, and the upper lifter 6U in pattern 4) as in patterns 3 and 4 shown in FIG. 3. Although the technique according to one or more embodiments of the present disclosure is not limited to this structure, in the present embodiment, the control system C performs the selection process as described below in both the first selection process and the second selection process. The control system C performs the selection process to satisfy the first condition. When the control system C cannot perform the selection process to satisfy the first condition, the control system C performs the selection process to satisfy the second condition. When the control system C cannot perform the selection process to satisfy the first condition and also cannot perform the selection process to satisfy the second condition, the control system C performs the selection process to satisfy neither the first condition nor the second condition. The control system C performs the selection process in this manner. Thus, patterns 1 and 2 are preferentially selected over patterns 3 to 6, and patterns 3 and 4 are preferentially selected over patterns 5 and 6.

[0043] Although the technique according to one or more embodiments of the present disclosure is not limited to this structure, in the present embodiment, the control system C performs the selection process as described below in both the first selection process and the second selection process. In the selection process, the control system C causes, of the upper lifter 6U and the lower lifter 6L, the lifter disposed on the first side in the vertical direction to hold an article W at a later position in the transfer order as in patterns 1, 3, and 5. In other words, in this example, the control system C causes, of the upper lifter 6U and the lower lifter 6L, the lifter disposed on a second side in the vertical direction to hold the article W (specifically, the article W[1]) at the top position in the transfer order. In the present embodiment, the first side in the vertical direction is the lower side Z1, and of the upper lifter 6U and the lower lifter 6L, the lifter disposed on the first side in the vertical direction is the lower lifter 6L. When, in the selection process, the control system C cannot cause, of the upper lifter 6U and the lower lifter 6L, the lifter disposed on the first side in the vertical direction to hold an article W at a later position in the transfer order, in the selection process, the control system C causes, of the upper lifter 6U and the lower lifter 6L, the lifter on the second side in the vertical direction opposite to the first side in the vertical direction to hold the article W at the later position in the transfer order as in patterns 2, 4, and 6. In other words, in this example, the control system C causes, of the upper lifter 6U and the lower lifter 6L, the lifter disposed on the first side in the vertical direction to hold the article W (specifically, the article W[1]) at the top position in the transfer order. In the present embodiment, the second side in the vertical direction is the upper side Z2, and of the upper lifter 6U and the lower lifter 6L, the lifter disposed on the second side in the vertical direction is the upper lifter 6U. The control system C performs the selection process in this manner. Thus, patterns 1, 3, and 5 are preferentially selected over patterns 2,

4, and 6.

[0044] As described above, patterns 1 and 2 are preferentially selected over patterns 3 to 6, and patterns 3 and 4 are preferentially selected over patterns 5 and 6. Patterns 1, 3, and 5 are preferentially selected over patterns 2, 4, and 6. Thus, for the six holding patterns shown in FIG. 3, pattern 1, pattern 2, pattern 3, pattern 4, pattern 5, and pattern 6 are preferentially selected in this order.

[0045] The control system C performs the selection process as described above. Thus, among the six holding patterns shown in FIG. 3, the pattern in which the four articles W are held by the upper lifter 6U and the lower lifter 6L is determined based on arrangement patterns of the four articles W on the layer transport devices 4 or priority relationships between the arrangement patterns and the six holding patterns. Selection rules for the holding pattern (FIG. 3) based on the arrangement patterns of the four articles W shown in FIGs. 8 to 13 are set based on each priority relationship described above. Thus, when the holding pattern based on the arrangement patterns of the four articles W is selected under the selection rules shown in FIGs. 8 to 13, the selection process is to be performed based on each priority relationship described above. The selection rules for the holding pattern shown in FIGs. 8 to 13 are examples, and may be changed as appropriate based on, for example, the details of the priority relationships on which the selection process is based or whether the selection process is to be based on the priority relationships.

[0046] FIGs. 8 to 13 show the arrangement patterns of the four articles W on the layer transport devices 4. In these figures, only the layer transport devices 4 on which at least one of the four articles W is disposed are aligned in the Z-direction. Two layer transport devices 4 adjacent to each other in the Z-direction in each figure may not be two layer transport devices 4 arranged in layers adjacent to each other in the Z-direction, and one or more other transport devices 4 may be arranged between the two layer transport devices 4 in the Z-direction. In FIGs. 8 to 13, the arrangement patterns in which the four articles W are arranged separately on four layer transport devices 4 are classified into four tiers, the arrangement patterns in which the four articles W are arranged separately on three layer transport devices 4 are classified into three tiers, and the arrangement patterns in which the four articles W are arranged separately on two layer transport devices 4 are classified into two tiers. The arrangement pattern in which the four articles W are arranged on the layer transport devices 4 is determined based on the layers (tiers) with the shelves 10 on which the four articles W are stored.

[0047] When the four articles W are arranged on the layer transport devices 4 in one of the arrangement patterns shown in FIG. 8, the selection process is performed to cause the four articles W to be held by the upper lifter 6U and the lower lifter 6L in pattern 1. In other words, the article W[1] and the article W[2] are selected as the articles W to be received by the upper

lifter 6U, and the article W[3] and the article W[4] are selected as the articles W to be received by the lower lifter 6L. The arrangement patterns of the four articles W shown in FIGs. 4(a), 6(a), and 7(a) are included in the arrangement patterns shown in FIG. 8.

[0048] As described above, when the four articles W are arranged on the layer transport devices 4 in one of the arrangement patterns shown in FIG. 8, the article W[1] and the article W[2] are selected as the articles W to be received by the upper lifter 6U, and the article W[3] and the article W[4] are selected as the articles W to be received by the lower lifter 6L to cause the articles W to be held in pattern 1. When the four articles W are arranged on the layer transport devices 4 in one of the arrangement patterns shown in FIG. 9, the article W[3] and the article W[4] are selected as the articles W to be received by the upper lifter 6U, and the article W[1] and the article W[2] are selected as the articles W to be received by the lower lifter 6L to cause the articles W to be held in pattern 2.

[0049] When the four articles W are arranged on the layer transport devices 4 in one of the arrangement patterns shown in FIG. 10, the article W[1] and the article W[4] are selected as the articles W to be received by the upper lifter 6U, and the article W[2] and the article W[3] are selected as the articles W to be received by the lower lifter 6L to cause the articles W to be held in pattern 3. When the four articles W are arranged on the layer transport devices 4 in one of the arrangement patterns shown in FIG. 11, the article W[2] and the article W[3] are selected as the articles W to be received by the upper lifter 6U, and the article W[1] and the article W[4] are selected as the articles W to be received by the lower lifter 6L to cause the articles W to be held in pattern 4.

[0050] When the four articles W are arranged on the layer transport devices 4 in one of the arrangement patterns shown in FIG. 12, the article W[1] and the article W[3] are selected as the articles W to be received by the upper lifter 6U, and the article W[2] and the article W[4] are selected as the articles W to be received by the lower lifter 6L to cause the articles W to be held in pattern 5. When the four articles W are arranged on the layer transport devices 4 in one of the arrangement patterns shown in FIG. 13, the article W[2] and the article W[4] are selected as the articles W to be received by the upper lifter 6U, and the article W[1] and the article W[3] are selected as the articles W to be received by the lower lifter 6L to cause the articles W to be held in pattern 6.

[0051] When all the four articles W are stored on the same shelf 10, all the four articles W are transferred to the lifting transport device 6 from the same layer transport device 4 as shown in FIG. 14. In FIG. 14, the article W[1], the article W[2], and the article W[3] are arranged on the same layer transport device 4, and the article W[4] is disposed on the layer transport device 4 in response to the article W[1] and the article W[2] being transferred to the upper lifter 6U. The article W[3] and the article W[4] are then transferred to the lower lifter 6L. In this manner,

when all the four articles W are stored on the shelf 10 in the same layer, the article W[1] and the article W[2] are selected as the articles W to be received by the upper lifter 6U, and the article W[3] and the article W[4] are selected as the articles W to be received by the lower lifter 6L to cause the articles W to be held in pattern 1.

[0052] The layer transport devices 4 may include a layer transport device 4 (hereafter referred to as a layer transport device for the upper side) from which only the upper lifter 6U can receive articles W, or a layer transport device 4 (hereafter referred to as a layer transport device for the lower side) from which only the lower lifter 6L can receive articles W. As shown in FIGs. 15 to 17, for example, the upper lifter 6U cannot retract to a position on the upper side Z2 due to, for example, a ceiling, and the two layer transport devices 4 (in other words, the layer transport devices 4 in the uppermost layer and the layer immediately below the uppermost layer) on the upper side Z2 may be layer transport devices for the upper side. In this case, when three or more of the four articles W are arranged on the layer transport devices for the upper side, the upper lifter 6U and the lower lifter 6L cannot receive the maximum number of articles W (four articles W in this example) holdable by the upper lifter 6U and the lower lifter 6L in both the first selection process and the second selection process.

[0053] Although not shown in the figures, the lower lifter 6L cannot retract to a position on the lower side Z1 due to, for example, a floor, and the two layer transport devices 4 (in other words, the layer transport devices 4 in the lowermost layer and the layer immediately above the lowermost layer) on the lower side Z1 may be layer transport devices for the lower side. In this case, when three or more of the four articles W are arranged on the layer transport devices for the lower side, the upper lifter 6U and the lower lifter 6L cannot receive the maximum number of articles W holdable by the upper lifter 6U and the lower lifter 6L in both the first selection process and the second selection process.

[0054] When the four articles include an article W that can be received by only one of the upper lifter 6U or the lower lifter 6L due to, for example, the size or the shape of the article W, the upper lifter 6U and the lower lifter 6L may also not receive the maximum number of articles W holdable by the upper lifter 6U and the lower lifter 6L.

[0055] In response to the upper lifter 6U and the lower lifter 6L not receiving the maximum number of articles W holdable by the upper lifter 6U and the lower lifter 6L in both the first selection process and the second selection process, the control system C performs the first selection process or the second selection process to cause the upper lifter 6U and the lower lifter 6L to receive articles W fewer than the maximum number of articles W holdable by the upper lifter 6U and the lower lifter 6L, and causes the remaining articles W to be selected in the first selection process or the second selection process performed in the next cycle. The articles W fewer than the maximum number of articles W described above (three or fewer articles W in

this example) refer to one or more articles W that are consecutive in the transfer order, starting from the article W (specifically, the article W[1]) at the top position in the transfer order.

[0056] In the situation shown in FIG. 15, the lower lifter 6L cannot receive the article W[3] or the article W[4] although the four articles W are arranged on the layer transport devices 4 in an arrangement pattern (refer to FIG. 8) in which the articles W can be held in pattern 1. In other words, the upper lifter 6U and the lower lifter 6L cannot receive the maximum number of articles W (four articles W in this example) holdable by the upper lifter 6U and the lower lifter 6L. The first selection process or the second selection process (the first selection process in this example) is thus performed to cause the upper lifter 6U and the lower lifter 6L to receive articles W fewer than the maximum number of articles W holdable by the upper lifter 6U and the lower lifter 6L, and the remaining articles W are to be selected in the first selection process or the second selection process performed in the next cycle. In FIG. 15, the article W[1] and the article W[2] are selected as the articles W to be received by the upper lifter 6U, and the article W[3] and the article W[4] are to be selected in the first selection process or the second selection process performed in the next cycle. More specifically, the article W[N] for the next cycle is referred to as an article W[N'], and the article W[3] becomes an article W[1'], the article W[4] becomes an article W[2'], the article W[5] becomes an article W[3'], and the article W[6] becomes an article W[4'].

[0057] When the lower lifter 6L does not receive any articles W as in the situation shown in FIG. 15, the layer transport devices 4 on which the articles W to be received by the lower lifter 6L are arranged are determined as being arranged on the lower side Z1 relative to the layer transport device 4 in the lowermost layer. Although not shown, when the upper lifter 6U does not receive any articles W, the layer transport devices 4 on which the articles W to be received by the upper lifter 6U are arranged are determined as being arranged on the upper side Z2 relative to the layer transport device 4 in the uppermost layer. Thus, in these cases, the layer transport device 4 at the lowermost position on the lower side Z1 among the layer transport devices 4 on which the articles W to be received by the upper lifter 6U are arranged is disposed on the upper side Z2 relative to the layer transport device 4 at the uppermost position on the upper side Z2 among the layer transport devices 4 on which the articles W to be received by the lower lifter 6L are arranged, and the first selection process is performed.

[0058] In the situation shown in FIG. 16, the lower lifter 6L cannot receive the article W[4]. In FIG. 16, the article W[1] and the article W[2] are selected as the articles W to be received by the upper lifter 6U, and the article W[3] is selected as the article W to be received by the lower lifter 6L through the first selection process. The article W[4] is to be selected in the first selection process or the second selection process performed in the next cycle. More specifically, the article W[4] becomes the article W[1'], the article W[5] becomes the article

W[2'], the article W[6] becomes the article W[3'], and the article W[7] becomes the article W[4'].

[0059] In the situation shown in FIG. 17, the lower lifter 6L cannot receive the article W[3] or the article W[4]. In FIG. 17, the article W[1] and the article W[3] are selected as the articles W to be received by the upper lifter 6U, and the article W[2] is selected as the article W to be received by the lower lifter 6L through the first selection process. The article W[4] is to be selected in the first selection process or the second selection process performed in the next cycle. More specifically, the article W[4] becomes the article W[1'], the article W[5] becomes the article W[2'], the article W[6] becomes the article W[3'], and the article W[7] becomes the article W[4'].

[0060] In FIG. 17, the control system C performs the first selection process or the second selection process to allow the upper lifter 6U and the lower lifter 6L to receive as many articles W as possible but fewer than the maximum number of articles W holdable by the upper lifter 6U and the lower lifter 6L. Thus, the article W[1] and the article W[3] are selected as the articles W to be received by the upper lifter 6U, and the article W[2] is selected as the article W to be received by the lower lifter 6L. In some embodiments, for example, holding the articles W consecutively in the transfer order by at least one of the upper lifter 6U or the lower lifter 6L may be prioritized over receiving many articles W. In this case, the article W[1] and the article W[2] are selected as the articles W to be received by the upper lifter 6U, and then the article W[3] becomes the article W[1'], the article W[4] becomes the article W[2'], the article W[5] becomes the article W[3'], and the article W[6] becomes the article W[4'].

Other Embodiments

[0061] (1) In the above embodiment, when the control system C cannot perform the first selection process as the selection process, the control system C performs the second selection process as the selection process. However, the present disclosure is not limited to this structure. When the control system C cannot perform the first selection process as the selection process, the control system C may perform the first selection process to cause the upper lifter 6U and the lower lifter 6L to receive articles W fewer than the maximum number of articles W holdable by the upper lifter 6U and the lower lifter 6L, and cause the remaining articles W to be selected in the first selection process performed in the next cycle.

[0062] (2) In the above embodiment, the position in the Z-direction at which the unloading device 2 receives articles W from each of the upper lifter 6U and the lower lifter 6L is offset to the lower side Z1 in the overall area of the lifting path 60 in the Z-direction. However, the present disclosure is not limited to this structure. The position in the Z-direction at which the unloading device 2 receives articles W from each of the upper lifter 6U and the lower lifter 6L may be offset to the upper side Z2 in the overall area of the lifting path 60 in the Z-direction. In this case, the upper side Z2 corresponds to the first side in the vertical direction. In this

case, for the six holding patterns shown in FIG. 3, pattern 2, pattern 1, pattern 4, pattern 3, pattern 6, and pattern 5 are preferentially selected in this order, unlike in the above embodiment. The position in the Z-direction at which the unloading device 2 receives articles W from each of the upper lifter 6U and the lower lifter 6L may be offset neither to the lower side Z1 nor to the upper side Z2 in the overall area of the lifting path 60 in the Z-direction.

[0063] (3) In the above embodiment, the control system C performs the transfer process to transfer multiple articles W from the upper lifter 6U and the lower lifter 6L to the unloading device 2 in a predetermined transfer order. However, the present disclosure is not limited to this structure. The control system C may transfer multiple articles W from the upper lifter 6U and the lower lifter 6L to the unloading device 2 in any order.

[0064] (4) In the above embodiment, each of the upper lifter 6U and the lower lifter 6L can hold two articles W. However, the present disclosure is not limited to this structure. Each of the upper lifter 6U and the lower lifter 6L may hold three or more articles W. When, for example, the upper lifter 6U and the lower lifter 6L include holders for articles W with different structures (e.g., the dimensions of the holders), the maximum number of articles W (a value greater than or equal to 2) holdable by the upper lifter 6U may be different from the maximum number of articles W (a value greater than or equal to 2) holdable by the lower lifter 6L.

[0065] (5) In the above embodiment, the layer transport devices 4 are conveyors. However, the present disclosure is not limited to this structure. For example, the transport vehicles 5 aligned in the Z-direction in multiple layers may serve as the layer transport devices 4. In this case, the lifting transport devices 6 receive articles W from the transport vehicles 5 serving as the layer transport devices 4.

[0066] (6) In the above embodiments, the unloading device 2 and the loading device 3 are conveyors. However, the present disclosure is not limited to this structure. At least one of the unloading device 2 or the loading device 3 may be, for example, a transport cart such as a tracked cart or a trackless cart, a pusher that pushes articles W, or a robotic arm.

[0067] (7) In the above embodiment, the article transport facility 100 includes the storage racks 1, the loading device 3, and the transport vehicles 5. However, the present disclosure is not limited to this structure. The article transport facility 100 may not include at least one of these components. For example, when the unloading device 2 is used for both loading and unloading based on the states of the article transport facility 100 at different times, the article transport facility 100 may not include the loading device 3 separate from the unloading device 2. In this case, the lifting transport device 6 corresponding to the unloading device 2 is used for article retrieval when the unloading device 2 is used for unloading, and is used for article receipt when the unloading device 2 is used for loading.

[0068] (8) The structure described in each of the above embodiments may be combined

with the structures described in other embodiments (including combinations of the other embodiments described as other embodiments) unless any contradiction arises. For other structures as well, the embodiments described herein are merely illustrative in all aspects. The embodiments may be modified variously as appropriate without departing from the spirit and scope of the present disclosure.

Overview of Present Embodiment

[0069] An overview of the article transport facility described above is provided below.

[0070] An article transport facility includes layer transport devices aligned in a vertical direction in a plurality of layers, a lifting transport device that transports, in the vertical direction, articles received from the layer transport devices, an unloading device that unloads the articles received from the lifting transport device, and a control system that controls the layer transport devices and the lifting transport device. The lifting transport device includes an upper lifter movable in the vertical direction along a lifting path, and a lower lifter movable, on a lower side relative to the upper lifter, in the vertical direction along the lifting path. Each of the upper lifter and the lower lifter holds a plurality of articles. The control system performs, as a selection process to select articles to be received by each of the upper lifter and the lower lifter, a first selection process to cause, among the layer transport devices on which the articles to be received by the upper lifter are arranged, a lowermost layer transport device to be on an upper side relative to an uppermost layer transport device among the layer transport devices on which the articles to be received by the lower lifter are arranged.

[0071] In this structure, when multiple articles are transported from the layer transport devices to the unloading device by the lifting transport device, the first selection process can be performed to avoid an overlap between a range in the vertical direction within which the upper lifter receives the articles from the layer transport devices and a range in the vertical direction within which the lower lifter receives the articles from the layer transport devices. This allows an overlap between the period of a receiving operation in which the upper lifter receives the articles from the layer transport devices and the period of a receiving operation in which the lower lifter receives the articles from the layer transport devices. This easily increases the efficiency of transporting articles with the lifting transport device.

[0072] In response to the first selection process being unperformable as the selection process, the control system may perform, as the selection process, a second selection process to cause, among the layer transport devices on which the articles to be received by the upper lifter are arranged, the lowermost layer transport device to be the uppermost layer transport device among the layer transport devices on which the articles to be received by the lower lifter are arranged.

[0073] In this structure, when multiple articles are transported from the layer transport

devices to the unloading device by the lifting transport device and when the first selection process cannot be performed, the second selection process can be performed to minimize an overlap between the range in the vertical direction within which the upper lifter receives the articles from the layer transport devices and the range in the vertical direction within which the lower lifter receives the articles from the layer transport devices. This allows an overlap between the period of the receiving operation in which the upper lifter receives the articles from the layer transport devices and the period of the receiving operation in which the lower lifter receives the articles from the layer transport devices relatively easily. This easily increases the efficiency of transporting articles with the lifting transport device.

[0074] As described above, in the structure in which, in response to the first selection process being unperformable as the selection process, the control system performs a second selection process as the selection process, the control system may perform, in response to the upper lifter and the lower lifter not receiving a maximum number of articles holdable by the upper lifter and the lower lifter in both the first selection process and the second selection process, the first selection process or the second selection process to cause the upper lifter and the lower lifter to receive articles fewer than the maximum number of articles holdable by the upper lifter and the lower lifter, and may cause the remaining articles to be selected in the first selection process or the second selection process performed in a next cycle.

[0075] In this structure, the first selection process and the second selection process are performed to cause the upper lifter and the lower lifter to receive as many articles as possible, up to the maximum number of articles holdable by the upper lifter and the lower lifter, thus increasing the efficiency of transporting articles with the lifting transport device. When the upper lifter and the lower lifter cannot receive the maximum number of articles holdable by the upper lifter and the lower lifter, the remaining articles are to be selected in the first selection process or the second selection process performed in the next cycle. This allows intended articles to be reliably transported to the unloading device.

[0076] In any of the above structures, the unloading device may receive the articles from each of the upper lifter and the lower lifter at a predetermined position in the vertical direction. The control system may perform a transfer process to transfer a plurality of articles from the upper lifter and the lower lifter to the unloading device in a predetermined transfer order. The control system may perform the selection process to cause the plurality of articles to be held consecutively in the transfer order by each of the upper lifter and the lower lifter.

[0077] In this structure, the articles held by one of the upper lifter or the lower lifter are all transferred to the unloading device, and then the articles held by the other of the upper lifter or the lower lifter are all transferred to the unloading device in the transfer process. This allows the articles to be transferred to the unloading device in the predetermined order. This reduces

the number of times the upper lifter and the lower lifter are lifted and lowered in the transfer process in the structure in which the unloading device receives articles at the predetermined position in the vertical direction. This easily increases the efficiency of transporting articles with the lifting transport device.

[0078] In the structure in which the control system performs the selection process to cause the plurality of articles to be held consecutively in the transfer order by each of the upper lifter and the lower lifter, the position in the vertical direction at which the unloading device receives the plurality of articles from each of the upper lifter and the lower lifter may be offset to a first side in the vertical direction in an overall vertical area of the lifting path. In the selection process, the control system may cause, of the upper lifter and the lower lifter, the lifter disposed on the first side in the vertical direction to hold an article at a later position in the transfer order.

[0079] In this structure, the lifter with a narrower lifting range in the vertical direction with respect to the unloading device transfers the articles to the unloading device after the lifter with a wider lifting range in the vertical direction. Thus, the lifter with the wider lifting range can complete the transfer of the articles first and move to receive next articles. In other words, the lifter that is likely to move a longer distance in the vertical direction to receive next articles can start moving first. This easily increases the efficiency of transporting articles with the lifting transport device.

[0080] The article transport facility according to one or more embodiments of the present disclosure produces at least one of the effects described above.

REFERENCE SIGNS LIST

[0081]

2 unloading device
4 layer transport device
6 lifting transport device
6U upper lifter
6L lower lifter
60 lifting path
100 article transport facility
C control system
W article
Z Z-direction (vertical direction)
Z1 lower side (first side in vertical direction)
Z2 upper side

CLAIMS

1. An article transport facility, comprising:

layer transport devices aligned in a vertical direction in a plurality of layers;

a lifting transport device configured to transport, in the vertical direction, articles received from the layer transport devices;

an unloading device configured to unload the articles received from the lifting transport device; and

a control system configured to control the layer transport devices and the lifting transport device,

the lifting transport device including

an upper lifter movable in the vertical direction along a lifting path, and

a lower lifter movable, on a lower side relative to the upper lifter, in the vertical direction along the lifting path,

each of the upper lifter and the lower lifter being configured to hold a plurality of articles,

the control system being configured to perform, as a selection process to select articles to be received by each of the upper lifter and the lower lifter, a first selection process to cause, among the layer transport devices on which the articles to be received by the upper lifter are arranged, a lowermost layer transport device to be on an upper side relative to an uppermost layer transport device among the layer transport devices on which the articles to be received by the lower lifter are arranged.

2. The article transport facility according to claim 1, wherein

in response to the first selection process being unperformable as the selection process, the control system performs, as the selection process, a second selection process to cause, among the layer transport devices on which the articles to be received by the upper lifter are arranged, the lowermost layer transport device to be the uppermost layer transport device among the layer transport devices on which the articles to be received by the lower lifter are arranged.

3. The article transport facility according to claim 2, wherein

in response to the upper lifter and the lower lifter not receiving a maximum number of articles holdable by the upper lifter and the lower lifter in both the first selection process and the second selection process, the control system performs the first selection process or the second selection process to cause the upper lifter and the lower lifter to receive articles fewer than the maximum number of articles holdable by the upper lifter and the lower lifter, and causes the remaining articles to be selected in the first selection process or the second selection process performed in a next cycle.

4. The article transport facility according to any one of claims 1 to 3, wherein

the unloading device is configured to receive the articles from each of the upper lifter and the lower lifter at a predetermined position in the vertical direction,

the control system is configured to perform a transfer process to transfer a plurality of articles from the upper lifter and the lower lifter to the unloading device in a predetermined transfer order, and

the control system performs the selection process to cause the plurality of articles to be held consecutively in the transfer order by each of the upper lifter and the lower lifter.

5. The article transport facility according to claim 4, wherein

the position in the vertical direction at which the unloading device receives the plurality of articles from each of the upper lifter and the lower lifter is offset to a first side in the vertical direction in an overall vertical area of the lifting path, and

in the selection process, the control system causes, of the upper lifter and the lower lifter, the lifter disposed on the first side in the vertical direction to hold an article at a later position in the transfer order.