TRANSPORT FACILITY

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a transport facility including an entry detection unit.

2. Description of the Related Art

[0002] FIG. 1 of JP 2003-218679A (Patent Document 1) discloses a transport facility including entry detection units (2, 3) and a sensor (4) that detects a transport target object (W) at detection positions in front of and behind a detection plane (light curtain) formed by the entry detection units (2, 3). The entry detection units (2, 3) of this transport facility are deactivated if the transport target object (W) is detected at a detection position of the sensor (4).

SUMMARY OF THE INVENTION

[0003] In the above-described transport facility, the entry detection units are deactivated if a transport target object is detected at a detection position in front of or behind the detection plane. As a result, if the transport target object is stopped at the detection position, the entry detection units will remain deactivated, and thus the transport target object cannot be stopped at the detection position. As a result, a sufficient transport distance is required in front of and behind the detection plane of the entry detection units in order for the entire transport target object to move out of the detection positions, resulting in the problem that the transport facility tends to be larger in size in the transport direction.

[0004] In view of this, it is desirable to realize a transport facility that includes an entry detection unit and that can easily be made smaller in size in the transport direction.

[0005] The transport facility according to the present disclosure includes: a transport device configured to transport a transport target object along a predetermined transport direction; an entry detection unit configured to detect an object passing through a detection plane set in such a manner as to intersect a movement route of the transport target object transportable by the transport device; and a deactivation device configured to deactivate the entry detection unit while the transport target object is passing through the detection plane,

the transport facility being characterized in that the deactivation device includes: a first detection unit configured to detect the transport target object at a first detection position set on a transport direction first side with respect to the detection plane, the transport direction first side being one side in the transport direction; a second detection unit configured to detect the transport target object at a second detection position set on a transport direction second side with respect to the detection plane, the transport direction second side being another side in the transport direction; and a third detection unit configured to detect that the transport target object is at a standby position set on the transport direction second side with respect to the detection plane, the standby position is set in such a manner that the entire transport target object is on the transport direction second side with respect to the detection plane and part of the transport target object is at the second detection position, the deactivation device deactivates the entry detection unit if at least either the first detection unit or the second detection unit detects the transport target object and the third detection unit does not detect the transport target object, and the deactivation device activates the entry detection unit if both of the first detection unit and the second detection unit do not detect the transport target object and if both of the second detection unit and the third detection unit detect the transport target object.

[0006] According to this configuration, even if the second detection unit detects the transport target object, if the third detection unit also detects the transport target object, the entry detection unit is activated. Accordingly, even if the entire transport target object is not on the transport direction second side with respect to the second detection position, the entry detection unit is activated if the transport target object is at the standby position. For this reason, the entry detection unit can be quickly activated after the transport target object has passed. In addition, compared to setting the standby position in such a manner that the entire transport target object is on the transport direction second side with respect to the second detection position, it is easier to shorten the distance from the detection plane of the entry detection unit to the end portion on the transport direction second side at the standby position. Therefore, it is easy to reduce the size in the transport direction of the transport facility including the entry detection unit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1 is a perspective view showing a schematic diagram of a transport facility according to a first embodiment.

FIG. 2 is a diagram showing a deactivation device included in the transport facility of FIG. 1.

FIG. 3 is a top view of the transport facility of FIG. 1

FIG. 4 is a diagram showing a state in which a transport target object is on a first side in the transport direction with respect to a first detection position.

FIG. 5 is a diagram showing a state in which a transport target object is detected at a first detection position.

FIG. 6 is a diagram showing a state in which a transport target object is detected at a second detection position.

FIG. 7 is a diagram showing a state in which a transport target object is at a standby position.

FIG. 8 is a diagram showing a state in which a transport target object is being transferred by a transfer device.

FIG. 9 is a top view of a transport facility according to a second embodiment.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0008] Hereinafter, a transport facility 10 according to a first embodiment will be described with reference to the drawings.

[0009] FIG. 1 is a perspective view showing a schematic diagram of a transport facility 10 according to the present embodiment. The transport facility 10 includes a transport device 11 that transports a transport target object W along a predetermined transport direction Y. Examples of the transport device 11 include a roller conveyor, a belt conveyor, a track-guided vehicle, and a trackless vehicle. Examples of the transport target object W include articles such as merchandise and machined products, transport containers in which articles are stored, transport platforms on which the articles are placed, and carts including transport containers or transport platforms.

[0010] Here, one side in the transport direction Y is a transport direction first side Y1, and the other side in the transport direction Y is a transport direction second side Y2. A direction orthogonal to an up-down direction Z and the transport direction Y is a width direction X. One side in the width direction

X is referred to as a width direction first side X1, and the other side in the width direction X is referred to as a width direction second side X2. In the illustrated example, the width direction X is a direction orthogonal to the up-down direction Z and the transport direction Y.

[0011] The transport facility 10 includes an entry detection unit 15 that detects an object passing through a detection plane S1 set in such a manner as to intersect a movement path of the transport target object W transported by the transport device 11. Examples of the entry detection unit 15 include distance measuring sensors using ultrasonic waves or millimeter waves, optical sensors of a transmission type, a mirror reflection type, and the like, and imaging devices including an image recognition system. Examples of an "object" include the transport target object W, a human body, a part of a human body (an arm or a head, etc.), and a foreign object. In this embodiment, the object includes the transport target object W. An object is a tangible object.

[0012] The detection plane S1 may be set in such a manner as to intersect the transport direction Y, and in the illustrated example, the detection plane S1 is set in such a manner as to be orthogonal to the transport direction Y. The detection plane S1 may be made of a plurality of lines, and for example, may be two lines emitted from a light projecting portion of an optical sensor toward a light receiving portion. The detection plane S1 of this embodiment is a plane called a light curtain that is formed by a plurality of optical sensors arranged at different positions in the up-down direction Z.

[0013] The transport facility 10 of this embodiment is provided with a general region E1 and a management region E2. The general region E1 and the management region E2 are pre-defined regions. For example, a warehouse for storing articles, a production facility for producing goods, and the like are installed in the management region E2. The warehouse includes, for example, an automatic transfer machine or the like for transferring articles between the warehouse and an automatic transport vehicle. The production facility includes, for example, an automatic machine tool. For this reason, the entry of tangible objects, including workers, into the management region E2 is generally restricted. If a tangible object enters the management region E2 by mistake, it is preferable to stop the operation of automatic transfer machine, automatic machine tool, and the like for safety reasons. For this reason, the detection plane S1 is set at the boundary between the general region E1 and the management region E2. In this embodiment, an entry prevention object

13 (see FIG. 3), such as a barrier, a fence, a wall, or a door, is provided at the boundary between the general region E1 and the management region E2 where no detection plane S1 is set.

[0014] FIG. 2 is a diagram showing a deactivation device 20 of the present embodiment. FIG. 3 is a top view of the transport facility 10 of the present embodiment. In the example shown in FIG. 3, on the detection plane S1 on the width direction first side X1, the transport device 11 transports the transport target object W from the transport direction second side Y2 to the transport direction first side Y1. On the detection plane S1 on the width direction second side X2, the transport device 11 transports the transport target object W from the transport direction first side Y1 to the transport direction second side Y2, but the transport target object W may also be conveyed in the opposite direction. The transport facility 10 is provided with a work region 41. Examples of work performed in the work region 41 include picking work, assorting work, and machining work. In this embodiment, these kinds of work are performed by a working robot (not shown).

[0015] The transport facility 10 includes the deactivation device 20 that deactivates the entry detection unit 15 while the transport target object W passes through the detection plane S1. The deactivation device 20 includes a first detection unit 21 that detects the transport target object W at a first detection position P1 set on the transport direction first side Y1 with respect to the detection plane S1. The deactivation device 20 includes a second detection unit 22 that detects the transport target object W at a second detection position P2 set on the transport direction second side Y2 with respect to the detection plane S1. The deactivation device 20 includes a third detection unit 23 that detects that the transport target object W is at a standby position P3m set on the transport direction second side Y2 with respect to the detection plane S1. Examples of the first detection unit 21, the second detection unit 22, and the third detection unit 23 include optical sensors of a transmission type, a mirror reflection type, and the like, non-contact detection units such as an imaging device including an image recognition system, and contact detection units such as a limit switch.

[0016] In this embodiment, the upper end of the first detection position P1 is lower than the upper end of the detection plane S1. The upper end of the first detection position P1 is lower than the center in the up-down direction Z of the detection plane S1. In the illustrated example, the first detection position P1

is a detection line along the width direction X, and the first detection unit 21 detects whether or not the transport target object W is on the detection line.

[0017] In this embodiment, the upper end of the second detection position P2 is lower than the upper end of the detection plane S1. The upper end of the second detection position P2 is lower than the center in the up-down direction Z of the detection plane S1. In the illustrated example, the second detection position P2 is a detection line along the width direction X, and the second detection unit 22 detects whether or not the transport target object W is on the detection line.

[0018] In this embodiment, the standby position P3m is set in such a manner that the entire transport target object W is on the transport direction second side Y2 with respect to the detection plane S1 and a part of the transport target object W is at the second detection position P2. The third detection unit 23 is configured to detect an end portion W2 on the transport direction second side Y2 of the transport target object W at the standby position P3m. The end portion W2 may be an edge on the transport direction second side Y2 of the transport target object W, or may be a region having a certain degree of spread in the transport direction Y including the edge. In the latter case, the above-mentioned spread is set to be at least greater than or equal to the maximum error in the stopping position in the transport direction Y of the transport target object W.

[0019] The standby position P3m of this embodiment is a position where the transport target object W stands by. The standby position P3m is a position where the transport target object W is received or where the transport target object W is delivered. The standby position P3m is a stop position where the transport of the transport target object W stops, but may also be a position where standby or work is performed while the transport target object W is transported.

[0020] The third detection unit 23 of this embodiment detects whether or not the transport target object W is on the detection line P3 along the width direction X, thereby detecting whether or not the transport target object W is at the standby position P3m. The upper end of the detection line P3 is lower than the upper end of the detection plane S1. The upper end of the detection line P3 is lower than the center in the up-down direction Z of the detection plane S1. The detection line P3 in the illustrated example is set on the transport direction second side Y2 with respect to the second detection position

P2.

[0021] The upper end of the first detection position P1 and the upper end of the second detection position P2 in this embodiment are set lower than the upper end of the detection plane S1. The upper end of the first detection position P1 and the upper end of the second detection position P2 are set lower than the upper ends of the transport container, the transport platform, and the like, for example. The upper end of the first detection position P1 and the upper end of the second detection position P2 are set to, for example, half or less, a quarter or less, or a tenth or less of the width in the up-down direction Z of the detection plane S1. It is desirable that the upper end of the first detection position P1 and the upper end of the second detection position P2 are as low as possible.

[0022] As shown in FIG. 2, the deactivation device 20 of this embodiment includes a control unit 25 that controls the operation of the entry detection unit 15. The control unit 25 performs control to switch the entry detection unit 15 between being activated and deactivated based on the detection results of the first detection unit 21, the second detection unit 22, and the third detection unit 23. In this embodiment, the functions of the control unit 25 are realized through cooperation between hardware such as an arithmetic processing device and a program executed on the hardware. The entire control unit 25 may be provided adjacent to the transport device 11, or may be provided partially adjacent to the transport device 11 and partially in a control device installed outside, such as in a centralized control room. The entire control unit 25 may be provided in an external control device. The control unit 25 of this embodiment is capable of wireless communication with a management device (Material Control Processor) that controls a later-described transfer device 30.

[0023] The deactivation device 20 deactivates the entry detection unit 15 if at least either the first detection unit 21 or the second detection unit 22 detects the transport target object W and the third detection unit 23 does not detect the transport target object W. The deactivation device 20 activates the entry detection unit 15 if both of the first detection unit 21 and the second detection unit 22 do not detect a transport target object, and if both of the second detection unit 22 and the third detection unit 23 detect the transport target object W.

[0024] In this embodiment, the distance in the transport direction Y between

the first detection position P1 and the second detection position P2 is set to be less than or equal to the dimension in the transport direction Y of the transport target object W. If there are a plurality of sizes of the transport target object W, then for the type of transport target object W that has the shortest dimension in the transport direction Y, the distance in the transport direction Y between the first detection position P1 and the second detection position P2 is set to be less than or equal to the dimension in the transport direction Y of the transport target object W. The distance in the transport direction Y between the first detection position P1 and the second detection position P2 is set to be greater than or equal to the dimension in the transport direction Y of a human body, for example. Examples of the distance in the transport direction Y between the first detection position P1 and the second detection position P2 are, for example, 0.5 m or more, 0.75 m or more, and 1.0 m or more.

[0025] In this embodiment, the distance in the transport direction Y between the detection plane S1 and the detection line P3 is set to be longer than the dimension in the transport direction Y of the transport target object W. If there are a plurality of sizes of the transport target object W, then for the type of transport target object W with the longest dimension in the transport direction Y, the distance in the transport direction Y between the detection plane S1 and the detection line P3 is set to be longer than the dimension in the transport direction Y of the transport target object W.

[0026] The distance in the transport direction Y between the second detection position P2 and the detection line P3 in this embodiment is set to be less than or equal to the dimension in the transport direction Y of the transport target object W. If there are a plurality of sizes of the transport target object W, then for the type of transport target object W with the shortest dimension in the transport direction Y, the distance in the transport direction Y between the second detection position P2 and the detection line P3 is set to be less than or equal to the dimension in the transport direction Y of the transport target object W.

[0027] The deactivation device 20 may be configured in such a manner that it is unable to distinguish between the above-mentioned foreign object and the transport target object W at each of the first detection position P1, the second detection position P2, and the standby position P3m. The deactivation device 20 may be configured to distinguish between and recognize the transport target object W and tangible objects other than the transport target object W using

an imaging device, a wireless tag, or the like at each of the first detection position P1, the second detection position P2, and the standby position P3m. For example, a tangible object detected by the first detection unit 21 or the second detection unit 22 in the transport facility 10 may be recognized as the transport target object W. A tangible object that is not detected by the first detection unit 21 or the second detection unit 22 but is detected by the detection plane S1 may be recognized as a tangible object other than the transport target object W.

[0028] The deactivation device 20 may be configured in such a manner that it is unable to distinguish between the above-mentioned foreign object and the transport target object W at the standby position (third detection position) P3m. The upper end of the standby position P3m in this embodiment is set lower than the upper end of the detection plane S1. The upper end of the standby position P3m is set lower than the upper ends of the transport container, the transport platform, and the like, for example. The upper end of the standby position P3m is set to, for example, half or less, a quarter or less, or a tenth or less of the width in the up-down direction Z of the detection plane S1. It is desirable that the upper end of the standby position P3m is as low as possible.

[0029] The transport facility 10 includes a transfer device 30 for transferring the transport target object W. The standby position P3m is a position where at least either reception of the transport target object W or delivery of the transport target object W is performed through the operation of the transfer device 30. The transfer device 30 stops operation if the activated entry detection unit 15 detects an object passing through the detection plane S1. In the illustrated example, the transfer device 30 includes a fork 31 capable of both receiving the transport target object W and delivering the transport target object W.

[0030] The transfer device 30 in this embodiment is allowed to receive the transport target object W under a condition that the third detection unit 23 detects the transport target object W. The transfer device 30 in this embodiment is allowed to deliver the transport target object W under the condition that the third detection unit 23 does not detect the transport target object W. In the illustrated example, reception of the transport target object W is allowed at the standby position P3m on the width direction first side X1, and delivery of the transport target object W is allowed at the standby position P3m on the width direction second side X2.

[0031] The transfer device 30 of this embodiment includes a travel section 32 and is configured to move along a pre-set path 33. The travel section 32 stops traveling if the activated entry detection unit 15 detects an object passing through the detection plane S1. Examples of the transfer device 30 include a track-guided vehicle, a trackless vehicle, a stacker crane, a forklift, and a robot arm. The path 33 may be a track-guided path formed by a rail or the like, or a path without a rail or the like, which is set based on, for example, coordinates on a floor surface.

[0032] FIG. 4 is a diagram showing a state in which the transport target object W is located on the transport direction first side Y1 with respect to the first detection position P1. FIG. 5 is a diagram showing a state in which the first detection unit 21 detects the transport target object W. FIG. 6 is a diagram showing a state in which the second detection unit 22 detects the transport target object W. FIG. 7 is a diagram showing a state in which both of the second detection unit 22 and the third detection unit 23 detect the transport target object W. FIG. 8 is a diagram showing a state in which the transfer device 30 transfers the transport target object W. In FIGS. 4 to 8, the detection plane S1 of the activated entry detection unit 15 is indicated by a solid line, and the detection plane S1 of the deactivated entry detection unit 15 is indicated by a dashed line.

[0033] An example of transport in which the transport target object W passes through the detection plane S1 from the transport direction first side Y1 to the transport direction second side Y2 in the transport facility 10 will be described below with reference to FIGS. 4 to 8 in the stated order.

[0034] In the state shown in FIG. 4, both of the first detection unit 21 and the second detection unit 22 do not detect the transport target object W, and therefore detection in the detection plane S1 by the entry detection unit 15 is activated. In this state, the third detection unit 23 does not detect the transport target object W either.

[0035] When the transport target object W is transported from the state shown in FIG. 4 to the transport direction second side Y2, the state becomes as shown in FIG. 5, where the first detection unit 21 detects the transport target object W at the first detection position P1 and the third detection unit 23 does not detect the transport target object W. In this state, detection by the entry detection unit 15 in the detection plane S1 is deactivated.

[0036] When the transport target object W is transported from the state

shown in FIG. 5 to the transport direction second side Y2 and passes through the detection plane S1, the state becomes as shown in FIG. 6, where the second detection unit 22 detects the transport target object W at the second detection position P2, and the third detection unit 23 does not detect the transport target object W. In this state, detection by the entry detection unit 15 in the detection plane S1 is deactivated.

[0037] When the transport target object W is transported from the state shown in FIG. 6 to the transport direction second side Y2, the state becomes as shown in FIG. 7, where the second detection unit 22 and the third detection unit 23 detect the transport target object W. In this state, detection by the entry detection unit 15 in the detection plane S1 is activated. When the third detection unit 23 detects the transport target object W, the transfer device 30 is permitted to receive the transport target object W, and the operation of receiving the transport target object W is performed as shown in FIG. 8. In the state shown in FIG. 8, both of the first detection unit 21 and the second detection unit 22 do not detect the transport target object W, and therefore detection by the entry detection unit 15 in the detection plane S1 is activated.

[0038] An example of transport in which the transport target object W passes through the detection plane S1 from the transport direction second side Y2 to the transport direction first side Y1 in the transport facility 10 will be described below with reference to FIGS. 8 to 4 in the stated order.

[0039] If the third detection unit 23 does not detect the transport target object W, the transfer device 30 is allowed to deliver the transport target object W, and the operation of delivering the transport target object W is performed as shown in FIG. 8. When the delivery operation of the transport target object W is completed, the state becomes as shown in FIG. 7, where the second detection unit 22 and the third detection unit 23 detect the transport target object W. In this state, detection by the entry detection unit 15 in the detection plane S1 is activated.

[0040] When the transport target object W is transported from the state shown in FIG. 7 to the transport direction first side Y1, the state becomes as shown in FIG. 6, where the second detection unit 22 detects the transport target object W at the second detection position P2, and the third detection unit 23 does not detect the transport target object W. In this state, detection by the entry detection unit 15 in the detection plane S1 is deactivated.

[0041] When the transport target object W is transported from the state

shown in FIG. 6 to the transport direction first side Y1 and passes through the detection plane S1, the state becomes as shown in FIG. 5, where the first detection unit 21 detects the transport target object W at the first detection position P1, and the third detection unit 23 does not detect the transport target object W. In this state, detection by the entry detection unit 15 in the detection plane S1 is deactivated.

[0042] When the transport target object W is transported from the state shown in FIG. 5 to the transport direction first side Y1, the state becomes as shown in FIG. 4, where both of the first detection unit 21 and the second detection unit 22 do not detect the transport target object W, and therefore detection by the entry detection unit 15 in the detection plane S1 is activated.

[0043] Note that although not shown in the drawings, in this embodiment, if both of the first detection unit 21 and the third detection unit 23 detect the transport target object W, detection by the entry detection unit 15 in the detection plane S1 is activated. If all of the first detection unit 21, the second detection unit 22, and the third detection unit 23 detect the transport target object W, detection by the entry detection unit 15 in the detection plane S1 is activated. If both of the first detection unit 21 and the second detection unit 22 detect the transport target object W, detection by the entry detection unit 15 in the detection plane S1 is deactivated.

[0044] The transport facility 10 according to a second embodiment will be described below with reference to the drawings. The following description will focus on differences from the first embodiment. Note that points that are not particularly described are the same as those in the first embodiment.

[0045] FIG. 9 is a top view of the transport device 11 of this embodiment, and corresponds to FIG. 3. The transport device 11 of this embodiment can transport the transport target object W both from the transport direction first side Y1 to the transport direction second side Y2 and from the transport direction second side Y2 to the transport direction first side Y1. The control unit 25 performs control to switch the entry detection unit 15 between being activated and being deactivated based on the detection results of the first detection unit 21, the second detection unit 22, the third detection unit 23, and a later-described fourth detection unit 24.

[0046] The deactivation device 20 of this embodiment includes a fourth detection unit 24 that detects the transport target object W at a fourth detection position P4m set on the transport direction first side Y1 with respect

to the first detection position P1. Examples of the fourth detection unit 24 include optical sensors of a transmission type, a mirror reflection type, and the like, and imaging devices including an image recognition system. A physical detection unit such as a limit switch may be used as the fourth detection unit 24.

[0047] The fourth detection position P4m of this embodiment is set in such a manner that the entire transport target object W is on the transport direction first side Y1 with respect to the detection plane S1 and part of the transport target object W is at the first detection position P1. The fourth detection unit 24 detects an end portion W1 on the transport direction first side Y1 of the transport target object W disposed at the fourth detection position P4m. This makes it easy to give the fourth detection unit 24 a simple configuration, and as a result, it is easy to achieve a reduction in size and cost of the transport facility 10. The end portion W1 may be an edge on the transport direction first side Y1 of the transport target object W, or may be a region having a certain degree of spread in the transport direction Y including the edge. In the latter case, the above-mentioned spread is set to be at least greater than or equal to the maximum error in the stopping position in the transport direction Y of the transport target object W.

[0048] In this embodiment, the fourth detection position P4m is a work position where a work subject 40 performs work on the transport target object W. Examples of the work subject 40 include a worker and a work robot. Note that the fourth detection position P4m may also be a standby position where the transport target object W stands by. The fourth detection position P4m of the present embodiment is a stop position where the transport of the transport target object W stops, but the fourth detection position P4m may also be a position where work or standby is performed while the transport target object W is being transported.

[0049] In the present embodiment, the fourth detection unit 24 detects whether or not the transport target object W is on the detection line P4 along the width direction X, and thereby detects whether or not the transport target object W is at the fourth detection position P4m. The upper end of the detection line P4 is lower than the upper end of the detection plane S1. The upper end of the detection line P4 is lower than the center in the up-down direction Z of the detection plane S1. In the illustrated example, the detection line P4 is set on the transport direction first side Y1 with respect to the first

detection position P1.

[0050] The deactivation device 20 deactivates the entry detection unit 15 if at least either the first detection unit 21 or the second detection unit 22 detects the transport target object W and the fourth detection unit 24 does not detect the transport target object W. The deactivation device 20 activates the entry detection unit 15 if both of the first detection unit 21 and the second detection unit 22 do not detect the transport target object W and if both of the first detection unit 21 and the fourth detection unit 24 detect the transport target object W. In this way, even if the first detection unit 21 detects the transport target object W, the entry detection unit 15 is activated if the fourth detection unit 24 also detects the transport target object W. Accordingly, even if the entire transport target object W is not located on the transport direction first side Y1 with respect to the first detection position P1, the entry detection unit 15 is activated if the transport target object W is positioned at the fourth detection position P4m.

[0051] In this embodiment, the distance in the transport direction Y between the detection plane S1 and the detection line P4 is set to be longer than the dimension in the transport direction Y of the transport target object W. If there are a plurality of sizes of the transport target object W, then for the type of transport target object W with the longest dimension in the transport direction Y, the distance in the transport direction Y between the detection plane S1 and the detection line P4 is set to be longer than the dimension in the transport direction Y of the transport target object W.

[0052] The distance in the transport direction Y between the first detection position P1 and the detection line P4 in this embodiment is set to be less than or equal to the dimension in the transport direction Y of the transport target object W. If there are a plurality of sizes of the transport target object W, then for the type of transport target object W that has the shortest dimension in the transport direction Y, the distance in the transport direction Y between the first detection position P1 and the detection line P4 is set to be less than the dimension in the transport direction Y of the transport target object W.

[0053] The deactivation device 20 may be configured in such a manner that it is not capable of distinguishing between the above-mentioned foreign object and the transport target object W at the fourth detection position P4m. The upper end of the fourth detection position P4m in this embodiment is set lower than the upper end of the detection plane S1. The upper end of the fourth

detection position P4m is set lower than the upper ends of the transfer container, the transfer table, and the like, for example. The upper end of the fourth detection position P4m is set to, for example, half or less, a quarter or less, or a tenth or less of the width in the up-down direction Z of the detection plane S1. It is desirable that the fourth detection position P4m is as low as possible.

[0054] In this embodiment, if both of the second detection unit 22 and the fourth detection unit 24 detect the transport target object W, detection by the entry detection unit 15 in the detection plane S1 is activated. If all of the first detection unit 21, the second detection unit 22, and the fourth detection unit 24 detect the transport target object W, detection by the entry detection unit 15 in the detection plane S1 is activated.

[0055] Next, other embodiments of the transport facility 10 will be described.

[0056] (1) In the above-described embodiment, a configuration was described as an example in which the deactivation device 20 deactivates the entire detection plane S1 detected by the entry detection unit 15. However, there is no limitation to such an example, and for example, a configuration may be adopted in which a plurality of entry detection units 15 are provided in such a manner that one detection plane S1 can be divided into a plurality of parts, and the deactivation device 20 deactivates at least one of the entry detection units 15 so as to deactivate only a portion of the divided detection plane S1.

[0057] (2) In the above-described embodiment, a configuration was described as an example in which the third detection unit 23 detects the end portion W2 on the transport direction second side Y2 of the transport target object W at the standby position P3m. However, the present invention is not limited to such an example, and for example, a configuration may be adopted in which an image of the standby position P3m is captured from above, and the transport target object W at the standby position P3m is detected through image recognition.

[0058] (3) In the above-described embodiment, a configuration was described as an example in which the transfer device 30 stops operating if the activated entry detection unit 15 detects an object passing through the detection plane S1. However, there is no limitation to this example, and for example, a configuration may be adopted in which an alarm is sounded if the activated entry detection unit 15 detects an object. For example, all functions of the transfer device 30 may be stopped, or only some of the functions may be stopped.

For example, the travel speed of the travel section 32 of the transfer device 30 may be limited. For example, the transport facility 10 does not need to include the transfer device 30, and a worker or a picking robot may load or unload an article on or from the transport target object W at the standby position P3m.

[0059] (4) In the above-described embodiment, a configuration was described as an example in which the transfer device 30 is allowed to receive the transport target object W under a condition that the third detection unit 23 detects the transport target object W. However, there is no limitation to such an example, for example, the transfer device 30 may receive the transport target object W regardless of the detection by the third detection unit 23.

[0060] (5) In the above-described embodiment, a configuration was described as an example in which the transfer device 30 includes the fork 31 and the travel section 32. However, there is no limitation to this example, and for example, the transfer device 30 may be a transfer robot that does not include the travel section 32 and is fixed to the floor. For example, a belt conveyor, roller conveyor, pusher, or the like may be provided on the travel section 32 instead of the fork 31, and a belt conveyor, roller conveyor, pusher, or the like may be provided on the transport device 11 side to form the transfer device 30.

[0061] (6) In the above-described embodiment, a configuration was described as an example in which the standby position P3m is a position where the transport target object W stands by and where the transport target object W is received or delivered. However, the present invention is not limited to this example, and for example, the standby position P3m may be a work position where the work subject 40 performs work on the transport target object W. For example, the standby position P3m need not be a position where the transport target object W stands by, but may be a passing position or a branching position through which the transport target object W passes in order to stand by at another location.

[0062] (7) In the above-described embodiment, a configuration was described as an example in which detection by the entry detection unit 15 in the detection plane S1 is activated if both of the first detection unit 21 and the third detection unit 23 detect the transport target object W. However, there is no limitation to this example, and for example, detection performed by the entry detection unit 15 may be deactivated if both of the first detection unit 21 and the third detection unit 23 detect the transport target object W. For example, detection performed by the entry detection unit 15 may be deactivated if both of the first

detection unit 21 and the fourth detection unit 24 detect the transport target object W. For example, detection performed by the entry detection unit 15 may be deactivated if all of the first detection unit 21, the second detection unit 22, and the third detection unit 23 detect the transport target object W. For example, detection performed by the entry detection unit 15 may be deactivated if all of the first detection unit 21, the second detection unit 22, and the fourth detection unit 24 detect the transport target object W.

[0063] (8) Note that the configurations disclosed in the above-described embodiments can also be applied in combination with configurations disclosed in other embodiments as long as no contradiction arises. Regarding other configurations as well, the embodiments disclosed in this specification are merely examples in all respects. Accordingly, various modifications can be made as appropriate within the scope of the present disclosure.

[0064] The transport facility according to the present disclosure will be described below.

[0065] In one aspect, the transport facility includes: a transport device configured to transport a transport target object along a predetermined transport direction; an entry detection unit configured to detect an object passing through a detection plane set in such a manner as to intersect a movement route of the transport target object transportable by the transport device; and a deactivation device configured to deactivate the entry detection unit while the transport target object is passing through the detection plane, the transport facility being characterized in that the deactivation device includes: a first detection unit configured to detect the transport target object at a first detection position set on a transport direction first side with respect to the detection plane, the transport direction first side being one side in the transport direction; a second detection unit configured to detect the transport target object at a second detection position set on a transport direction second side with respect to the detection plane, the transport direction second side being another side in the transport direction; and a third detection unit configured to detect that the transport target object is at a standby position set on the transport direction second side with respect to the detection plane, the standby position is set in such a manner that the entire transport target object is on the transport direction second side with respect to the detection plane and part of the transport target object is at the second detection position, the deactivation device deactivates the entry detection unit if at least either the

first detection unit or the second detection unit detects the transport target object and the third detection unit does not detect the transport target object, and the deactivation device activates the entry detection unit if both of the first detection unit and the second detection unit do not detect the transport target object and if both of the second detection unit and the third detection unit detect the transport target object.

[0066] According to this configuration, even if the second detection unit detects the transport target object, the entry detection unit is activated if the third detection unit also detects the transport target object. Accordingly, even if the entire transport target object is not on the transport direction second side with respect to the second detection position, the entry detection unit is activated in response to the transport target object being at the standby position. For this reason, the entry detection unit can be quickly activated after the transport target object has passed. In addition, compared to setting the standby position in such a manner that the entire transport target object is on the transport direction second side with respect to the second detection position, it is easier to shorten the distance from the detection plane of the entry detection unit to the end portion on the transport direction second side at the standby position. Therefore, it is easy to reduce the size in the transport direction of the transport facility including the entry detection unit.

[0067] In one aspect, the third detection unit is configured to detect an end portion on the transport direction second side of the transport target object at the standby position.

[0068] According to this configuration, the third detection unit can easily be given a simple configuration, and as a result, it is easy to achieve a reduction in size and cost of the transport facility.

[0069] In one aspect, the transport facility includes a transfer device configured to transfer the transport target object, in which the standby position is a position where at least either reception or delivery of the transport target object is performed through operation of the transfer device, and the transfer device is configured to stop the operation if the activated entry detection unit detects the object passing through the detection plane.

[0070] According to this configuration, the operation of the transfer device can be stopped in response to a human body, a foreign object, or the like other than the transport target object entering on the transport direction second side with respect to the detection plane of the entry detection unit. This makes it easier

to ensure the safety of people and to avoid breakdown or the like of the transfer device due to, for example, a foreign object. Also, according to this configuration, the entry detection unit is activated while the transport target object is at the standby position, and therefore the entry detection unit can function appropriately.

[0071] In one aspect, the transfer device is allowed to receive the transport target object under a condition that the third detection unit detects the transport target object.

[0072] According to this configuration, since there is no need to separately provide a detection unit that detects that the transport target object is at a position where the transport target object can be received by the transfer device, it is easy to suppress an increase in cost caused by providing the third detection unit.

Reference Signs List

[0073]

10	Transport facility
11	Transport device
15	Entry detection unit
20	Deactivation device
21	First detection unit
22	Second detection unit
23	Third detection unit
30	Transfer device
P1	First detection position
P2	Second detection position
P3m	Standby position
S1	Detection plane
W	Transport target object

What Is Claimed Is:

1. A transport facility comprising:

a transport device configured to transport a transport target object along a predetermined transport direction;

an entry detection unit configured to detect an object passing through a detection plane set in such a manner as to intersect a movement route of the transport target object transportable by the transport device; and

a deactivation device configured to deactivate the entry detection unit while the transport target object is passing through the detection plane,

the transport facility being characterized in that

the deactivation device includes:

a first detection unit configured to detect the transport target object at a first detection position set on a transport direction first side with respect to the detection plane, the transport direction first side being one side in the transport direction;

a second detection unit configured to detect the transport target object at a second detection position set on a transport direction second side with respect to the detection plane, the transport direction second side being another side in the transport direction; and

a third detection unit configured to detect that the transport target object is at a standby position set on the transport direction second side with respect to the detection plane,

the standby position is set in such a manner that the entire transport target object is on the transport direction second side with respect to the detection plane and part of the transport target object is at the second detection position,

the deactivation device deactivates the entry detection unit if at least either the first detection unit or the second detection unit detects the transport target object and the third detection unit does not detect the transport target object, and

the deactivation device activates the entry detection unit if both of the first detection unit and the second detection unit do not detect the transport target object and if both of the second detection unit and the third detection unit detect the transport target object.

2. The transport facility according to claim 1,

wherein the third detection unit is configured to detect an end portion on the transport direction second side of the transport target object at the standby position.

3. The transport facility according to claim 1 or 2, further comprising

a transfer device configured to transfer the transport target object,

wherein the standby position is a position where at least either reception or delivery of the transport target object is performed through operation of the transfer device, and

the transfer device is configured to stop the operation if the activated entry detection unit detects the object passing through the detection plane.

4. The transport facility according to claim 3,

wherein the transfer device is allowed to receive the transport target object under a condition that the third detection unit detects the transport target object.