[0007] Generally speaking, spacing between adjacent substrates stored in the rack 84 is small for the purpose of densely storing the substrates and increasing a storable number of substrates relative to the installation area of the rack 84. On the other hand, the thickness of the end effector 85 is large in order for the end effector 85 to have a function of holding each of the substrates 81 to 83 in a sandwiching manner and to have strength. Therefore, when an attempt is made to insert the end effector 85 between two substrates 81 and 82 (or substrates 82 and 83), the end effector 85 cannot be inserted, or even if the end effector 85 can be inserted between the two substrates, there is a risk that the end effector 85 comes into contact with, for example, the substrates 81 to 83 and thereby the substrates become damaged. For this reason, it is necessary to significantly increase spacing among the substrates stored in the rack 84, which, however, results in an increase in the installation area of the rack 84.

[0008] Such a problem occurs not only when the substrates 81 to 83 are carried out of the rack 84 but also when the substrates 81 to 83 are carried into the rack 84. That is, there is no problem when the substrates 81 to 83 are carried into the rack 84 sequentially in the arrangement direction; however, in a case where two substrates 81 and 83 are carried into the rack 84 first and thereafter the substrate 82 is carried into the rack 84, there occurs a problem that is similar to one occurring at the time of carrying substrates out of the rack 84. In order to eliminate the problem, it is again necessary to significantly increase spacing among the substrates 81 to 83 stored in the rack 84, which results in an increase in the installation area of the rack 84.

[0009] Embodiments~~In view of the above, an object~~ of the present invention ~~is to~~ provide a plate-shaped member transfer facility which is capable of, even if plate-shaped members are densely stored in a rack with narrow spacing among them, additionally carrying a plate-shaped member into between two spaced apart plate-shaped members in the rack

and carrying out of the rack any plate-shaped member from among the plurality of plate-shaped members arranged in the rack, without inserting an end effector into the substrate container of the rack.

Solution to Problem

~~[0010] A plate-shaped member transfer facility according to the present invention includes: a rack configured to store a plurality of plate-shaped members, which are supported by a support so as to be raised and extend in a conveying direction, such that the plurality of plate-shaped members stored in the rack are arranged in an arrangement direction crossing the conveying direction, the rack being configured to allow each of the plurality of plate-shaped members to be carried into and out of the rack in the conveying direction through an insertion opening; and a plate-shaped member transfer mechanism configured to carry each plate-shaped member into or out of the rack in the conveying direction through the insertion opening. The plate-shaped member transfer mechanism includes: a flip rotation mechanism positioned in track-side space facing the insertion opening of the rack, the flip rotation mechanism including a flip configured to support the plate-shaped member and be rotatable around a rotation axis parallel to the conveying direction, the flip rotation mechanism being configured to rotate the flip to raise or lay down the plate-shaped member; a conveyance mechanism extending in the conveying direction and including a sender configured to send, in the conveying direction, the plate-shaped member that has been raised by the flip rotation mechanism; and a moving mechanism configured to move the flip rotation mechanism and the conveyance mechanism in the arrangement direction. The conveyance mechanism is configured to transfer the plate-shaped member in the raised state between the track-side space in which the flip rotation mechanism is positioned and the rack by means of the sender.~~

[0010] According to an aspect, there is provided a plate-shaped member transfer facility comprising: a rack configured to store a plurality of plate-shaped members, which are supported by a support so as to be raised and extend in a conveying direction, such that the plurality of plate-shaped members stored in the rack are arranged in an arrangement direction crossing the conveying direction, the rack being configured to allow each of the plurality of plate-shaped members to be carried into and out of the rack in the conveying direction through an insertion opening; and a plate-shaped member transfer mechanism configured to carry each plate-shaped member into or out of the rack in the conveying direction through the insertion opening, wherein the plate-shaped member transfer mechanism includes: a flip rotation mechanism positioned in track-side space facing the insertion opening of the rack, the flip rotation mechanism including a flip configured to support the plate-shaped member and be rotatable around a rotation axis parallel to the conveying direction, the flip rotation mechanism being configured to rotate the flip such that the plate-shaped member on a conveyor is placed on the flip and raised, or rotate the flip such that the plate-shaped member on the flip is laid down and placed on the conveyor; a conveyance mechanism extending in the conveying direction and including a sender configured to send, in the conveying direction, the plate-shaped member that has been raised by the flip rotation mechanism; and a moving mechanism configured to move the flip rotation mechanism and the conveyance mechanism in the arrangement direction, and the conveyance mechanism is configured to transfer the plate-shaped member in the raised state between the track-side space and the rack by means of the sender.

[0011] According to embodiments of the present invention, the plate-shaped member transfer mechanism can raise the plate-shaped member supported by the flip, by rotating the flip by means of the flip rotation mechanism. Further, by moving the flip rotation mechanism and the conveyance mechanism to a given position of the rack in the arrangement direction and moving the plate-shaped member in the raised state in the conveying direction by means of the sender, the plate-shaped member transfer mechanism can carry the plate-shaped member in the track-side space into the rack through the insertion opening, thereby storing the plate-shaped member in the rack. Thus, the plate-shaped member transfer mechanism can raise the plate-shaped member from a horizontal state, and insert the plate-shaped member into the rack for storage. It should be noted that, in the present invention, the term "horizontal state" includes not only a state where the plate-shaped member is in a truly horizontal orientation but also a state where the plate-shaped member is slightly inclined from the truly horizontal orientation.

[0012] Further, according to embodiments of the present invention, the plate-shaped member stored in the rack can be moved in the conveying direction and returned to the track-side space, by moving the flip rotation mechanism and the conveyance mechanism to the given position of the rack and then driving the sender. Then, after the plate-shaped member returned to the track-side space has moved onto the flip which serves as an end effector, the plate-shaped member can be caused to be in the horizontal state by laying down the plate-shaped member through rotation of the flip by means of the flip rotation mechanism. Thus, the plate-shaped member transfer mechanism can retrieve the plate-shaped member stored in the rack in the raised state from the rack and then cause the plate-shaped member to be in the horizontal state.

[0013] As described above, according to embodiments of the present invention, the plate-shaped

member is moved and transferred in the conveying direction by means of the sender. Therefore, it is not necessary to directly insert the conveyance mechanism or the flip into the rack at the time of carrying the plate-shaped member into or out of the rack. Accordingly, unlike conventional art, even if the plate-shaped members are densely stored with narrow spacing among them in the arrangement direction in order to reduce the installation area of the facility, a risk that the end effector comes into contact with a stored plate-shaped member to cause damage to the plate-shaped member is eliminated in the following situations: a situation where a plate-shaped member is additionally carried into between two plate-shaped members; and a situation where a plate-shaped member at a given position is carried out from among a plurality of arranged plate-shaped members. Therefore, the plate-shaped members can be carried into and out of the rack securely and speedily.

[0014] An embodiment of the~~The above~~ invention preferably includes: a track-side sending part serving as the sender; a track-side conveyance mechanism disposed in the track-side space; a rack-side sending part serving as the sender; and a rack-side conveyance mechanism disposed at the rack.

[0015] According to the above configuration, the plate-shaped member can be transferred between the track-side and rack-side conveyance mechanisms, by moving the track-side conveyance mechanism to the front of the rack-side conveyance mechanism at a storage position by means of the moving mechanism and then driving the track-side and rack-side sending parts. Therefore, it is not necessary to slide and insert the conveyance mechanism into the rack, and accordingly, a time for sliding and inserting the conveyance mechanism into the rack can be eliminated, which makes it possible to reduce the time for carrying each plate-shaped member into or out of the rack.

[0016] In an embodiment of the above invention, the track-side conveyance mechanism and the rack-side

conveyance mechanism are preferably configured to transfer the plate-shaped member in the raised state between the track-side sending part and the rack-side sending part.

[0017] According to the above configuration, the plate-shaped member can be transferred between the track-side conveyance mechanism and the rack-side conveyance mechanism. Therefore, the plate-shaped member can be inserted into the rack without sliding and inserting the track-side and rack-side conveyance mechanisms into the rack.

[0018] In an embodiment of the above invention, the moving mechanism preferably includes: a track-side moving mechanism configured to move the track-side conveyance mechanism in the arrangement direction; and a rack-side moving mechanism configured to move the rack-side conveyance mechanism in the arrangement direction.

[0019] According to the above configuration, it is not necessary to provide the rack-side conveyance mechanism for each storage position of the rack, which realizes reduction in the number of components. Moreover, for example, the track-side conveyance mechanism and the rack-side conveyance mechanism may be moved independently of each other to respective positions, and thereby the track-side conveyance mechanism and the rack-side conveyance mechanism can be operated at the respective different positions, and the track-side conveyance mechanism and the rack-side conveyance mechanism can perform respective different operations in parallel. In this manner, the carry-in time and carry-out time can be reduced.

[0020] In an embodiment of the above invention, the track-side moving mechanism is preferably configured to move the track-side conveyance mechanism and the flip rotation mechanism together in the arrangement direction.

[0021] According to the above configuration, the flip rotation mechanism and the track-side conveyance mechanism are moved together. Therefore, positional alignment between these mechanisms is not necessary, and an operating program for each

mechanism can be made simple. In addition, the number of components of the moving mechanism can be reduced, and the manufacturing cost can be reduced, accordingly.

[0022] In an embodiment of the above invention, it is preferred that the rack includes a plurality of support members; the plurality of support members are arranged to be spaced apart from each other in the conveying direction, and are configured to support the plate-shaped member at upper surfaces of the respective support members; the rack-side sending part includes a rack-side driving member configured to send the plate-shaped member by moving the plate-shaped member on a face of the rack-side sending part; and the rack-side conveyance mechanism is configured to lift and lower the rack-side sending part between a rack-side conveyance position and a rack-side standby position, the rack-side conveyance position being a position at which the face of the rack-side sending part is positioned higher than the upper surfaces of the support members, the rack-side standby position being a position at which the face of the rack-side sending part is positioned lower than the upper surfaces of the support members.

[0023] According to the above configuration, by lifting the rack-side sending part to the rack-side conveyance position, the plate-shaped member can be moved smoothly within the rack in the left-right direction without causing the plate-shaped member to come into contact with the support members, and the plate-shaped member can be transferred smoothly between the rack and the track-side space. Also, by lowering the rack-side sending part to the rack-side standby position, the plate-shaped member placed on the face of the rack-side sending part can be lowered onto the support members and stored in the rack such that the plate-shaped member is away from the face of the rack-side sending part. In this manner, damage to the plate-shaped member can be suppressed during the storing work.

[0024] In an embodiment of the above invention, it is preferred that the track-side sending part includes a

track-side driving member configured to send the plate-shaped member by moving the plate-shaped member on a face of the track-side sending part, and the track-side conveyance mechanism is configured to lift and lower the track-side sending part between a track-side conveyance position and a track-side standby position, the track-side conveyance position being a position at which the face of the track-side sending part is positioned at a height that is substantially the same as a height of the face of the rack-side sending part when the rack-side sending part is at the rack-side conveyance position, the track-side standby position being a position at which the face of the track-side sending part is positioned lower than the upper surfaces of the support members.

[0025] According to the above configuration, by lifting the track-side sending part to the conveyance position, the plate-shaped member can be moved smoothly within the rack in the left-right direction without causing the plate-shaped member to come into contact with the support members, and the plate-shaped member can be transferred smoothly between the rack and the track-side space. In this manner, damage to the plate-shaped member can be suppressed during the storing work. Since the track-side sending part can be lowered to the standby position, the track-side sending part can be removed from the plate-shaped member in the middle of inserting the plate-shaped member into the rack and the track-side sending part can be moved to the front of a next storage position before the rack-side conveyance mechanism is moved to the next storage position. In this manner, the time for carrying-out of the plate-shaped member can be reduced.

[0026] It is preferred that an embodiment of the above invention further includes a position detection sensor configured to detect whether the track-side sending part and the rack-side sending part are aligned in the conveying direction, and the track-side sending part and the

rack-side sending part are configured to perform transfer of the plate-shaped member when the position detection sensor detects that the track-side sending part and the rack-side sending part are aligned in the conveying direction.

[0027] According to the above configuration, failing in transferring the plate-shaped member between the track-side sending part and the rack-side sending part to cause damage to the plate-shaped member can be prevented.

[0028] In an embodiment of the above invention, the flip rotation mechanism is preferably configured to rotate the flip to lay down the plate-shaped member supported by the flip when the flip rotation mechanism is moved by the moving mechanism.

[0029] According to the above configuration, the flip rotation mechanism is moved with the plate-shaped member laid down. In this manner, the amount of wind that occurs when the plate-shaped member is moved can be reduced. The wind occurring when the plate-shaped member is moved causes the plate-shaped members arranged and stored in the rack to flutter, causing a risk that the plate-shaped members become damaged. Since the present invention is capable of suppressing the wind from occurring, such fluttering of the plate-shaped members can be suppressed and thereby damage to the plate-shaped members can be prevented.

[0030] In an embodiment of the above invention, it is preferred that the flip includes a plurality of rollable spherical rollers, and is configured to support a rear surface of the plate-shaped member by means of the plurality of spherical rollers.

[0031] According to the above configuration, the plate-shaped member is supported by the rollable spherical rollers. Therefore, when the plate-shaped member is moved by the sender, the plate-shaped member may be slidingly moved while being leaned against the flip, and even in such a manner, the plate-shaped member can be moved smoothly. Therefore, when the plate-shaped member is transferred between the

rack and the flip, the plate-shaped member can be slidingly moved along the flip and the flip prevents the plate-shaped member from falling over.

[0032] The above aspect, configurations~~object, other objects~~, features, and advantages of the present invention will be made clear by the following detailed description of preferred embodiments with reference to the accompanying drawings.

Advantageous Effects of Invention

[0033] According to embodiments of the present invention, even if plate-shaped members are densely stored in a rack with narrow spacing among them, a plate-shaped member can be additionally carried into between two spaced apart plate-shaped members in the rack, and also, any plate-shaped member among the plurality of plate-shaped members arranged in the rack can be carried out of the rack, without inserting an end effector into the substrate container of the rack.

Brief Description of Drawings

[0034] [Fig. 1] Fig. 1 is a plan view showing an overall stocker facility according to an embodiment of the present invention.

[Fig. 2] Fig. 2 is a perspective view showing in an enlarged manner a track robot and racks included in the stocker facility shown in Fig. 1.

[Fig. 3] Fig. 3 is a perspective view showing a state where the plurality of racks included in the stocker facility shown in Fig. 2 are partially removed.

[Fig. 4] Fig. 4 is a front view of the stocker facility shown in Fig. 3.

[Fig. 5] Fig. 5 is a block diagram showing a control system configuration of the stocker facility shown in Fig. 1.

[Fig. 6] Fig. 6 is a perspective view showing in an enlarged manner the track