LOAD PORT AND TRANSFER APPARATUS

TECHNICAL FIELD

[0001] The present disclosure relates to a load port and a transfer apparatus.

BACKGROUND

[0002] Patent Document 1 discloses an equipment front-end module (EFEM) device for delivering a transfer target object to and from a processing apparatus using a transfer robot provided inside a housing.

[Prior Art Document]

[0003] Patent Document

Patent Document 1: Japanese Laid-Open Publication No. 2023-22095

[0004] A semiconductor manufacturing apparatus is provided with a processing apparatus for processing substrates and a transfer apparatus. The transfer apparatus includes an EFEM device that uses a transfer robot installed inside a housing to deliver transfer target objects such as substrates and consumable components (e.g., focus rings) to and from the processing apparatus, and a load port connected to the EFEM device and on which containers for storing substrates, consumable components and the like are mounted.

[0005] In the related art, when connecting a load port to an EFEM device, a level adjuster for the load port is provided on a rear side of the load port, that is, on an EFEM device side. In such a case, in a case where the load port is attached to the EFEM device, the level adjuster cannot be accessed from a load port side. Therefore, for example, when a level of the load port does not meet required specifications, the load port is removed from the EFEM device, and then the level of the load port is adjusted using the level adjuster. This process is repeated until the level of the load port meets the specifications. Consequently, connecting the load port to the EFEM device requires a large number of operational processes. Therefore, the technique of the present disclosure provides a load port and a transfer apparatus that can efficiently adjust the level of the

load port when connecting the load port to a housing that accommodates a transfer robot.

SUMMARY

[0006] According to one embodiment of the present disclosure, there is provided a load port including a mounting surface on which a container for accommodating substrates is mounted, and configured to be connectable to a housing for accommodating a transfer robot for transferring the substrates, the load port including a connector configured to connect the load port to the housing, wherein the connector is provided with an access portion to an adjuster for adjusting a level of the load port relative to the housing, and a cutout portion into which a positioning pin provided in the housing is locked is provided at a central portion of the connector in a width direction.

[0007] According to the present disclosure, it is possible to efficiently perform a level adjustment of a load port when connecting the load port to a housing that accommodates a transfer robot.

BRIEF DESCRIPTION OF DRAWINGS

[0008] FIG. 1 is a plan view schematically showing a wafer processing system provided with a transfer apparatus according to a first embodiment.

FIG. 2 is a cross-sectional side view of the transfer apparatus, showing a state in which a door is closed.

FIG. 3 is a cross-sectional side view of the transfer apparatus, showing a state in which the door is open.

FIG. 4 is a cross-sectional plan view of the transfer apparatus.

FIG. 5 is a cross-sectional view of a load port.

FIG. 6 is a front view of the load port.

FIG. 7 is a front perspective view of the load port with a protective cover removed.

FIG. 8 is a rear perspective view of the load port with the protective cover removed.

FIG. 9 is a front view of the load port with the protective cover removed.

FIG. 10 is a rear view of the load port with the protective cover removed.

FIG. 11 is a partially enlarged view of a cutout portion of the load port.

FIG. 12 is a front view of an adjuster of a main body.

FIG. 13 is a cross-sectional view of the adjuster of the main body.

FIG. 14 is a perspective view of the transfer robot.

FIGS. 15A to 15E are explanatory diagrams showing states in which the load port is being connected to a housing.

FIG. 16 is an explanatory diagram showing a state in which a level of the load port in an apparatus depth direction is adjusted.

FIG. 17 is an explanatory diagram showing a state in which a level of the load port in an apparatus width direction is adjusted.

FIG. 18 is a front view of an adjuster of a load port according to a second embodiment.

FIG. 19 is a cross-sectional view of the adjuster of the load port according to the second embodiment.

DETAILED DESCRIPTION

[0009] A load port and a transfer apparatus according to this embodiment will be described below with reference to the drawings. In the present specification and the drawings, elements having substantially the same functional configurations are denoted by the same reference numerals, and redundant descriptions thereof will be omitted. In the drawings, an X direction is an apparatus width direction, which is a direction in which a plurality of load ports 101 described later is disposed side by side. A Y direction is an apparatus depth direction, which is a direction in which a front wall 121 and a rear wall 122 of a main body 102 of a transfer apparatus 20 to be described later are disposed side by side. A negative side of the Y direction is a front side, and a positive side of the Y direction is a rear side. A Z direction is a vertical direction.

(First Embodiment)

<Wafer Processing System 1>

[0010] FIG. 1 is a plan view schematically showing a wafer processing system 1 provided with a transfer apparatus 20 according to a first embodiment.

[0011] As shown in FIG. 1, the wafer processing system 1 includes a processing apparatus 10 and a transfer apparatus 20. The processing apparatus 10 and the transfer apparatus 20 are installed adjacent to each other.

[0012] The processing apparatus 10 is an apparatus for processing a semiconductor wafer (hereinafter referred to as "wafer") W as a substrate, and includes, for example, a processing module 30 and a vacuum transfer module 40.

[0013] A plurality of processing modules 30 is provided, for example. Each processing module 30 processes the wafer W under a reduced pressure atmosphere, that is, a vacuum atmosphere. Processes performed by the processing module 30 includes, for example, a film formation processing, an etching process, an impurity diffusion process, and the like. Further, each processing module 30 includes a vacuum processing chamber 31 in which the above-mentioned processes are performed on the wafer W under the vacuum atmosphere. Each vacuum processing chamber 31 is connected to a vacuum transfer chamber 41 of the vacuum transfer module 40, which will be described later, via a gate valve G1.

[0014] The vacuum transfer module 40 includes the vacuum transfer chamber 41, an interior of which is maintained in the vacuum atmosphere. The vacuum transfer chamber 41 is configured to be sealable and is formed to have a substantially polygonal shape (a quadrilateral shape in the example of the drawings) in a plan view. The vacuum transfer chamber 41, which is connected to the respective processing modules 30, is also connected to a load-lock module 50 to be described later. Specifically, the vacuum transfer chamber 41 is connected to a load-lock chamber 51 of the load-lock module 50 described later via a gate valve (not shown). A transferer 42 for transferring the wafer W is provided inside the vacuum transfer chamber 41. The vacuum transfer module 40 uses the transferer 42 to load and unload the wafer W between the vacuum processing chambers 31 and the load-lock chambers 51 from the vacuum transfer chamber 41.

[0015] Further, the processing apparatus 10 is provided with the load-lock modules 50 at an end at a transfer apparatus 20 side. For example, a plurality of load-lock modules 50 is provided. Each load-lock module 50 is used for delivering the wafer W between a space under a vacuum atmosphere and a space under a non-reduced pressure atmosphere, that is, an atmospheric pressure atmosphere. Each load-lock module 50 includes a load-lock chamber 51 configured such that an interior thereof can be switched between the atmospheric pressure atmosphere and the vacuum atmosphere. The load-lock chamber 51 is provided so as to connect the vacuum transfer module 40 and the transfer apparatus 20.

[0016] The transfer apparatus 20 is an apparatus for loading and unloading the wafer W into and from the processing apparatus 10. Specifically, the transfer apparatus 20 is configured to deliver the wafer W between a front-opening unified pod (FOUP) 900, which is a container for accommodating a plurality of wafers W, and the processing apparatus 10 without exposing the wafers W to an external atmosphere. The transfer apparatus 20 includes a load port 101 and a main body 102, which is also called an EFEM device.

[0017] The load port 101 is configured to accommodate the FOUP 900 and is provided along the apparatus width direction (X direction) in plurality (five in the example of the drawing).

[0018] The main body 102 is disposed on a rear side of the load port 101 (positive side in the Y direction). Specifically, the main body 102 is disposed adjacent to the load port 101. The load-lock chamber 51 is connected to the main body 102. Specifically, for example, the load-lock chamber 51 is connected to a rear side of the main body 102 (positive side in the Y direction). An interior of the main body 102 is maintained at the atmospheric pressure atmosphere. A transfer robot 110 for supporting and transferring the wafer W is provided inside the main body 102. The transfer robot 110 can transfer the wafer W between the FOUP 900 mounted on the load port 101 and the load-lock chamber 51, or the like.

[0019] The wafer processing system 1 described above is provided with at least one controller C. The controller C processes computer-executable instructions that cause the wafer processing system 1 to perform the various processes described in the present specification. The controller C may be configured to control individual components of the wafer processing system 1 to

perform the various processes described herein. In one embodiment, a part or the entirety of the controller C may be included in the wafer processing system 1. The controller C may include a processor, a memory, and a communication interface. The controller C is implemented, for example, by a computer. The processor may be configured to read a program that provides a logic or routine for enabling various control operations, and to perform the various control operations by executing the read program. The program may be stored in the memory in advance, or may be obtained via a medium when needed. The obtained program is stored in the memory and is read from the memory and executed by the processor. The medium may be any computer-readable storage medium, or may be a communication line connected to the communication interface. The storage medium may be transitory or non-transitory. The processor may be a central processing unit (CPU), or may be one or more circuits. The memory may include a random access memory (RAM), a read only memory (ROM), a hard disk drive (HDD), a solid state drive (SSD), or a combination thereof. The communication interface may communicate with the wafer processing system 1 via a communication line such as a local area network (LAN) or the like.

<Wafer Processing>

[0020] Next, wafer processing performed by the wafer processing system 1 configured as described above will be described. The following wafer processing will be carried out under the control of the controller C.

[0021] First, the wafer W is taken out from the FOUP 900 by the transfer robot 110 and loaded into the load-lock chamber 51 of the load-lock module 50. Subsequently, the load-lock chamber 51 is sealed and kept in a vacuum atmosphere.

[0022] Subsequently, the gate valve (not shown) on a vacuum transfer chamber 41 side of the load-lock chamber 51 is opened, and the wafer W is unloaded from the load-lock chamber 51 to the vacuum transfer chamber 41 by the transferer 42.

[0023] Next, after the gate valve is closed, the gate valve G1 corresponding to the processing module 30 that performs a desired processing is opened. Subsequently, the wafer W is loaded

into the vacuum processing chamber 31 of the target processing module 30 by the transferer 42. Thereafter, the gate valve G1 is closed, and the desired processing is performed on the wafer W in the processing module 30.

[0024] After the desired processing is completed, the wafer W is returned from the vacuum processing chamber 31 to the FOUP 900 in the reverse order of when the wafer W is loaded into the vacuum processing chamber 31 from the FOUP 900. This completes a sequence of the wafer processing.

<Transfer Apparatus 20>

[0025] FIGS. 2 and 3 are cross-sectional side views of the transfer apparatus 20. FIG. 2 shows a state in which a door 190 (described later) is closed, and FIG. 3 shows a state in which the door 190 (described later) is open. FIG. 4 is a cross-sectional plan view of the transfer apparatus 20. FIGS. 5 and 6 are a cross-sectional view and a front view of the load port 101, respectively. FIGS. 7 to 10 are a front perspective view, a rear perspective view, a front view, and a rear view of the load port 101 with a protective cover removed, respectively. FIG. 11 is a partially enlarged view of a cutout portion 144 (described later) of the load port 101. FIGS. 12 and 13 are a front view and a cross-sectional view of an adjuster 220 of a main body 102 (described later), respectively. FIG. 14 is a perspective view of the transfer robot 110.

[0026] As shown in FIGS. 2 to 4, the transfer apparatus 20 includes the load port 101 and the main body 102 described above, and further includes a lower accommodation portion 103 for accommodating various components.

[0027] The main body 102 includes a housing 120 having a substantially rectangular parallelepiped shape. The housing 120 includes a front wall 121, a rear wall 122, a pair of side walls 123, a bottom wall 124, and a ceiling wall 125.

[0028] The front wall 121 extends in the apparatus width direction (X direction) in a plan view on the front side (negative side in the Y direction) of the main body 102. The load port 101 and the lower accommodation portion 103 are connected to the front wall 121. The lower accommodation portion 103 is disposed below the load port 101. The front wall 121 is

provided with an opening 126 in which the load port 101 is provided. The front wall 121 is also provided with an opening 127 which is a load/unload port for the wafers W with respect to the lower accommodation portion 103.

[0029] The rear wall 122 faces the front wall 121 in the apparatus depth direction and extends in the apparatus width direction in a plan view on the rear side of the main body 102 (positive side in the Y direction). The load-lock module 50 is connected to the rear wall 122. An opening 128 is provided in the rear wall 122 at a position corresponding to the load-lock chamber 51. The opening 128 is provided in the rear wall 122 at a vertical position that is substantially the same as a delivery position inside the load-lock chamber 51. The delivery position inside the load-lock chamber 51 is a vertical position of the wafer W when the wafer W is delivered between the load-lock chamber 51 and the transfer robot 110.

[0030] The pair of side walls 123 face each other in the apparatus width direction and extend in the apparatus depth direction in a plan view. The bottom wall 124 and the ceiling wall 125 face each other in the vertical direction and extend along a horizontal direction (X direction and Y direction).

[0031] The main body 102 has an internal space defined by the front wall 121, the rear wall 122, the side walls 123, the bottom wall 124, and the ceiling wall 125. The internal space is divided vertically into a lower transfer space S1 and an upper accommodation space S2 by a partition wall 129 provided between the bottom wall 124 and the ceiling wall 125. As will be described later, a purified gas is supplied from the accommodation space S2 to the transfer space S1, and an opening 130 for supplying the gas is provided in the partition wall 129.

[0032] The lower accommodation portion 103 is constituted by a plurality of accommodation portions stacked in the vertical direction, and includes, for example, an upper first accommodation portion 103A and a lower second accommodation portion 103B.

[0033] The first accommodation portion 103A accommodates a function expansion module constituted by at least one selected from the group of a measurement module for performing measurements on a film formed on the wafer W, an inspection module for inspecting defects in the wafer W, or an alignment module for adjusting an orientation position of the wafer W. The

aforementioned opening 127 is provided in the front wall 121 of the main body 102 at a position corresponding to the first accommodation portion 103A.

[0034] The measurement module or the inspection module accommodated in the first accommodation portion 103A includes, for example, a module including a stage (not shown) on which a wafer W is mounted and which is configured to be movable in the horizontal direction, and an imager (not shown) for imaging the wafer W that is mounted on the stage and moving in the horizontal direction. Alternatively, or additionally, the measurement module or the inspection module may include a module in which the imager (not shown) images the wafer W, which is supported by the transfer robot 110 that has been inserted via the opening 127 and which is moving in the horizontal direction.

[0035] The second accommodation portion 103B accommodates electrical components including a power supply. No opening such as the opening 127 is provided in the second accommodation portion 103B. In other words, between the first accommodation portion 103A and the second accommodation portion 103B, only the upper accommodation portion 103A has an opening that serves as a load/unload port for the wafer W.

[0036] As shown in FIGS. 5 to 10, the load port 101 includes a connecting plate 140 as a connector that connects the load port 101 to the housing 120 of the main body 102. The connecting plate 140 is attached to a front surface of the front wall 121 so as to cover the opening 126 when the connecting plate 140 is connected to the housing 120.

[0037] The connecting plate 140 is configured such that an upper connecting plate 140A and a lower connecting plate 140B are integrated. The upper connecting plate 140A protrudes and extends above the mounting portion 150, which will be described later. The lower connecting plate 140B extends so as to cover a rear surface of the mounting portion 150, which will be described later.

[0038] Upper corners of the upper connecting plate 140A are provided with a pair of openings 141 that serve as access portions. When the connecting plate 140 is connected to the housing 120, an adjustment screw portions 222 of an adjuster 220, which will be described later, are exposed from the respective openings 141 when viewed on the front side.

[0039] Further, in a central portion of the upper connecting plate 140A, an opening 142 which serves as a load/unload port for loading and unloading wafers W into and from the FOUP 900 is provided below the pair of openings 141.

[0040] The lower connecting plate 140B is provided with slits 143 extending in the vertical direction to raise and lower an arm 202 of a mover 200, which will be described later.

[0041] Further, a cutout portion 144 is provided at a lower end of the lower connecting plate 140B in the central portion in the apparatus width direction (X direction). A positioning pin 230 described later, which is provided on the front wall 121 of the main body 102, is locked into the cutout portion 144. As shown in FIG. 11, an upper portion of the cutout portion 144 constitutes a positioning surface 144a for setting a position of the load port 101 in the apparatus width direction. In addition, the cutout portion 144 has a tapered shape widening from top to bottom.

[0042] As described later, when connecting the load port 101 to the housing 120, the positioning pin 230 is locked into the cutout portion 144, and then the load port 101 is rotated using the positioning pin 230 as a pivot point. This adjusts a level of the load port 101 in the apparatus width direction (X direction).

[0043] Fixing screw holes 145 are provided at four corners of the connecting plate 140. That is, a pair of fixing screw holes 145 are provided at the upper corners of the upper connecting plate 140A, and a pair of fixing screw holes 145 are provided at lower corners of the lower connecting plate 140B. Further, at the upper corners of the upper connecting plate 140A, the pair of fixing screw holes 145 are provided outward of the pair of openings 141 in the apparatus width direction.

[0044] Fixing screws 146 to be described later are inserted through and screwed into the fixing screw holes 145. The fixing screws 146 fasten the connecting plate 140 and the front wall 121 of the main body 102 via the adjuster 220 to be described later. The fixing screw holes 145 are configured to be larger than the fixing screws 146, and gaps are formed between the fixing screw holes 145 and the fixing screws 146.

[0045] The load port 101 includes a mounting portion 150. The mounting portion 150 includes

an isolation cover 160 and a main cover 161.

[0046] An accommodation space S3, which accommodates the mover 200 to be described later, is defined by the isolation cover 160 and a front surface of the connecting plate 140. Further, the isolation cover 160 covers the slits 143 from the front side. By providing the isolation cover 160, a gas inside the transfer space S1 of the main body 102 can be suppressed from leaking out of the transfer apparatus 20.

[0047] An accommodation space S4, which accommodates a forward/backward mover 180 to be described later, is defined by the main cover 161, the connecting plate 140 and the isolation cover 160. Further, the main cover 161 covers the forward/backward mover 180 to be described later and the isolation cover 160. In this embodiment, the main cover 161 covers a front wall and a ceiling wall of the isolation cover 160, but does not cover a bottom wall of the isolation cover 160.

[0048] The bottom wall of the isolation cover 160 and a bottom wall of the main cover 161 constitute a bottom surface 150a of the mounting portion 150. The bottom surface 150a is inclined upward (toward the positive side in the Z direction) from the rear side (positive side in the Y direction) to the front side (negative side in the Y direction) in the apparatus depth direction. This inclination of the bottom surface 150a makes it easier to lock the positioning pin 230 into the cutout portion 144 when connecting the load port 101 to the housing 120 as described later.

[0049] A pair of sliders 162 are provided at the bottom surface 150a of the mounting portion 150. The sliders 162 extend in the apparatus depth direction (Y direction) from a rear end to a front end of the bottom surface 150a. When connecting the load port 101 to the housing 120 as described later, the sliders 162 are slid on an upper surface of the first accommodation portion 103A of the lower accommodation portion 103. For this reason, the sliders 162 are made of a material that can easily slide on the upper surface of the first accommodation portion 103A, for example, resin (rubber). The sliders 162 may be provided, for example, over an entire surface of the bottom surface 150a. However, in order to reduce resistance against the upper surface of the first accommodation portion 103A, a contact area with the upper surface of the first

accommodation portion 103A is reduced. Further, when the load port 101 is connected to the main body 102, the sliders 162 are spaced apart from the upper surface of the first accommodation portion 103A.

[0050] Further, the load port 101 includes a stage 170 and a forward/backward mover 180.

[0051] The stage 170 includes a mounting surface 170a for the FOUP 900 that accommodates the wafers W. Specifically, an upper surface of the stage 170 serves as the mounting surface 170a for the FOUP 900. The stage 170 supports the FOUP 900 on the mounting surface 170a. The FOUP 900 mounted on the mounting surface 170a is disposed such that a lid 901, which is a door of the FOUP 900, faces the opening 142 of the connecting plate 140. The stage 170 is provided on an upper surface of the main cover 161 described above.

[0052] The stage 170 is provided with a nozzle 171 for supplying a gas to the FOUP 900 on the stage 170. Specifically, the nozzle 171 supplies an inert gas such as a nitrogen gas into the FOUP 900 mounted on the stage 170. The nozzle 171 is movable by the forward/backward mover 180. Specifically, the nozzle 171 is movable together with the stage 170 which is moved by the forward/backward mover 180. In addition, the nozzle 171 protrudes from a lower surface of the stage 170, and a lower portion of the nozzle 171 protrudes into the aforementioned accommodation space S4.

[0053] The forward/backward mover 180 moves the stage 170 forward and backward in the horizontal direction. Specifically, the forward/backward mover180 moves the stage 170 forward and backward relative to the opening 142. More specifically, the forward/backward mover180 moves the stage 170 between a forward position and a rear position. The forward position is a position where the FOUP 900 is delivered between an external transfer device for the FOUP 900 and the stage 170. The rear position is a position where the wafer W is delivered between the FOUP 900 and the interior of the main body 102 via the opening 142.

[0054] The forward/backward mover 180 includes, for example, a guide 181 and a support 182. The guide 181 guides the movement of the stage 170 in the apparatus depth direction. Specifically, the guide 181 guides the movement of the support 182, which supports the stage 170, in a front-rear direction. An upper end of the support 182 is connected to the stage 170,

and a lower end of the support 182 is connected to the guide 181 so that the support 182 is movable in the apparatus depth direction in which the guide 181 extends. The forward/backward mover 180 is accommodated in the aforementioned accommodation space S4.

[0055] Further, the load port 101 includes a door 190 and a mover 200.

[0056] The door 190 opens and closes the opening 142. The door 190 is configured to unlock the lid 901 of the FOUP 900 and to hold the lid 901. With the unlocked lid 901 held by the door 190, the door 190 is opened to thereby open the lid 901. During the opening/closing operation of the door 190, the door 190 moves inside the main body 102 (specifically, inside the transfer space S1).

[0057] The mover 200 opens and closes the door 190 and the lid 901 and also raises and lowers the door 190 and the lid 901, functioning as an elevator. The mover 200 includes, for example, an actuator 201, an arm 202, and an elevating body 203.

[0058] The actuator 201 drives the raising and lowering of the door 190. Specifically, the actuator 201 drives the raising and lowering of the elevating body 203 that supports the door 190 via the arm 202. The actuator 201 is provided inside the load port 101 so as to extend in the vertical direction (Z direction). The actuator 201 may be an electro-pneumatic actuator such as an air cylinder, or may be an electromechanical actuator.

[0059] The arm 202 supports the door 190 and is driven by the actuator 201. An upper end of the arm 202 is connected to the door 190, which may be located inside the main body 102 (specifically, inside the transfer space S1), and a lower end of the arm 202 is connected via the elevating body 203 to the actuator 201, which is located inside the load port 101, that is, outside the main body 102. In order to allow the arm 202 to be raised and lowered in such a connected state, the slits 143 are provided in the front wall 121 of the main body 102 as described above. That is, the front wall 121 of the main body 102 is provided with the slits 143 through which the arm 202 can be inserted and through which the arm 202 passes during the raising and lowering of the arm 202.

[0060] The elevating body 203 is raised and lowered along the actuator 201. That is, the elevating body 203 is moved in the vertical direction.

[0061] The mover 200 is configured to be capable of moving in the apparatus depth direction (Y direction). For example, the arm 202 that supports the door 190 is connected to the elevating body 203 so as to be movable in the front-rear direction.

[0062] The mover 200 is accommodated in the accommodation space S4 of the main cover 161 described above. Specifically, the accommodation space S4 accommodates parts of the mover 200 located outside the main body 102, that is, the actuator 201 of the mover 200, portions of the arm 202, and the elevating body 203.

[0063] The mover 200 further includes an actuator (not shown) that drives the forward/backward movement of the door 190. The mover 200 is controlled by the controller C. Specifically, the actuator of the mover 200 and the actuator 201 are controlled by the controller C.

[0064] Further, the load port 101 includes a first protective cover 210 and a second protective cover 211.

[0065] The first protective cover 210 covers the connecting plate 140. Specifically, the first protective cover 210 covers the upper connecting plate 140A other than the opening 142, and the lower connecting plate 140B other than the mounting portion 150. The second protective cover 211 covers a lower portion of the mounting portion 150. Specifically, the second protective cover 211 covers side walls of the isolation cover 160 and side walls of the main cover 161.

[0066] As shown in FIGS. 2, 3 and 5, the main body 102 includes an adjuster 220.

[0067] The adjuster 220 adjusts a level of the load port 101 in the apparatus depth direction (Y direction) relative to the housing 120 of the main body 102, and also adjusts the position of the load port 101 in the apparatus depth direction. The adjuster 220 is provided on the front surface of the front wall 121 of the main body 102 at a position corresponding to the pair of openings 141 of the load port 101.

[0068] As shown in FIGS. 12 and 13, the adjuster 220 includes a block body 221 and a pair of adjustment screw portions 222.

[0069] The block body 221 has a substantially rectangular parallelepiped shape. The block body 221 is attached to the front surface of the front wall 121.

[0070] The adjustment screw portions 222 are provided in a pair at both ends of the block body

221 in the apparatus width direction (X direction). Each adjustment screw portion 222 has a pair of tension screws 223 and a compression screw 224.

[0071] The tension screws 223 are provided in a pair in the vertical direction (Z direction). Since the tension screws 223 are provided in a pair as such, when performing the level adjustment of the load port 101 in the apparatus depth direction using the adjuster 220 as described later, tilting of the block body 221 is suppressed. Tip ends 223a of the tension screws 223 are screwed into to the front wall 121. The tension screws 223 are inserted through the block body 221, and screw heads 223b of the tension screws 223 are exposed on the front surface of the block body 221.

[0072] The compression screw 224 is provided outward of the tension screws 223 in the apparatus width direction. A tip end 224a of the compression screw 224 is brought into contact with or spaced apart from the front surface of the front wall 121. The compression screw 224 is inserted through the block body 221, and the screw head 224b of the compression screw 224 is exposed from a front surface of the block body 221.

[0073] Each adjustment screw portion 222 is provided at a position corresponding to the opening 141 of the load port 101. When the connecting plate 140 is connected to the housing 120, the adjustment screw portions 222 are exposed from the opening 141 when viewed from the front side. The operator can then access the adjustment screw portions 222 from the opening 141.

[0074] The block body 221 is provided with fixing screw holes 225 outward of the compression screws 224 in the apparatus width direction. The fixing screw holes 225 are provided at positions corresponding to the fixing screw holes 145 of the load port 101. Fixing screws 146 are inserted through and screwed into the fixing screw holes 225. That is, the fixing screws 146 are screwed into the fixing screw holes 145 of the load port 101 and the fixing screw holes 225 of the adjuster 220, and are further screwed into the front wall 121 of the main body 102. The fixing screw holes 225 are larger than the fixing screws 146, and gaps are formed between the fixing screw holes 225 and the fixing screws 146.

[0075] As described later, when connecting the load port 101 to the housing 120, a distance between the block body 221 and the front wall 121 is adjusted by tightening or loosening at least

one of the tension screws 223 or the compression screws 224 of the adjuster 220. This adjusts the level of the load port 101 in the apparatus depth direction (Y direction). At this time, the position of the load port 101 in the apparatus depth direction is also adjusted.

[0076] Further, as shown in FIGS. 2, 3 and 5, the main body 102 includes the positioning pin 230.

[0077] The positioning pin 230 protrudes from the front surface of the front wall 121 of the main body 102 and is provided at a position corresponding to the cutout portion 144 of the load port 101. The positioning pin 230 is locked into the cutout portion 144. As shown in FIG. 11, the upper portion of the cutout portion 144 constitutes the positioning surface 144a, and the position of the load port 101 in the apparatus width direction is set by locking the positioning pin 230 to the positioning surface 144a of the cutout portion 144.

[0078] Further, as shown in FIGS. 2 and 3, the main body 102 includes a door 240 and an elevator 250.

[0079] The door 240 opens and closes the opening 128 in the rear wall 122 described above. The elevator 250 raises and lowers the door 240 to open and close the opening 128. The door 240 and the elevator 250 are provided inside the main body 102 (specifically, inside the transfer space S1).

[0080] The elevator 250 includes an actuator (not shown) that drives the raising and lowering of the door 240. The elevator 250 is controlled by the controller C. Specifically, the actuator of the elevator 250 is controlled by the controller C.

[0081] Further, the main body 102 includes a transfer robot 110 that supports and transfers the wafer W as described above. Specifically, the transfer robot 110 transfers the wafer W between the opening 142 and the opening 128, or the like. The transfer robot 110 is accommodated in the transfer space S1 described above and mounted on the bottom wall 124.

[0082] As shown in FIG. 14, the transfer robot 110 includes a horizontal arm 260 and a vertical articulated arm 270 as transfer arms.

[0083] The horizontal arm 260 is configured to transfer the wafer W in the horizontal direction. The horizontal arm 260 is, for example, a multi-joint arm and includes a fork 261, a first arm

262, and a second arm 263.

[0084] The fork 261 supports the wafer W at a tip side of the fork 261. The fork 261 is connected to a tip side of the first arm 262 such that the fork 261 is rotatable about an axis (hereinafter referred to as "vertical axis") at a base side of the fork 261 extending in the vertical direction (Z direction). The first arm 262 is connected to a tip side of the second arm 263 such that the first arm 262 is rotatable about a vertical axis at a base side of the first arm 262. The second arm 263 is connected to a tip portion of the vertical articulated arm 270 so as to be rotatable about a vertical axis.

[0085] The vertical articulated arm 270 is constituted by an articulated arm and is configured to be capable of at least raising and lowering the horizontal arm 260. In this embodiment, the vertical articulated arm 270 is configured to be capable of moving the horizontal arm 260 in the vertical direction (Z direction) and the apparatus width direction (X direction). The vertical articulated arm 270 includes an arm 271 provided to be capable of pivoting in the vertical direction and a base 272 connected to the arm 271 and fixed to a support 280 to be described later.

[0086] The arm 271 includes, for example, a first arm 271A and a second arm 271B. The horizontal arm 260 is connected to a tip side of the first arm 271A. Further, the first arm 271A is connected to a tip side of the second arm 271B so as to be rotatable about an axis (hereinafter referred to as "front-rear axis") extending in the apparatus depth direction at a base side of the first arm 271A. The second arm 271B is connected to an upper end of the base 272 so as to be rotatable about a front-rear axis at a base side of the second arm 271B.

[0087] The base 272 supports the horizontal arm 260 via the arm 271. The base 272 includes a pair of plate-shaped members 273 and a bottom member 274.

[0088] The pair of plate-shaped members 273 are disposed side by side in the apparatus depth direction (Y direction). The second arm 271B is pivotally supported between the pair of plate-shaped members 273.

[0089] The plate-shaped member 273 extends along the vertical direction in the transfer space S1. Further, when viewed in the apparatus depth direction, the plate-shaped member 273 is

shaped substantially as an isosceles triangle having a pair of long sides extending in the vertical direction and a short side connecting the pair of long sides.

[0090] The bottom member 274 is disposed to connect lower ends of the pair of plate-shaped members 273. A bottom surface of the bottom member 274 is provided with a plurality of, for example, two positioning pins (not shown). The positioning pins are inserted into pin holes provided in the support 280, which will be described later.

[0091] Further, as shown in FIGS. 2 to 4, the main body 102 includes the support 280 and exhaust boxes 290 which serve as a pair of exhausters.

[0092] The support 280 and the pair of exhaust boxes 290 are provided on the bottom wall 124 and arranged side by side in the apparatus width direction (X direction). Specifically, the pair of exhaust boxes 290 are arranged side by side on both sides of the support 280 in the apparatus width direction. A front surface (surface on the negative side in the Y direction) of the support 280 extending in the apparatus width direction and front surfaces of the exhaust boxes 290 are continuous. Further, a rear surface (surface on the positive side in the Y direction) of the support 280 extending in the apparatus width direction and rear surfaces of the exhaust boxes 290 are continuous.

[0093] The support 280 fixes and supports the transfer robot 110. An upper surface of the support 280 is provided with a plurality of, for example, two pin holes (not shown) at positions corresponding to the positioning pins of the transfer robot 110 described above. When the transfer robot 110 is mounted on the support 280, the positioning pins are inserted into the pin holes. This fixes the transfer robot 110 at a desired position relative to the support 280.

[0094] The exhaust boxes 290 exhaust the transfer space S1. The exhaust boxes 290 include a fan filter unit (not shown) therein and filters and discharges a gas inside the transfer space S1. In this embodiment, the filtered gas is returned to the accommodation space S2 as described later. This filtered gas may also be discharged outside of the main body 102 (specifically, for example, into a cleanroom where the transfer apparatus 20 is installed).

[0095] Further, the main body 102 includes a fan filter unit (FFU) 300 which serves as an air-blower.

[0096] The FFU 300 supplies a purified gas, that is, a gas from which particles have been filtered out, from top to bottom in the transfer space S1. The FFU 300 is installed in the aforementioned accommodation space S2 and is supported, for example, by the partition wall 129. As described above, the opening 130 is formed in the partition wall 129, and the FFU 300 supplies the purified gas to the transfer space S1 via the opening 130.

[0097] In this embodiment, one end of a supply pipe 310, which supplies an inert gas such as a nitrogen gas to the accommodation space S2, is connected to the main body 102. A gas supplier 311 is connected to the other end of the supply pipe 310. The gas supplier 311 includes, for example, an inert gas source, a switching valve for switching between supply and stop of supply of the inert gas, a flow rate adjustment valve for adjusting the flow rate of the inert gas, and the like.

[0098] Since the supply pipe 310 described above is provided, in this embodiment, the FFU 300 can supply the purified inert gas into the accommodation space S2.

[0099] In this embodiment, the FFU 300 and the exhaust box 290 circulate the inert gas inside the main body 102. The inert gas is circulated through a circulation path constituted by, for example, the transfer space S1, the accommodation space S2, and a return path (not shown). That is, the purified inert gas is sent downward from the accommodation space S2 to the transfer space S1 via the opening 130 by the FFU 300, reaches a lower end of the transfer space S1, and is then returned to the accommodation space S2 via the return path by the exhaust boxes 290.

[0100] The return path is provided so as to extend in the vertical direction through the transfer space S1 and the accommodation space S2, and an arrangement thereof is arbitrary. For example, the return path may be provided along a rear surface of the front wall 121 of the main body 102, or may be provided inside a column that constitutes the main body 102.

[0101] Further, in the above example, the inert gas is circulated inside the main body 102. Alternatively, a dry air may be circulated. In this case, for example, the dry air is supplied from the gas supplier 311 to the accommodation space S2 via the supply pipe 310.

<Method of Connecting Load Port 101>

[0102] Next, a method of connecting the load port 101 to the housing 120 of the main body 102 will be described. FIGS. 15A to 15E are explanatory diagrams showing states in which the load port 101 is being connected to the housing 120. FIG. 16 is an explanatory diagram showing a state in which the level of the load port 101 in the apparatus depth direction (Y direction) is adjusted. FIG. 17 is an explanatory diagram showing a state in which the level of the load port 101 in the apparatus width direction (X direction) is adjusted.

[0103] First, as shown in FIG. 15A, the load port 101 in a state where the first protective cover 210 and the second protective cover 211 are removed is mounted on the upper surface of the first accommodation portion 103A of the lower accommodation portion 103. Since the bottom surface 150a of the mounting portion 150 is inclined upward from the rear side (positive side in the Y direction) to the front side (negative side in the Y direction), the load port 101 is mounted while being tilted forward.

[0104] Next, as shown in FIG. 15B, the load port 101 is moved to the rear side in the apparatus depth direction to be disposed in front of the front wall 121. Since the sliders 162 are provided on the bottom surface 150a, the load port 101 can be moved smoothly.

[0105] Next, as shown in FIG. 15C, the load port 101 is raised at the rear side, and the positioning pin 230 is locked into the cutout portion 144. The sliders 162 are separated from the upper surface of the first accommodation portion 103A, and the load port 101 is supported by the positioning pin 230. As described above, the upper portion of the cutout portion 144 constitutes the positioning surface 144a, and the position of the load port 101 in the apparatus width direction is set by the positioning pin 230.

[0106] Next, the four corners of the connecting plate 140 of the load port 101 are temporarily fixed to the front wall 121 of the housing 120 by the fixing screws 146. Specifically, the fixing screws 146 are screwed into the fixing screw holes 145 of the load port 101 and the fixing screw holes 225 of the adjuster 220, and are then screwed into the front wall 121 of the main body 102.

[0107] Next, as shown in FIG. 15D, a leveler 500 is placed on the stage 170 of the load port 101. Subsequently, the level (levelness) of the load port 101 relative to the housing 120 is measured using the leveler 500.

[0108] Next, as shown in FIG. 15E, the level of the load port 101 relative to the housing 120 is adjusted based on the measurement result of the leveler 500. Specifically, a level of the load port 101 in the apparatus depth direction (Y direction) and a level of the load port 101 in the apparatus width direction (X direction) are adjusted. When the level of the load port 101 based on the measurement result of the leveler 500 meets required specifications, the level adjustment of the load port 101 is omitted.

[0109] As shown in FIG. 16, the level adjustment of the load port 101 in the apparatus depth direction (Y direction) is performed using the adjuster 220. When the front wall 121 and the connecting plate 140 are temporarily fixed as described above, the adjuster 220 is disposed close to the connecting plate 140. At this time, the adjustment screw portion 222 is exposed from the opening, and a worker can access the adjustment screw portion 222 from the opening 141.

[0110] When tilting the load port 101 forward (toward the negative side in the Y-direction), the pair of tension screws 223 of the adjuster 220 are loosened, and the compression screw 224 is tightened and pushed. When tilting the load port 101 backward (toward the positive side in the Y-direction), the pair of tension screws 223 of the adjuster 220 are loosened, and the compression screw 224 is loosened and pulled. Then, by using the positioning pin 230 locked in the cutout portion 144 as a pivot point, the upper portion of the load port 101 is moved forward or backward as described above, thereby adjusting the level in the apparatus depth direction. At this time, the level in the apparatus depth direction can be adjusted while monitoring the level of the load port 101 measured by the leveler 500.

[0111] Further, when the upper portion of the load port 101 is moved forward or backward by using the adjuster 220 as such, the position of the load port 101 in the apparatus depth direction is also adjusted.

[0112] As shown in FIG. 17, the level adjustment of the load port 101 in the apparatus width direction (X direction) is performed by rotating the upper portion of the load port 101 in the X direction using the positioning pin 230, which is locked into the cutout portion 144, as a pivot point. The level adjustment of the load port 101 in the apparatus width direction includes, for example, coarse adjustment and fine adjustment.

[0113] When coarsely adjusting the level of the load port 101 in the apparatus width direction, the pair of tension screws 223 of the adjuster 220 are loosened, and the pair of fixing screws 146 of the lower connecting plate 140B are loosened, thereby moving the load port 101 in the apparatus width direction together with the block body 221. At this time, the level in the apparatus width direction can be adjusted while monitoring the level of the load port 101 measured by the leveler 500. Alternatively, an amount of movement (movement angle) of the load port 101 in the apparatus width direction may be set based on the measurement result of the leveler 500 so that the level of the load port 101 meets the specifications.

[0114] When finely adjusting the level of the load port 101 in the apparatus width direction, the fixing screws 146 at the four corners of the connecting plate 140 are loosened, and the load port 101 is moved in the apparatus width direction by utilizing the gaps between the fixing screw holes 145 and the fixing screws 146. At this time, the block body 221 is not moved.

[0115] As described above, once the level of the load port 101 relative to the housing 120 is adjusted, the load port 101 is fixed to the front wall 121 by tightening the fixing screws 146 at the four corners of the connecting plate 140. Further, the first protective cover 210 is attached to the connecting plate 140, and the second protective cover 211 is attached to the lower portion of the mounting portion 150.

[0116] In this way, a sequence of processes for connecting the load port 101 to the housing 120 is completed. Each process may be performed manually by an operator, or may be performed automatically by an apparatus that performs each process.

<Main Effects of the Embodiment>

[0117] In the related art, an adjuster for adjusting the level of the load port is provided on the rear side of the load port. However, an opening for accessing the adjuster is not formed in the connecting plate of the load port as in this embodiment. Therefore, the connection of the load port to the housing of the main body (EFEM device) is performed using the following procedure. First, the positioning pin of the housing is inserted into the load port, and the housing and load port are temporarily fixed with the fixing screws. Next, the leveler is placed on the stage of the

load port to measure the level (levelness) of the load port. Next, in a case where the level of the load port does not meet the specifications, the load port is removed from the housing, and the adjuster is adjusted. As described above, the load port of the related art does not have the opening of this embodiment, and the adjuster can only be accessed from the front side, which necessitates such a removal operation the load port. Next, the load port is reattached to the housing, and the level of the load port is measured using the leveler. The operational processes above are repeated until the level of the load port meets the specifications. As described above, when the load port of the related art is used, the adjuster cannot be accessed from the load port side. Therefore, the repetition of removing the load port, adjusting the adjuster, and attaching the load port is required, which increases the number of operational processes required.

[0118] In this embodiment, the load port 101 is provided with the pair of openings 141 at the upper corners of the upper connecting plate 140A. When the connecting plate 140 is connected to the housing 120, the adjustment screw portions 222 of the adjuster 220 are exposed from the openings 141. The worker can then access the adjustment screw portions 222 from the openings 141. Therefore, when adjusting the level of the load port 101, it is not necessary to remove the load port 101 as in the related art, and the level adjustment can be performed while keeping the load port 101 attached to the housing 120. As a result, the number of operational processes can be reduced, and operational efficiency of level adjustment of the load port 101 at manufacturing sites and startup sites can be improved. In addition, maintainability of the load port 101 can be improved, and the level adjustment of the load port 101 can be performed efficiently.

[0119] Further, in this embodiment, the adjustment screw portions 222 are accessed from the front side (negative side in the Y-direction) of the load port 101 through the openings 141 to adjust the level of the load port 101 in the apparatus depth direction. In addition, the upper portion of the load port 101 is accessed from the front side (negative side in Y-direction) of the load port 101, and the upper portion of the load port 101 is moved forward or backward using the positioning pin 230 as a pivot point, thereby adjusting the level of the load port 101 in the apparatus width direction. Since the level adjustment of the load port 101 is performed only

from the front side of the load port 101, the operational efficiency can be improved.

[0120] Further, in this embodiment, the level adjustment of the load port 101 can be performed in which the load port 101 is attached to the housing 120, while monitoring the level of the load port 101 measured by the leveler 500. Therefore, accuracy of the level adjustment of the load port 101 can be improved. In addition, it is possible to shorten a time required for the level adjustment of the load port 101.

[0121] In the housing of the related art, a Y-direction adjuster is provided at a position corresponding to the upper portion of the load port to adjust the level of the load port in the apparatus depth direction (Y direction), and an X-direction adjuster is provided at a position corresponding to the lower portion of the load port to adjust the level of the load port in the apparatus width direction (X direction). The X-direction adjuster includes two positioning pins and a block body to which the positioning pins are attached. The two positioning pins are locked into two cutout portions formed in the lower portion of the load port. The block body is configured such that at least one end of the block body is movable in the vertical direction. By moving the at least one end of the block body in the vertical direction with the positioning pins locked into the cutout portions, the level of the load port in the apparatus width direction is adjusted.

[0122] In this regard, according to this embodiment, the adjuster 220 including the adjustment screw portions 222 is concentrated at the upper portion of the load port 101 to adjust the level of the load port 101 in the apparatus depth direction. In addition, the positioning pin 230 is provided on the front wall 121 of this embodiment, and the upper portion of the load port 101 is moved forward or backward using the positioning pin 230, which is locked into the cutout portion 144, as a pivot point, thereby adjusting the level of the load port 101 in the apparatus width direction. Therefore, two adjusters at upper and lower portions, as in the related art, are not required, and the level adjustment of the load port 101 can be easily performed.

[0123] In particular, in this embodiment, the lower accommodation portion 103 is provided below the load port 101. Therefore, it is difficult to access the lower portion of the load port 101. Concentrating the adjuster 220 at the upper portion of the load port 101 contributes to

improving the operational efficiency. This embodiment is useful in this regard as well.

[0124] For the transfer apparatus 20, there is a demand for a reduced on-site apparatus footprint. By reducing the apparatus footprint, it becomes possible to install many devices on site, thereby improving manufacturing productivity.

[0125] In the transfer apparatus of the related art, a transfer robot having a horizontal articulated arm is installed inside the main body (EFEM device). When the horizontal articulated arm is used, an arm constituting the horizontal articulated arm is long in the horizontal direction, and an operation range of the transfer robot extends in the horizontal direction (X direction and Y direction). Therefore, the transfer apparatus of the related art requires a large space in the apparatus depth direction (Y direction).

[0126] In this regard, in the transfer apparatus 20 of this embodiment, the transfer robot 110 includes the vertical articulated arm 270, and an operation range of the vertical articulated arm 270 extends in the vertical direction (Z direction) and the apparatus width direction (X direction). Therefore, a length of the main body 102 in the apparatus depth direction (Y direction) can be reduced. In addition, although the horizontal arm 260 supported by the vertical articulated arm 270 moves in the horizontal direction, each of the first arm 262 and the second arm 263 that constitute the horizontal arm 260 is short. This further reduces the length of the main body 102 in the apparatus depth direction (Y direction). Therefore, according to the transfer apparatus 20 of this embodiment, the length of the main body 102 in the apparatus depth direction can be reduced, thereby reducing the apparatus footprint. While reducing the apparatus footprint as such, the operation of connecting the load port 101 to the housing 120 can be made efficient, thereby reducing apparatus cost.

[0127] Further, the cutout portion 144 in this embodiment is provided at the lower end of the lower connecting plate 140B in the central portion in the apparatus width direction (X direction). Therefore, when the positioning pin 230 is locked into the cutout portion 144, the load port 101 can be appropriately supported by the positioning pin 230.

[0128] Further, the cutout portion 144 of this embodiment has a tapered shape widening from top to bottom, and also has a positioning surface 144a at the upper portion thereof. Therefore,

when locking the positioning pin 230 into the cutout portion 144, the positioning pin 230 can be easily inserted from below the cutout portion 144. Moreover, by locking the positioning pin 230 to the positioning surface 144a, the position of the load port 101 in the apparatus width direction can be appropriately fixed and set.

[0129] Further, in the load port 101 of this embodiment, the bottom surface 150a of the mounting portion 150 is inclined upward (toward the positive side in the Z direction) from the rear side (positive side in the Y direction) to the front side (negative side in the Y direction) in the apparatus depth direction. Since the bottom surface 150a is inclined as such, when connecting the load port 101 to the housing 120, the load port 101 is first mounted on the upper surface of the first accommodation portion 103A while being tilted forward. Then, when locking the positioning pin 230 into the cutout portion 144, the load port 101 needs to be raised only at the rear side. This makes it easier to lock the positioning pin 230 into the cutout portion 144. In addition, since the bottom surface 150a is inclined, a center of gravity of the load port 101 can be located at the center in a plan view, which stabilizes the load port 101.

[0130] Further, in the load port 101 of this embodiment, the sliders 162 are provided on the bottom surface 150a. Therefore, when connecting the load port 101 to the housing 120, the load port 101 can be smoothly moved on the upper surface of the first accommodation portion 103A.

(Second Embodiment)

[0131] FIGS. 18 and 19 are a front view and a cross-sectional view of an adjuster 400 of a load port 101, respectively.

[0132] In the first embodiment, the adjuster 220 is provided on the housing 120 (front wall 121) of the main body 102. However, in the second embodiment, the adjuster 400 is provided on the upper connecting plate 140A of the load port 101. Further, in the first embodiment, the openings 141 are provided on the upper connecting plate 140A as access portions to the adjuster 220. However, in the second embodiment, as will be described later, adjustment screw portions 402 are used as access portions to a block body 401 of the adjuster 400. In other words, in the

second embodiment, no opening 141 is provided on the upper connecting plate 140A.

[0133] As shown in FIGS. 18 and 19, the adjuster 400 includes a block body 401 and a pair of adjustment screw portions 402.

[0134] The block body 401 has a substantially rectangular parallelepiped shape. The block body 401 is attached to a rear surface of the upper connecting plate 140A.

[0135] The adjustment screw portions 402 are provided in a pair at upper corners of the upper connecting plate 140A. That is, the pair of adjustment screw portions 402 are provided at the same positions as the pair of openings 141 in the first embodiment. Each adjustment screw portion 402 includes a pair of tension screws 403 and a compression screw 404.

[0136] The tension screws 403 are provided in a pair in the vertical direction (Z direction). Tip ends 403a of the tension screws 403 are screwed into the block body 401. The tension screws 403 are inserted through the upper connecting plate 140A, and screw heads 403b of the tension screws 403 are exposed on the front surface of the upper connecting plate 140A.

[0137] The compression screw 404 is provided outward of the tension screws 403 in the apparatus width direction. A tip end 404a of the compression screw 404 is brought into contact with or spaced apart from the front surface of the block body 401. The compression screw 404 is inserted through the upper connecting plate 140A, and a screw head 404b of the compression screw 404 is exposed on the front surface of the upper connecting plate 140A.

[0138] As described above, the screw heads 403b of the tension screws 403 and the screw head 404b of the compression screw 404 are exposed on the front surface of the upper connecting plate 140A. Therefore, the worker can access the adjustment screw portions 402.

[0139] The block body 401 is provided with fixing screw holes 405 outward of the compression screws 404 in the apparatus width direction. The fixing screw holes 405 are provided at positions corresponding to the fixing screw holes 145 of the load port 101. Fixing screws 146 are inserted through and screwed into the fixing screw holes 405. That is, the fixing screws 146 are screwed into the fixing screw holes 145 of the load port 101 and the fixing screw holes 405 of the adjuster 400, and are further screwed into the front wall 121 of the main body 102. The fixing screw holes 405 are larger than the fixing screws 146, and gaps are formed between the

fixing screw holes 405 and the fixing screws 146.

[0140] The level adjustment of the load port 101 in the apparatus depth direction (Y direction) is performed using the adjuster 400 configured as described above.

[0141] When tilting the load port 101 forward (toward the negative side in the Y-direction), the pair of tension screws 403 of the adjuster 400 are loosened, and the compression screw 404 is tightened and pushed inward. When tilting the load port 101 backward (toward the positive side in the Y-direction), the pair of tension screws 403 of the adjuster 400 are loosened, and the compression screw 404 is loosened and pulled. Then, by using the positioning pin 230 locked into the cutout portion 144 as a pivot point, the upper portion of the load port 101 is moved forward or backward as described above, thereby adjusting the level in the apparatus depth direction. At this time, the level in the apparatus depth direction can be adjusted while monitoring the level of the load port 101 measured by the leveler 500.

[0142] Further, by moving the upper portion of the load port 101 forward or backward using the adjuster 400, the position of the load port 101 in the apparatus depth direction is also adjusted.

[0143] According to this embodiment, when connecting the connecting plate 140 to the housing 120, the worker can access the adjustment screw portions 402 exposed on the front surface of the upper connecting plate 140A. Therefore, when adjusting the level of the load port 101, it is not necessary to remove the load port 101 as in the related art, and the level adjustment can be performed with the load port 101 attached to the housing 120. As a result, the number of operational processes can be reduced. Therefore, the same effects as those of the first embodiment described above can be achieved in the second embodiment as well.

[0144] Further, when adjusting the level of the load port 101, a clearance between the load port 101 and the housing 120 (front wall 121) becomes important, and an initial value may be set for this clearance. In this regard, in the first embodiment, since the block body 221 of the adjuster 220 is attached to the front wall 121, the initial value of the clearance can be set by defining an amount of protrusion of the block body 221 from the front surface of the front wall 121. Accordingly, from this viewpoint, the first embodiment may be more advantageous.

<Modifications>

[0145] In the first and second embodiments, the cutout portion 144 is provided at the lower end of the lower connecting plate 140B. However, the position of the cutout portion 144 is not limited thereto. For example, the cutout portion 144 may be provided at the upper portion of the upper connecting plate 140A. However, in a case where the cutout portion 144 is provided at the upper portion of the upper connecting plate 140A, the upper connecting plate 140A becomes bent, and thus a higher strength is required for the upper connecting plate 140A. From the viewpoint of the strength of the connecting plate 140, the cutout portion 144 may be provided at the lower end of the lower connecting plate 140B.

[0146] In the first and second embodiments, the upper portion of the cutout portion 144 constitutes a positioning surface 144a, and the cutout portion 144 has a tapered shape widening from top to bottom. However, a shape of the cutout portion 144 is not limited thereto. The shape of the cutout portion 144 is arbitrary as long as the cutout portion 144 can lock the positioning pin 230 and fix the position of the load port 101 in the apparatus width direction.

[0147] The embodiments disclosed herein should be considered as exemplary and not limitative in all respects. The embodiments described above may be omitted, replaced, or modified in various ways without departing from the scope and spirit of the appended claims. For example, the constituent elements of the embodiments described above may be combined arbitrarily. Such combinations will naturally provide the functions and effects of the respective constituent elements in the combinations, as well as other functions and effects that will be apparent to those skilled in the art from the description herein.

[0148] Furthermore, the effects described herein are merely descriptive or exemplary and not limitative. In other words, the technique of the present disclosure may provide other effects that will be apparent to those skilled in the art from the description herein, in addition to or in place of the effects described herein.

[0149] The following configuration examples also fall within the technical scope of the present disclosure.

(1) A load port including a mounting surface on which a container for accommodating substrates

is mounted, and configured to be connectable to a housing for accommodating a transfer robot for transferring the substrates, the load port including:

a connector configured to connect the load port to the housing,

wherein the connector is provided with an access portion to an adjuster for adjusting a level of the load port relative to the housing, and

wherein a cutout portion into which a positioning pin provided in the housing is locked is provided at a central portion of the connector in a width direction.

(2) The load port of (1), wherein an upper portion of the cutout portion constitutes a positioning surface for setting a position of the load port in an apparatus width direction.

(3) The load port of (1) or (2), wherein the cutout portion has a tapered shape widening from top to bottom.

(4) The load port of any one of (1) to (3), wherein the cutout portion is provided at a lower portion of the connector.

(5) The load port of any one of (1) to (4), wherein the access portion is an opening for accessing the adjuster.

(6) The load port of (5), wherein the opening includes a pair of openings provided at upper corners of the connector.

(7) The load port of any one of (1) to (4), wherein the access portion is an adjustment screw portion configured to adjust a level of the load port in a depth direction.

(8) The load port of any one of (1) to (7), wherein the connector is provided with an opening for loading and unloading the substrates into and from the container.

(9) The load port of any one of (1) to (8), further including:

a mounting portion provided integrally with the connector and including the mounting surface,

wherein the mounting portion includes a bottom surface inclined upward toward a side opposite from the connector.

(10) The load port of (9), wherein a slider extending toward the side opposite from the connector is provided on the bottom surface of the mounting portion.

(11) A transfer apparatus configured to load and unload substrates into and from a processing apparatus for processing the substrates, the transfer apparatus including:

a housing configured to accommodate a transfer robot for transferring the substrates;

a load port having a mounting surface on which a container for accommodating the substrates is mounted and configured to be connectable to the housing; and

an adjuster configured to adjust a level of the load port relative to the housing,

wherein the load port includes a connector configured to connect the load port to the housing,

wherein the housing is provided with a positioning pin,

wherein the connector is provided with an access portion to the adjuster, and

wherein a cutout portion into which the positioning pin is locked is provided at a central portion of the connector in a width direction.

(12) The transfer apparatus of (11), wherein an upper portion of the cutout portion constitutes a positioning surface for setting a position of the load port in an apparatus width direction.

(13) The transfer apparatus of (11) or (12), wherein the cutout portion has a tapered shape widening from top to bottom.

(14) The transfer apparatus of any one of (11) to (13), wherein the cutout portion is provided at a lower portion of the connector.

(15) The transfer apparatus of any one of (11) to (14), wherein the adjuster is provided in the housing, and

wherein the access portion is an opening for accessing the adjuster.

(16) The transfer apparatus of (15), wherein the opening includes a pair of openings provided at upper corners of the connector.

(17) The transfer apparatus of any one of (11) to (14), wherein the access portion is an adjustment screw portion configured to adjust a level of the load port in a depth direction.

(18) The transfer apparatus of any one of (11) to (17), wherein the connector is provided with an opening for loading and unloading the substrates into and from the container.

(19) The transfer apparatus of any one of (11) to (18), further including:

a mounting portion provided integrally with the connector and including the mounting surface,

wherein the mounting portion includes a bottom surface inclined upward toward a side opposite from the connector.

(20) The transfer apparatus of (19), wherein a slider extending toward the side opposite from the connector is provided on the bottom surface of the mounting portion.

EXPLANATION OF REFERENCE NUMERALS

[0150] 10: processing apparatus, 20: transfer apparatus, 101: load port, 120: housing, 140: connecting plate, 141: opening, 144: cutout portion, 110: transfer robot, 170a: mounting surface, 220: adjuster, 230: positioning pin, 900: FOUP, W: wafer

WHAT IS CLAIMED IS:

1. A load port including a mounting surface on which a container for accommodating substrates is mounted, and configured to be connectable to a housing for accommodating a transfer robot for transferring the substrates, the load port comprising a connector configured to connect the load port to the housing,

wherein the connector is provided with an access portion to an adjuster for adjusting a level of the load port relative to the housing, and

wherein a cutout portion into which a positioning pin provided in the housing is locked is provided at a central portion of the connector in a width direction.

2. The load port of Claim 1, wherein an upper portion of the cutout portion constitutes a positioning surface for setting a position of the load port in an apparatus width direction.

3. The load port of Claim 1, wherein the cutout portion has a tapered shape widening from top to bottom.

4. The load port of Claim 1, wherein the cutout portion is provided at a lower portion of the connector.

5. The load port of Claim 1, wherein the access portion is an opening for accessing the adjuster.

6. The load port of Claim 5, wherein the opening includes a pair of openings provided at upper corners of the connector.

7. The load port of Claim 1, wherein the access portion is an adjustment screw portion configured to adjust a level of the load port in a depth direction.

8. The load port of any one of Claims 1 to 7, wherein the connector is provided with an opening for loading and unloading the substrates into and from the container.

9. The load port of any one of Claims 1 to 7, further comprising:

a mounting portion provided integrally with the connector and including the mounting surface,

wherein the mounting portion includes a bottom surface inclined upward toward a side opposite from the connector.

10. The load port of Claim 9, wherein a slider extending toward the side opposite from the connector is provided on the bottom surface of the mounting portion.

11. A transfer apparatus configured to load and unload substrates into and from a processing apparatus for processing the substrates, the transfer apparatus comprising:

a housing configured to accommodate a transfer robot for transferring the substrates;

a load port including a mounting surface on which a container for accommodating the substrates is mounted and configured to be connectable to the housing; and

an adjuster configured to adjust a level of the load port relative to the housing,

wherein the load port includes a connector configured to connect the load port to the housing,

wherein the housing is provided with a positioning pin,

wherein the connector is provided with an access portion to the adjuster, and

wherein a cutout portion into which the positioning pin is locked is provided at a central portion of the connector in a width direction.

12. The transfer apparatus of Claim 11, wherein an upper portion of the cutout portion constitutes a positioning surface for setting a position of the load port in an apparatus width direction.

13. The transfer apparatus of Claim 11, wherein the cutout portion has a tapered shape widening from top to bottom.

14. The transfer apparatus of Claim 11, wherein the cutout portion is provided at a lower portion of the connector.

15. The transfer apparatus of Claim 11, wherein the adjuster is provided in the housing, and wherein the access portion is an opening for accessing the adjuster.

16. The transfer apparatus of Claim 15, wherein the opening includes a pair of openings provided at upper corners of the connector.

17. The transfer apparatus of Claim 11, wherein the access portion is an adjustment screw portion configured to adjust a level of the load port in a depth direction.

18. The transfer apparatus of any one of Claims 11 to 17, wherein the connector is provided with an opening for loading and unloading the substrates into and from the container.

19. The transfer apparatus of any one of Claims 11 to 17, further comprising:

a mounting portion provided integrally with the connector and including the mounting surface,

wherein the mounting portion includes a bottom surface inclined upward toward a side opposite from the connector.

20. The transfer apparatus of Claim 19, wherein a slider extending toward the side opposite from the connector is provided on the bottom surface of the mounting portion.