TRANSFER DEVICE AND CIRCULATION METHOD

TECHNICAL FIELD

[0001] The present disclosure relates to a transfer device and a circulation method.

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]

[Patent Document]

[0003] Patent Document 1: Japanese Patent Laid-Open Publication No. 2023-22095

SUMMARY

[0004] A semiconductor manufacturing apparatus is provided with a processing apparatus for processing substrates and a transfer device. The transfer device 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) between itself and the processing apparatus, and a load port connected to the EFEM device and configured to place thereon containers for storing substrates and consumable components. There is a demand for reducing an on-site device footprint (occupied area), as well as for minimizing manufacturing costs.

[0005] Therefore, the technique disclosed herein provides a transfer device and a circulation method that can contribute to cost reduction while suppressing an increase in device footprint of the transfer device that loads and unloads substrates or the like into and from a processing device for processing the substrates.

[0006] According to one embodiment of the present disclosure, a transfer device for loading and unloading substrates to and from a processing apparatus configured to process the substrates,

includes: a main body including a transfer space in which a transfer robot configured to transfer the substrates is provided, and an upper space provided above the transfer space, wherein the main body is configured to be capable of supplying a gas in the upper space to the transfer space, wherein the main body further includes: a housing constituting the transfer space, the housing including a wall configured to form a front surface to which a load port configured to support a container for accommodating the substrates is connected, a rear surface to which a load lock provided in the processing apparatus is connected, and a pair of side surfaces connecting the front surface and the rear surface in a device depth direction and facing each other in a device width direction, and a plurality of columns connected to the wall; an exhaust passage formed within the column and configured to discharge a gas in another space, which is separate from the transfer space and the upper space of the main body; a return passage formed within the column and configured to return at least a gas in the transfer space to the upper space; and an exhaust box provided inside the housing and configured to be supplied with the gas discharged from the exhaust passage and the gas in the transfer space, and wherein the return passage is configured to return the gas supplied into the exhaust box back to the upper space.

[0007] According to the present disclosure, it is possible to contribute to cost reduction while suppressing an increase in device footprint of a transfer device that loads and unloads substrates or the like into and from a processing device for processing the substrates.

BRIEF DESCRIPTION OF DRAWINGS

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

FIG. 2 is a cross-sectional side view of the transfer device.

FIG. 3 is a cross-sectional side view of the transfer device.

FIG. 4 is a cross-sectional side view of the transfer device.

FIG. 5 is a top view of a main body.

FIG. 6 is a cross-sectional front view of the transfer device.

FIG. 7 is a perspective view of a lower portion of one end of the main body in a device

width direction.

FIG. 8 is a cross-sectional view of a load port.

FIG. 9 is a rear side view of the load port.

FIG. 10 is a front view of a transfer robot.

FIG. 11 is a cross-sectional perspective view for explaining a storage space.

FIG. 12 is a perspective view for explaining components disposed in the storage space.

FIG. 13 is a side view of a flow path former on a side of the storage space.

FIG. 14 is a partially enlarged side view of a rear column on the side of the storage space.

FIG. 15 is a view for explaining a relationship between a gas supply surface and an exhaust surface.

FIG. 16 is a view for explaining the relationship between the gas supply surface and the exhaust surface.

FIG. 17 is a partially enlarged side view of a rear lower part of the transfer device.

FIG. 18 is a bottom view of the transfer device.

FIG. 19 is a partially enlarged view of the transfer device shown in FIG. 4.

FIG. 20 is an exploded view of a sub-exhaust box.

DETAILED DESCRIPTION

[0009] A transfer device according to an embodiment will be described below with reference to the drawings. In this specification and the drawings, elements having substantially the same functional configurations are designated by same reference numerals, and redundant descriptions thereof will be omitted. In the drawings, an X direction is a device width direction described later, which is a direction in which a pair of side surfaces 123a of a main body 102 of a transfer device 20 described later are arranged side by side and in which multiple load ports 101 are arranged side by side. A Y direction is a device depth direction, which is a direction in which a front surface 121a and a rear surface 122a of the main body 102 of the transfer device 20 described later are arranged side by side. A negative side in the Y direction is a front side, and

a positive side in the Y direction is a rear side. A Z direction is a vertical direction, i.e., a height direction.

<Wafer Processing System 1>

[0010] FIG. 1 is a plan view schematically showing a wafer processing system 1 provided with the transfer device 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 device 20. The processing apparatus 10 and the transfer device 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] Multiple processing modules 30 are provided, for example. Each processing module 30 processes the wafer W under a reduced pressure atmosphere, i.e., a vacuum atmosphere. The processes performed by the processing module 30 includes, for example, a film formation process, an etching process, an impurity diffusion process, and the like. Further, each processing module 30 includes vacuum processing chambers 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 shown in 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 described later. Specifically, the vacuum transfer chamber 41 is connected to the load lock chamber 51 of the load lock module 50 described later via a gate valve (not shown). A transfer mechanism 42 for transferring the wafer W is provided inside the vacuum transfer chamber 41.

The vacuum transfer module 40 uses the transfer mechanism 42 to transfer the wafer W between the vacuum transfer chamber 41 and the vacuum processing chambers 31 and between the vacuum transfer chamber 41 and the load lock chambers 51.

[0015] Further, the processing apparatus 10 is provided with the load lock modules 50 at an end facing the transfer device 20. For example, a plurality of load lock modules 50 are provided. Each load lock module 50 is used for delivering the wafer W between a space under the vacuum atmosphere and a space under a non-reduced pressure atmosphere, i.e., atmospheric pressure atmosphere. Each load lock module 50 includes the load lock chamber 51 configured to switch between the atmospheric pressure atmosphere and the vacuum atmosphere. The load lock chamber 51 is provided to connect the vacuum transfer module 40 and the transfer device 20.

[0016] The transfer device 20 is a device that loads and unloads the wafer W into and from the processing apparatus 10. Specifically, the transfer device 20 is configured to deliver the wafer W between a front-opening unified pod (FOUP) 2000, 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 device 20 includes the load port 101 and the main body 102, which is also called an EFEM device.

[0017] The load port 101 is configured to accommodate the FOUP 2000 and is provided in multiple locations (five locations in the example shown) along the device width direction (X direction).

[0018] The main body 102 is disposed on the rear side (positive side in the Y direction) of the load port 101. 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 the rear side (positive side in the Y direction) of the main body 102. An interior of the main body 102 is maintained at the atmospheric pressure atmosphere.

[0019] The main body 102 includes a housing 120 that constitutes a transfer space S1 in which a transfer robot 110 for supporting and transferring the wafers W is provided. There is one transfer robot 110 provided in the transfer space S1. The transfer robot 110 can deliver the wafers W between the FOUP 2000 placed on the load port 101 and the load lock chamber 51,

and the like.

[0020] Further, the main body 102 has a storage space S11, which is connected to the transfer space S1 and stores the wafers W. In this embodiment, the storage space S11 is connected to the rear side (positive side in the Y direction) of the transfer space S1. Specifically, the storage space S11 is connected to the rear side of each of both ends of the transfer space S1 in the device width direction (X direction). The storage space S11 and the transfer space together are covered by the housing 120. The storage space S11 is also configured to accommodate a plurality of wafers W, for example, to accommodate more wafers W than the number of wafers W that can be accommodated in the FOUP 2000.

[0021] The wafer processing system 1 described above is provided with at least one control device C. The control device C processes computer-executable instructions that cause the wafer processing system 1 to perform various processes described herein. The control device 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 an entirety of the control device C may be included in the wafer processing system 1. The control device C may include a processor, a memory, and a communication interface. The control device C is implemented, for example, by a computer. The processor may be configured to perform various control operations by reading from the memory a program that provides a logic or routine for enabling the various control operations, and 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 read from the memory and executed by the processor. The medium may be various storage media readable by a computer, 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>

[0022] Next, one example of 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 control device C.

[0023] First, the wafer W is sequentially taken out from the FOUP 2000 by the transfer robot 110 and loaded into the storage space S11. Further, the wafer W loaded into the storage space S11 is sequentially taken out from the FOUP 2000 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 the vacuum atmosphere.

[0024] Subsequently, the gate valve (not shown) of the load lock chamber 51 on a side of the vacuum transfer chamber 41 is opened, and the wafer W is unloaded from the load lock chamber 51 to the vacuum transfer chamber 41 by the transfer mechanism 42.

[0025] Subsequently, after the gate valve is closed, the gate valve G1 for the processing module 30 that performs a desired process is opened. Subsequently, the wafer W is loaded by the transfer mechanism 42 into the vacuum processing chamber 31 of the target processing module 30. Thereafter, the gate valve G1 is closed, and the desired process is performed on the wafer W in the processing module 30.

[0026] After the desired processing is completed, the wafer W is returned from the vacuum processing chamber 31 to the FOUP 2000 in the reverse order of the transfer from the FOUP 2000 to the vacuum processing chamber 31. Specifically, the wafer W after processing is loaded from the vacuum processing chamber 31 into the storage space S11, and then returned to the FOUP 2000. This terminates the series of wafer processing operations.

<Transfer Device 20>

[0027] An example of a configuration of the transfer device 20 will be described using FIG. 1 and FIGS. 2 to 20. FIGS. 2 to 4 are cross-sectional side views of the transfer device 20, respectively. FIG. 2 shows a central portion of the transfer device 20 in the device width

direction (Y direction), FIG. 3 shows a portion of the transfer device 20 in the device width direction, which includes the storage space S11, and FIG. 4 shows a portion of the transfer device 20 in the device width direction, which includes a column described later. FIG. 5 is a top view of the main body 102. FIG. 6 is a cross-sectional front view of the transfer device 20, and shows a portion of a configuration inside the housing 120. FIG. 7 is a perspective view of a lower portion of one end of the main body 102 in the device width direction. FIG. 8 is a cross-sectional view of the load port 101. FIG. 9 is a rear side view of the load port 101. FIG. 10 is a front view of the transfer robot 110. FIG. 11 is a perspective cross-sectional view for explaining the storage space S11. FIG. 12 is a perspective view for explaining components disposed in the storage space S11. FIG. 13 is a side view of a flow path former, which will be described later, on a side of the storage space S11. FIG. 14 is a partially enlarged side view of a rear column on the side of the storage space S11. FIGS. 15 and 16 are views for explaining a relationship between a gas supply surface and an exhaust surface, which will be described later. FIG. 17 is a partially enlarged side view of a rear lower portion of the transfer device 20. FIG. 18 is a bottom view of the transfer device 20. FIG. 19 is a partially enlarged view of the transfer device shown in FIG. 4. FIG. 20 is an exploded view of the sub-exhaust box, which will be described later. In the following, a configuration of the main body 102 of the transfer device 20 on the positive side in the X direction will be mainly described. Since the configuration of the main body 102 on the negative side in the X direction is the same as the configuration of the main body 102 on the positive side in the X direction, the description thereof will be omitted as appropriate.

[0028] As shown in FIGS. 2 to 6, the transfer device 20 includes the load port 101 and the main body 102 described above, and further includes a lower accommodator 103 for accommodating various components.

[0029] The main body 102 includes the housing 120 having a U-shape in a plan view. The housing 120 includes a wall 120A, a plurality of columns 500 and 510, and a beam 520.

[0030] The wall 120A includes a front wall 121 having a front surface 121a, a rear wall 122 having a rear surface 122a, a pair of side walls 123 each having a side surface 123a, a bottom

wall 124, and a top wall 125.

[0031] The front surface 121a is located on the front side (negative side in the Y direction) of the main body 102 and extends in the device width direction (X direction) in a plan view. The load port 101 and the lower accommodator 103 are connected to the front surface 121a. The lower accommodator 103 is disposed below the load port 101. The front surface 121a is provided with an opening 126 in which the load port 101 is installed. The front surface 121a is also provided with an opening 127 which is a load/unload port for the wafers W with respect to the lower accommodator 103.

[0032] The rear surface 122a faces the front surface 121a in the device depth direction (Y direction). A central portion of the rear surface 122a in the device width direction (X direction) is located on the rear side (positive side in the Y direction) of the main body 102 and extends in the device width direction (X direction) in a plan view. A load lock module 50 is connected to the central portion of the rear surface 122a in the device width direction. Openings 128 are provided in the central portion of the rear surface 122a in the device width direction at a position corresponding to the load lock chamber 51. The openings 128 are provided in a portion of the rear surface 122a substantially at the same vertical position as a delivery position within the load lock chamber 51. The delivery position within the load lock chamber 51 is a position of the wafer W in the vertical direction when the wafer W is delivered between the load lock chamber 51 and the transfer robot 110.

[0033] Further, both ends of the rear surface 122a in the device width direction are located on the rear side (positive side in the Y direction) of the central portion of the rear surface 122a in the device width direction (X direction) so that the storage space S11 is formed inside the housing 120.

[0034] The pair of side surfaces 123a connect the front surface 121a and the rear surface 122a in the device depth direction (Y direction). In one embodiment, the pair of side surfaces 123a connect the front surface 121a and the rear surface 122a in the device depth direction via outer circumferential surfaces of the columns 500 and 510. In addition, the pair of side surfaces 123a face each other in the device width direction (X direction). Each side surface 123a extends in

the device depth direction in a plan view.

[0035] The bottom wall 124 and the top wall 125 face each other in the vertical direction and extend in the horizontal direction (in the X and Y directions), respectively.

[0036] 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 top wall 125. The internal space is divided vertically into a lower transfer space S1 and an upper space (also called an accommodation space) S2 at the central portion in the device width direction (X direction) by a partition wall 131 provided between the bottom wall 124 and the top wall 125. Further, at both ends in the width direction of the device, the internal space is divided vertically into the lower transfer space S1 and storage space S11 and the accommodation space S2 by the partition wall 131. As will be described later, a purified gas is supplied from the accommodation space S2 to the transfer space S1, and an opening 132A for supplying the gas is provided in the partition wall 131. In addition, as will be described later, the purified gas is supplied from the accommodation space S2 to the storage space S11, and an opening 132B for supplying the gas is provided in the partition wall 131.

[0037] As shown in FIG. 5, each of the columns 500 and 510 is connected to the wall 120A.

[0038] The columns 500 are disposed at a corner of the housing 120 on the negative side in the X direction and the front side (negative side in the Y direction), and at a corner of the housing 120 on the positive side in the X direction and the front side (negative side in the Y direction). The columns 500 disposed on the front side extend in the vertical direction. As shown in FIG. 5, the columns 500 are disposed to protrude toward the front side (negative side in the Y direction) of the transfer device 20. This makes it possible to maximize a volume of the transfer space S1.

[0039] The columns 510 are disposed at a corner of the housing 120 on the negative side in the X direction and the rear side (positive side in the Y direction), and at a corner on the positive side in the X direction and the rear side (positive side in the Y direction). As shown in FIGS. 4 and 7, the columns 510 include, for example, an upper member 511 located on an upper side and a lower member 512 located on a lower side so as to be continuous with the upper member 511.

[0040] A rear surface 512a of the lower member 512 is disposed on the front side (negative side in the Y direction) of a rear surface 511a of the upper member 511. Specifically, the upper member 511 extends in the vertical direction. An upper portion of the lower member 512 is an inclined portion 513 that extends obliquely downward toward the front side, and a portion of the lower member 512 below the inclined portion 513 extends in the vertical direction. That is, the column 510 extends vertically downward from the upper end thereof to the inclined portion 513, the inclined portion 513 extends obliquely downward toward the front side, and the portion from the inclined portion 513 to the lower end extends vertically downward. Thus, a space S21 is formed below the upper member 511 of the column 510 (specifically below the inclined portion 513). Peripheral components (e.g., a storage exhaust duct 750 described later) provided outside the main body 102 are disposed, or accommodated in the space S21.

[0041] Further, both ends of the rear surface 122a of the wall 120A in the device width direction may have the same shape as the rear surface 511a of the column 510. Thus, a space S22 similar to the space S21 is also formed below the rear surface 122a of the wall 120A.

[0042] The beam 520 is connected to the wall 120A at a lower rear portion of the main body 102. For example, the beam 520 is provided to extend in the device width direction along a central portion of the rear wall 122 in the device width direction (X direction).

[0043] As shown in FIGS. 8 and 9, the load port 101 includes a connecting plate 140, an isolation cover 150, and a main cover 151.

[0044] The connecting plate 140 is attached to the front surface 121a so as to cover the opening 126 when connected to the main body 102. An upper side of the connecting plate 140 extends to protrude from above the main cover 151. An opening 141, which is a load/unload port for the wafers W, is provided on the upper side of the connecting plate 140 above the isolation cover 150 and the main cover 151. A lower side of the connecting plate 140 extends so as to cover a rear surface of the isolation cover 150 and a rear surface of the main cover 151. Slits 142 for raising and lowering an arm 192 of a moving mechanism 190, which will be described later, are provided on the lower side of the connecting plate 140 to extend in the vertical direction.

[0045] The isolation cover 150 forms an accommodation space S3 between itself and a front

surface of the connecting plate 140 to accommodate the moving mechanism 190 described later. The isolation cover 150 also covers the slits 142 from the front side. By providing the isolation cover 150, it is possible to suppress leakage of a gas from the transfer space S1 of the main body 102 to the outside of the transfer device 20.

[0046] The main cover 151 forms an accommodation space S4 between the connecting plate 140 and the isolation cover 150 to accommodate a forward/backward movement mechanism 170, which will be described later. The main cover 151 also covers the forward/backward movement mechanism 170 and the isolation cover 150. In this embodiment, the main cover 151 covers a front wall and a top wall of the isolation cover 150, but does not cover a bottom wall thereof.

[0047] The bottom wall of the isolation cover 150 and a bottom wall of the main cover 151 constitute a bottom surface of the load port 101. A slider 152 is provided on the bottom surface of the load port 101. When attaching the load port 101 to the main body 102, the slider 152 is slid on an upper surface of a first accommodator 103A of the lower accommodator 103, which will be described later. When the load port 101 is connected to the main body 102, the slider 152 is spaced apart from the upper surface of the first accommodator 103A.

[0048] Further, the load port 101 includes a stage 160 and the forward/backward movement mechanism 170.

[0049] The stage 160 includes a placement surface 160a for the FOUP 2000 that accommodates the wafers W. Specifically, an upper surface of the stage 160 serves as the placement surface 160a for the FOUP 2000. The stage 160 supports the FOUP 2000 on the placement surface 160a thereof. The FOUP 2000 placed on the placement surface 160a is disposed so that a lid 2001, which is a door of the FOUP 2000, faces the opening 141 of the connecting plate 140. The stage 160 is provided on the upper surface of the main cover 151 described above.

[0050] The stage 160 is provided with a nozzle 161 that supplies a gas to the FOUP 2000. Specifically, the nozzle 161 supplies an inert gas such as nitrogen gas into the FOUP 2000 placed on the stage 160. The nozzle 161 is movable by the forward/backward movement mechanism 170. Specifically, the nozzle 161 is movable together with the stage 160 which is

moved by the forward/backward movement mechanism 170. In addition, the nozzle 161 protrudes from a lower surface of the stage 160, and a lower portion thereof protrudes into the aforementioned accommodation space S4.

[0051] The forward/backward movement mechanism 170 moves the stage 160 forward and backward in the horizontal direction. Specifically, the forward/backward movement mechanism 170 moves the stage 160 forward and backward relative to the opening 141. More specifically, the forward/backward movement mechanism 170 moves the stage 160 between a forward position and a backward position. The forward position is a position where the FOUP 2000 is delivered between the external transfer device for the FOUP 2000 and the stage 160. The backward position is a position for delivering the wafer W between the FOUP 2000 and the main body 102 via the opening 141.

[0052] The forward/backward movement mechanism 170 includes, for example, a guide 171 and a support 172. The guide 171 guides movement of the stage 160 in the device depth direction. Specifically, the guide 171 guides movement of the support 172, which supports the stage 160, in the front-rear direction. An upper end of the support 172 is connected to the stage 160, and a lower end thereof is connected to the guide 171 so as to be movable in the device depth direction in which the guide 171 extends. The forward/backward movement mechanism 170 is accommodated in the aforementioned accommodation space S4.

[0053] The load port 101 further includes a door 180 and the moving mechanism 190.

[0054] The door 180 opens and closes the opening 141. The door 180 is configured to unlock the lid 2001 of the FOUP 2000 and to hold the lid 2001. With the unlocked lid 2001 held by door 180, the door 180 is opened, thereby opening the lid 2001. During the opening/closing operation of the door 180, the door 180 moves inside the main body 102 (specifically, inside the transfer space S1).

[0055] The moving mechanism 190 has the function of a lifting mechanism, which opens and closes the door 180 and the lid 2001 and also raises and lowers them. The moving mechanism 190 includes, for example, an actuator 191, the arm 192, and a lifting body 193.

[0056] The actuator 191 drives raising and lowering of the door 180. Specifically, the actuator

191 drives raising and lowering of the lifting body 193 that supports the door 180 via the arm 192. The actuator 191 is installed inside the load port 101 so as to extend in the vertical direction (in the Z direction). The actuator 191 may be an electro-pneumatic actuator such as an air cylinder, or an electromechanical actuator.

[0057] The arm 192 supports the door 180 and is driven by the actuator 191. For example, as shown in FIG. 8, a pair of arms 192 are provided along the device width direction (X direction). An upper end of each arm 192 is connected to the door 180 which may be located inside the main body 102 (specifically, inside the transfer space S1), and a lower end of each arm 192 is connected via the lifting body 193 to the actuator 191 which is located inside the load port 101, i.e., outside the main body 102. In order to raise and lower the arms 192 in this connected state, the slits 142 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 142 through which the arms 192 can be inserted and through which the arms 192 pass when they are raised and lowered. The slits 142 are provided for the respective arms 192, for example.

[0058] The lifting body 193 moves up and down along the actuator 191, i.e., moves in the vertical direction.

[0059] The moving mechanism 190 is configured to move the door 180 in the device depth direction (Y direction). For example, the arms 192 that support the door 180 are connected to the lifting body 193 so as to be movable in the front-rear direction.

[0060] The moving mechanism 190 is accommodated in the accommodation space S4 of the main cover 151 described above. Specifically, the accommodation space S4 accommodates a portion of the moving mechanism 190 located outside the main body 102, namely the actuator 191 of the moving mechanism 190, a portion of the arm 192, and the lifting body 193.

[0061] The moving mechanism 190 further includes an actuator (not shown) that drives forward and backward movement of the door 180. The moving mechanism 190 is controlled by the control device C. Specifically, the aforementioned actuator of the moving mechanism 190 and the actuator 191 are controlled by the control device C.

[0062] As shown in FIGS. 2 to 4, the lower accommodator 103 includes a plurality of

accommodators stacked in the vertical direction, and includes, for example, the upper first accommodator 103A and a lower second accommodator 103B.

[0063] The first accommodator 103A accommodates a function expansion module configured as at least one 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 of the substrate. The aforementioned opening 127 is provided in the front wall 121 of the main body 102 at a position corresponding to the first accommodator 103A.

[0064] The measurement module or the inspection module accommodated in the first accommodator 103A includes, for example, a module including a stage (not shown) on which the wafer W is placed and which is configured to move in the horizontal direction, and an imager (not shown) for imaging the wafer W placed on the stage and moving in the horizontal direction. Alternatively, or additionally, the measurement module or the inspection module may include a module configured to use an imager (not shown) to image the wafer W which is supported by the transfer robot 110 inserted through the opening 127 and moving in the horizontal direction.

[0065] The second accommodator 103B accommodates electrical components including a power supply unit. No opening like the opening 127 is provided in the second accommodator 103B. In other words, of the first accommodator 103A and the second accommodator 103B, only the upper accommodator 103A has an opening that serves as a load/unload port for the wafers W.

[0066] The main body 102 includes a door 200 and a lifting mechanism 210.

[0067] The door 200 opens and closes the opening 128 in the rear wall 122 described above. The lifting mechanism 210 raises and lowers the door 200 to open and close the opening 128. The door 200 and the lifting mechanism 210 are installed inside the main body 102 (specifically inside the transfer space S1).

[0068] The lifting mechanism 210 includes an actuator (not shown) that drives the door 200 up and down. The lifting mechanism 210 is controlled by the control device C. Specifically, the actuator of the lifting mechanism 210 is controlled by the control device C.

[0069] Further, the main body 102 includes the 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 141 and the storage space S11, between the opening 128 and the storage space S11, and the like. The transfer robot 110 is accommodated in the transfer space S1 described above and placed on the bottom wall 124.

[0070] As shown in FIG. 10, the transfer robot 110 includes a horizontal arm 220 and a vertical articulated arm 230 as transfer arms.

[0071] The horizontal arm 220 is configured to transfer the wafer W in the horizontal direction. The horizontal arm 220 is, for example, a multi-joint arm and includes a fork 221, a first arm 222, and a second arm 223.

[0072] The fork 221 supports the wafer W at its tip. The fork 221 is connected at its base end to a tip of the first arm 222 so as to be rotatable about an axis (hereinafter referred to as "vertical axis") extending in the vertical direction (Z direction). The first arm 222 is connected at its base end to a tip of the second arm 223 so as to be rotatable about a vertical axis. The second arm 223 is connected to a tip of the vertical articulated arm 230 so as to be rotatable about a vertical axis.

[0073] The vertical articulated arm 230 is configured as an articulated arm and is configured to be capable of at least moving the horizontal arm 220 up and down. In this embodiment, the vertical articulated arm 230 is configured to be capable of moving the horizontal arm 220 in the vertical direction (Z direction) and the device width direction (X direction). The vertical articulated arm 230 includes an arm 231 provided to be rotatable in the vertical direction, and a base 232 connected to the arm 231 and fixed to a support stage 240 which will be described later.

[0074] The arm 231 includes, for example, a first arm 231A and a second arm 231B. The horizontal arm 220 is connected to a tip of the first arm 231A. Further, the first arm 231A is connected at its base end to a tip of the second arm 231B so as to be rotatable about an axis (hereinafter referred to as "front-rear axis") extending in the device depth direction. The second arm 231B is connected to an upper end of the base 232 so as to be rotatable about the front-rear axis on the base end side thereof.

[0075] The base 232 supports the horizontal arm 220 via the arm 231. The base 232 includes a

pair of plate-shaped members 233 and a bottom member 234.

[0076] The pair of plate-shaped members 233 are arranged side by side in the device depth direction (Y direction). Specifically, of the pair of plate-shaped members 233, a first plate-shaped member 233A is disposed on the front side (negative side in the Y direction), and a second plate-shaped member 233B is disposed on the rear side (positive side in the Y direction). The second arm 231B is pivotally supported between the first plate-shaped member 233A and the second plate-shaped member 233B.

[0077] The plate-shaped members 233 extend in the vertical direction within the transfer space S1. Further, a shape of the plate-shaped members 233 when viewed in the device depth direction is a substantially isosceles triangle including a pair of long sides extending along the vertical direction and a short side connecting the pair of long sides.

[0078] The bottom member 234 is disposed to connect a lower end of the first plate-shaped member 233A and a lower end of the second plate-shaped member 233B. A bottom surface of the bottom member 234 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 stage 240, which will be described later.

[0079] As shown in FIGS. 2 to 4 and 6, the main body 102 includes the support stage 240 and a pair of exhaust boxes 250 which serve as an exhauster.

[0080] The support stage 240 and the pair of exhaust boxes 250 are provided on the bottom wall 124 and are arranged side by side in the device width direction (X direction). Specifically, the pair of exhaust boxes 250 are arranged side by side on both sides of the support stage 240 in the device width direction.

[0081] The support stage 240 fixes and supports the transfer robot 110. An upper surface of the support stage 240 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 placed on the support stage 240, the positioning pins are inserted into the pin holes. Thus, the transfer robot 110 is fixed at a desired position with respect to the support stage 240.

[0082] The gas in the transfer space S1 flows into the exhaust box 250. For example, a portion of the gas discharged from the transfer space S1 into the exhaust box 250 is discharged to the outside of the device via a transfer space exhaust duct 760 described later, and the rest is returned to the accommodation space S2 via a return passage B described later.

[0083] As shown in FIGS. 2 and 3, the main body 102 includes a first FFU 260 which serves as a first gas supply that supplies an ambient gas (specifically, ambient gas existing above) to the transfer space S1.

[0084] The first FFU 260 blows the gas to be supplied to the transfer space S1. Specifically, the first FFU 260 supplies a purified gas, i.e., a gas from which particles, alkaline substances, acidic substances, organic substances, and the like are filtered out, downward from above the transfer space S1. The first FFU 260 is installed in the aforementioned accommodation space S2 above the transfer space S1 and is supported, for example, by the partition wall 131. As described above, the opening 132A is formed in the partition wall 131, and the first FFU 260 supplies the purified gas to the transfer space S1 via the opening 132A.

[0085] As mentioned above, the main body 102 has the storage space S11. For example, as shown in FIGS. 3, 4, and 6, the storage space S11 is divided into a plurality of regions R along the vertical direction. Specifically, the storage space S11 is divided into five regions R arranged in the vertical direction by partition plates 600. Hereinafter, the five regions R may be referred to as a first region R1, a second region R2, a third region R3, a fourth region R4, and a fifth region R5, in an order sequentially from top to bottom.

[0086] In each region R, as shown in FIGS. 10 and 11, in order to accommodate a plurality of wafers W, multiple pairs (e.g., twenty-five pairs) of support claws 610 are provided so as to be arranged along the vertical direction. Each pair of support claws 610 supports the wafer W horizontally by supporting a peripheral edge portion thereof. The support claws 610 and the partition plates 600 are supported by a frame 620 as shown in FIG. 12. When the frame 620 is fixed, the support claws 610 and the partition plates 600 are fixed within the main body 102 (specifically within the storage space S11).

[0087] Further, as shown in FIGS. 6 and 11, the main body 102 is provided with a gas supply

passage D for supplying a gas to the storage space S11. The gas supply passage D includes individual gas supply passages D1 for the respective regions R of the storage space S11, and a gas is supplied individually to the respective regions R via the individual gas supply passages D1. Hereinafter, the individual gas supply passages D1 corresponding to the first region R1, the second region R2, the third region R3, the fourth region R4, and the fifth region R5 may be referred to as a first individual gas supply passage D11, a second individual gas supply passage D12, a third individual gas supply passage D13, a fourth individual gas supply passage D14, and a fifth individual gas supply passage D15, respectively.

[0088] At least a portion of the gas supply passage D is formed within the wall 120A of the housing 120. Specifically, the wall 120A includes a wall body 630, which includes the rear surface 122a of the housing 120, and a gas supply passage former 640 that forms a space between itself and the wall body 630. The space serves as the gas supply passage D.

[0089] As shown in FIG. 13, the gas supply passage former 640 includes a flat plate portion 641 formed in a flat plate shape. The gas supply passage former 640 further includes first to fourth partition walls 651 to 654 each extending from the flat plate portion 641 toward the wall body 630. The first partition wall 651 forms a space serving as the first individual gas supply passage D11 and a space serving as the second individual gas supply passage D12 between the flat plate portion 641 and the wall body 630, and separates these spaces. The second partition wall 652 forms a space serving as the second individual gas supply passage D12 and a space serving as the third individual gas supply passage D13 between the flat plate portion 641 and the wall body 630, and separates these spaces. The third partition wall 653 forms a space serving as the third individual gas supply passage D13 and a space serving as the fourth individual gas supply passage D14 between the flat plate portion 641 and the wall body 630, and separates these spaces. The fourth partition wall 654 forms a space serving as the fourth individual gas supply passage D14 and a space serving as the fifth individual gas supply passage D15 between the flat plate portion 641 and the wall body 630, and separates these spaces.

[0090] Further, the main body 102 is further provided with gas supply ports 660 that are continuous with the gas supply passage D. The gas supply ports 660 are formed, for example,

on a gas supply surface 641a of the flat plate portion 641 of the gas supply passage former 640, which faces the storage space, for the respective regions R within the storage space S11.

[0091] Further, the main body 102 includes a baffle 670 that covers the gas supply port 660. The baffle 670 has a plurality of through-holes 671 formed in a portion facing the gas supply ports 660.

[0092] Further, as shown in FIGS. 6 and 11, the main body 102 is provided with an exhaust passage E for discharging the gas supplied to the storage space S11. In this embodiment, the exhaust passage E is formed within the column 510 on the rear side (positive side in the Y direction).

[0093] Further, the main body 102 is provided with an exhaust port 700 that is continuous with the exhaust passage E. As shown in FIG. 11, the exhaust port 700 is formed in the column 510 on the rear side facing the storage space S11, i.e., in an exhaust surface 510a facing the storage space S11. Specifically, as shown in FIGS. 4 and 14, the exhaust port 700 is formed in the exhaust surface 510a for each region within the storage space S11.

[0094] Further, the main body 102 includes a baffle 710 that covers the exhaust port 700. The baffle 710 has a plurality of through-holes 711 formed in a portion facing the exhaust port 700.

[0095] In this embodiment, the gas supply port 660 and the exhaust port 700 are formed to satisfy the following conditions. As shown in FIG. 15, a virtual normal line L1 extending from the gas supply surface 641a where the gas supply port 660 is formed, and a virtual normal line extending from the exhaust surface 510a where the exhaust port is formed, intersect with the transfer space S1. The gas supply surface 641a and the exhaust surface 510a are not parallel. Alternatively, the gas supply port 660 and the exhaust port 700 may be formed so that the gas supply surface 641a and the exhaust surface 510a are parallel as shown in FIG. 16. By arranging the gas supply port 660 and the exhaust port 700 as shown in FIGS. 15 and 16, it is possible to form an appropriate gas flow in the storage space S11, while more effectively suppressing a downflow from the first FFU 260 formed in the transfer space S1 from being drawn into the exhaust port 700.

[0096] Further, as shown in FIGS. 3 and 6, the main body 102 includes a second FFU 720 as a

second gas supply, in addition to the first FFU 260.

[0097] The second FFU 720 blows a gas to be supplied to the storage space S11. Specifically, the second FFU 720 supplies a purified gas, i.e., a gas from which particles are filtered out, toward the gas supply passage D. This allows the gas supply passage D to supply a gas from the second FFU to the storage space S11. The second FFU 720 is installed, for example, in the aforementioned accommodation space S2 and is supported by the partition wall 131. As described above, the opening 132B is formed in the partition wall 131, and the second FFU 720 supplies the purified gas to the gas supply passage D via the opening 132B.

[0098] Further, as shown in FIG. 4, the transfer device 20 further includes the storage exhaust duct 750 that discharges the gas in the exhaust passage E of the column 510 on the rear side to the outside of the device. The storage exhaust duct 750 is an external exhaust passage component that constitutes an external exhaust passage for discharging the gas in the exhaust passage E to the outside of the device. The storage exhaust duct 750 is used, for example, to discharge a gas from the storage space S11 to the outside of the device when the transfer device 20 is started up. One end of the storage exhaust duct 750 is connected, for example, to the lower member 512 of the column 510 from the rear side, i.e., to the rear surface 512a. The exhaust passage E and the flow path in the storage exhaust duct 750 are in communication with each other via a communication port 751 provided at a portion of the lower member 512 to which the storage exhaust duct 750 is connected.

[0099] As shown in FIGS. 17 and 18, the storage exhaust duct 750 includes a storage exhaust duct 750A connected to the column 510 on the positive side in the X direction, and a storage exhaust duct 750B connected to the column 510 on the negative side in the X direction.

[0100] The storage exhaust duct 750A connected to the column 510 on the positive side in the X direction includes an on-off valve 752, a flow rate adjustment valve 753, a flexible exhaust tube 754, an in-beam exhaust passage 755, an exhaust pipe 756, and the like. The on-off valve 752 switches start and stop of the exhaust from the exhaust passage E via the storage exhaust duct 750. The flow rate adjustment valve 753 adjusts an amount of an exhaust gas discharged from the exhaust passage E via the storage exhaust duct 750. The flexible exhaust tube 754 connects

the flow rate adjustment valve 753 and the in-beam exhaust passage 755. The in-beam exhaust passage 755 is formed inside a central portion of the beam 520 in the device width direction (X direction). The central portion of the beam 520 in the device width direction is a portion located in a region where a position of the central portion in the device width direction (X direction) overlaps with the load lock chamber 51. The exhaust pipe 756 connects the in-beam exhaust passage 755 to an integrated box described later, which is located on the negative side in the X direction.

[0101] Of the exhaust passages within the storage exhaust duct 750A (i.e., the external exhaust passages formed by the storage exhaust duct 750A, which is an external exhaust passage component), the portion located in the region where the position thereof in the device width direction (X direction) overlaps with the load lock chamber 51 is configured as an in-beam exhaust passage.

[0102] On the other hand, the storage exhaust duct 750B connected to the column 510 on the negative side in the X direction is connected directly to the integrated box without going through the in-beam exhaust passage 755.

[0103] At least the end of the storage exhaust duct 750 on the side of the column 510 is accommodated in the space S21 below the upper member 511 of the column 510 (specifically, below the inclined portion 513). For example, the on-off valve 752 and the flow rate adjustment valve 753 are disposed, i.e., accommodated, in the space S21. In addition, the space S21 can also accommodate peripheral components other than the storage exhaust duct 750, and can accommodate, for example, tubes that supply a gas for operating the components of the transfer device 20, and power cables that supply electric power to the components.

[0104] Further, the transfer device 20 includes the transfer space exhaust duct 760. The transfer space exhaust duct 760 discharges the gas in the transfer space S1 to the outside of the device, specifically discharges the gas in the exhaust box 250 to the outside of the device. The transfer space exhaust duct 760 is accommodated, for example, in the space S22 on the negative side in the X direction.

[0105] The transfer device 20 further includes an integrated box 770. The integrated box 770 is

used for connecting the storage exhaust duct 750 and the transfer space exhaust duct 760 together to an external exhaust mechanism (not shown) of the transfer device 20. Downstream ends of the storage exhaust duct 750 and the transfer space exhaust duct 760 are connected to the integrated box 770, and one end of a main exhaust pipe (not shown) having the other end connected to the exhaust mechanism is also connected to the integrated box 770. The integrated box 770 is accommodated, for example, so as to straddle the aforementioned spaces S21 and S22 on the negative side in the X direction. Although not shown, the storage exhaust duct 750 and the transfer space exhaust duct 760 may also extend downward from the transfer device 20 and may be connected to a factory-side exhaust line.

[0106] Further, as shown in FIG. 4, the transfer device 20 includes the return passage B that returns the gas supplied to the transfer space S1 from the accommodation space S2 (upper space of the transfer space S1) provided with the first FFU 260 back to the accommodation space S2. In this embodiment, the exhaust passage E is formed in column 510 on the rear side (positive side in the Y direction), and the return passage B is formed inside the column 500 on the front side. That is, in this embodiment, the column 510 having the exhaust passage E formed therein and the column 510 having the return passage B formed therein are arranged side by side along the device depth direction (Y direction) so as to face each other.

[0107] In this embodiment, the gas supplied to the storage space S11 and discharged to the exhaust passage E is circulated using the return passage B. A configuration for this purpose is described below.

[0108] An outlet 701 communicating with the exhaust passage E of the column 510 is formed in the front surface 510b of the lower end of the column 510 on the rear side. The front surface 510b extends in the device width direction (X direction). Further, a fan 800 for guiding the gas supplied to the storage space S11 into the exhaust passage E is installed in the exhaust passage E within the lower end of the column 510 on the rear side. The fan 800 can blow the gas in the exhaust passage E toward the outlet 701, i.e., can blow the gas in the exhaust passage E via the outlet 701 into a sub-exhaust box 810 described later. Specifically, the fan 800 is installed in a portion of the column 510 below the inclined portion 513 in the exhaust passage E. The fan

800 may also be provided in the sub-exhaust box 810 described later.

[0109] Further, the exhaust passage E is formed in conformity with a shape of the column 510 on the rear side having the inclined portion 513.

[0110] An inlet 702 communicating with the return passage B is formed in the rear surface 500a of the lower end of the column 500 on the front side. The rear surface 500a extends in the device width direction (X direction). In this embodiment, the outlet 701 is formed at a first height position, and the inlet 702 is formed at a second height position different from the first height position (in the illustrated example, the second height position is higher than the first height position). A fan (not shown) for guiding the gas around the inlet 702 into the return passage B may be installed in the return passage B of the column 500 on the front side.

[0111] Further, as shown in FIGS. 6, 19, and 20, the sub-exhaust box 810 to which the gas discharged from the exhaust passage E of the column 510 on the rear side is supplied is provided inside the housing 120 as a member that guides the gas discharged from the exhaust passage E of the column 510 on the rear side to the return passage B of the column 500 on the front side.

[0112] On the positive side in the X direction of the main body 102, the sub-exhaust box 810 is provided on the bottom wall 124. Specifically, the sub-exhaust box 810 is provided on the bottom wall 124 so as to be arranged side by side in the device width direction (X-direction) of the exhaust box 250 (hereinafter sometimes referred to as "main exhaust box 250"). Further, the sub-exhaust box 810 is provided to connect the column 510 on the rear side and the column 500 on the front side. Specifically, the sub-exhaust box 810 is provided to connect the outlet 701 of the column 510 on the rear side and the inlet 702 of the column 510 on the front side.

[0113] Further, in this embodiment, the sub-exhaust box 810 is configured to receive a gas from the transfer space S1. Specifically, the sub-exhaust box 810 is connected to the main exhaust box 250, and as shown in FIG. 20, an opening 811 is formed in the surface thereof facing the main exhaust box 250. More specifically, the sub-exhaust box 810 is disposed such that a first box 821 described later is adjacent to the main exhaust box 250 in the device width direction (X direction), and the opening 811 is formed in a surface 821a of the first box 821 facing the main exhaust box 250.

[0114] The main exhaust box 250 has an opening 251 formed on an end surface 250a on the side of the sub-exhaust box 810, i.e., on the side of the exhaust passage E and the return passage B in the device width direction (X direction) in a plan view. An internal space of the main exhaust box 250 and an internal space of the sub-exhaust box 810 are in communication with each other via the openings 811 and 251. The end surface 250a extends in the device depth direction (Y direction).

[0115] The sub-exhaust box 810 includes, for example, the first box 821 and a second box 822, which are provided at different height positions from each other. For example, the first box 821 is provided below the second box 822. The first box 821 and the second box 822 are formed to have a hollow shape, specifically a hollow rectangular parallelepiped shape.

[0116] The first box 821 is connected to a portion of the column 510 on the rear side where the outlet 701 is formed. The surface 821a of the first box 821 on the side of the main exhaust box 250 becomes a first surface connected to the end surface 250a of the main exhaust box 250. The surface 821a extends in the device depth direction (Y direction) and has the opening 811 formed therein, as described above. The internal space of the main exhaust box 250 and the internal space of the first box 821 are in communication with each other via the openings 811 and 251.

[0117] Further, a rear surface 821b of the first box 821 is a second surface connected to an end surface on a side of the return passage B in a plan view, i.e., the front surface 510b, of the column 510 having the exhaust passage E formed therein. The rear surface 821b extends in the device width direction (X direction) and has an opening 812 formed therein. The internal space of the first box 821 and the exhaust passage E formed in the column 510 are in communication via the opening 812 and the outlet 701.

[0118] Further, an upper surface 821c of the first box 821 is connected to a lower surface 822a of the second box 822. The upper surface 821c extends horizontally and has an opening 813 formed therein. Just like the upper surface 821c of the first box 821, the lower surface 822a of the second box 822 extends horizontally and has an opening 814 formed therein. The internal space of the first box 821 and the internal space of the second box 822 are in communication

with each other via the openings 813 and 814.

[0119] Further, a front surface 822b of the second box 822 is a third surface connected to an end surface on the side of the exhaust passage E in a plan view, i.e., the rear surface 500a, of the column 500 having the return passage B formed therein. The front surface 822b extends in the device width direction (X direction) and has an opening 815 formed therein. The internal space of the second box 822 and the return passage B formed in the column 500 are in communication with each other via the opening 815 and the inlet 702.

[0120] Further, the sub-exhaust box 810 may be provided with a fan 830 that blows a gas from the main exhaust box 250 into the sub-exhaust box 810. The fan 830 is provided, for example, in the first box 821.

[0121] Further, as shown in FIG. 6, one end of a supply pipe 270 for supplying an inert gas such as nitrogen gas to the accommodation space S2 may be connected to the housing 120. A gas supply mechanism 271 is connected to the other end of the supply pipe 270. The gas supply mechanism 271 includes, for example, an inert gas source, a switching valve for switching start and stop of supply of an inert gas, a flow rate adjustment valve for adjusting a flow rate of the inert gas, and so on.

[0122] By providing the supply pipe 270 as described above, a purified inert gas can be supplied from the first FFU 260 and the second FFU 720, and the inert gas can be circulated inside the main body 102. Alternatively, dry air may be circulated inside the main body 102. In this case, for example, the dry air is supplied from the gas supply mechanism 271 to the accommodation space S2 via the supply pipe 270.

[0123] In the transfer device 20 configured as described above, the gas supplied to the storage space S11 is discharged via the exhaust passage E formed in the column 510 of the housing 120. The transfer device 20 also supplies the gas in the accommodation space S2 to the transfer space S1 and the storage space S11 and returns the gas discharged from the exhaust passage E and the gas in the transfer space S1 supplied to the sub-exhaust box 810 provided in the housing 120, to the accommodation space S2 via the return passage B. This makes it possible to supply the gas in the accommodation space S2 to the transfer space S1 and the storage space S11 again. In

addition, the transfer device 20 may recirculate a portion of the gas discharged to the exhaust passage E and may discharge the rest to the outside of the device via the storage exhaust duct 750. Further, the transfer device 20 supplies a gas to the storage space S11 from the second FFU 720 provided in the main body 102 separately from the first FFU 260.

<Main Effects of Present Embodiment>

[0124] As described above, in this embodiment, the exhaust passage E for discharging the gas supplied to the storage space S11 is formed within the column 510 that constitutes the housing 120. Therefore, compared to a case where the exhaust passage E is provided outside the housing 120, it is possible to suppress an increase in the device footprint, reduce the number of components, and contribute to reducing manufacturing costs.

[0125] Further, in this embodiment, the sub-exhaust box 810 supplies the gas discharged from the exhaust passage E to the return passage B. Accordingly, it is possible to suppress downflow formed in the transfer space S1 from being disturbed by the gas discharged from the exhaust passage E. As a result, it is possible to suppress particles from swirling up due to the disturbance of the downflow and generation of vortices in the transfer space S1.

[0126] Further, in this embodiment, the return passage B is formed inside the column 500. The column 510 having the exhaust passage E formed therein and the column 500 having the return passage B formed therein are arranged side by side along the device depth direction (Y direction) so as to face each other. Thus, the distance from the column 510 having the exhaust passage E formed therein to the column 500 having the return passage B formed therein can be made short. Therefore, in this embodiment, when the gas supplied from the accommodation space S2 to the storage space S11 and discharged via the exhaust passage E is returned to and circulated through the accommodation space S2 via the return passage B, it is possible to suppress enlargement of the member (specifically, the sub-exhaust box 810) that guides the gas discharged from the exhaust passage E of the column 510 to the return passage B of the column 500. Accordingly, it is possible to contribute to reducing the manufacturing costs of the sub-exhaust box 810. As a result, it is possible to contribute to reducing the manufacturing costs of the transfer device 20.

[0127] Further, in this embodiment, the sub-exhaust box 810 has the hollow first box 821 and the hollow second box 822 that are provided at different height positions. The first box 821 and the second box 822 are connected so that the hollow portions thereof are in communication with each other. The first box 821 has the first surface (surface 821a) connected to the end surface 250a of the main exhaust box 250 on the side of the exhaust passage E and the return passage B in a plan view, and the second surface (rear surface 821b) connected to the end surface (front surface 510b) of the column 510 having the exhaust passage E formed therein on the side of the return passage B in a plan view. In addition, the second box 822 has the third surface (front surface 822b) connected to the end surface (rear surface 500a) of the column 500 having the return passage B formed therein on the side of the exhaust passage E in a plan view.

[0128] In a configuration in which the sub-exhaust box 810 is configured as a single rectangular parallelepiped box unlike this embodiment, it may be difficult to connect the first to third surfaces closely to the end surfaces (the surface 821a, the front surface 510b, and the rear surface 500a) of the corresponding members. In contrast, in this embodiment, since the sub-exhaust box 810 is configured as described above, each of the first to third surfaces can be connected closely to the end surfaces of the corresponding members. Therefore, it is possible to suppress gas leakage into the transfer space S1 from a connection portion between the sub-exhaust box 810 and the main exhaust box 250, and from connection portions between the sub-exhaust box 810 and the column 500 and between the sub-exhaust box 810 and the column 510. As a result, it is possible to suppress the downflow formed in the transfer space from being disturbed by the gas leaking from the connection portions. Further, in this embodiment, the first box 821 and the second box 822 may have a simple rectangular parallelepiped shape. Therefore, according to this embodiment, it is possible to reduce the manufacturing costs of the sub-exhaust box 810. As a result, it is possible to reduce the manufacturing costs of the transfer device 20.

[0129] Further, in this embodiment, the column 510 disposed on the rear side extends downward from the upper end thereof to the inclined portion 513, the inclined portion 513 extends obliquely downward toward the front side, and the portion from the inclined portion 513 to the lower end extends downward. The exhaust passage E is formed inside the column 510 in

conformity with the shape of the column 510. Therefore, the space S21 below the inclined portion 513 can be used as the storage space for the storage exhaust duct 750 or the like. As a configuration for forming an accommodation space at the same position as in this embodiment, it is conceivable to adopt a configuration in which the column 510 on the rear side and the exhaust passage E are formed in a crank shape. Compared to this configuration, according to this embodiment, it is possible to make smooth the gas flow within the exhaust passage E.

[0130] Further, in this embodiment, the fan 800 is provided to guide the gas supplied to the storage space S11 into the exhaust passage E. Therefore, it is possible to adjust an exhaust flow rate from the storage space S11. In addition, it is possible to secure a flow rate at which the gas supplied from the accommodation space S2 to the storage space S11 and discharged through the exhaust passage E is returned to the accommodation space S2 via the return passage B.

[0131] Further, in this embodiment, among the plurality of columns, the column 510 disposed on the rear side is configured as the upper member 511 and the lower member 512, and the rear surface 512a of the lower member 512 is disposed in front of the rear surface 511a of the upper member. Specifically, the column 510 extends vertically downward from its upper end to the inclined portion 513, the inclined portion 513 extends obliquely downward toward the front side, and the lower member 512 extends vertically downward from the inclined portion 513 to the lower end. Therefore, the space S21 below the upper member 511 (specifically below the inclined portion 513) (i.e., the space on the rear side of the rear surface 512a of the lower member 512) can be used as a storage space for accommodating the storage exhaust duct and the like. If the rear surface 512a of the lower member 512 of the column 510 on the rear side is at the same position as the rear surface 511a of the upper member 511 unlike this embodiment, when the storage exhaust duct 750 and the like are installed in the space on the rear side of the rear surface 512a of the lower member 512, the device footprint of the transfer device 20 would be expanded rearward. According to this embodiment, the storage exhaust duct 750 and the like can be accommodated in the space S21 below the upper member 511 of the column 510 on the rear side, which contributes to reducing the device footprint. Specifically, it is possible to suppress the rearward expansion of the device footprint of the transfer device 20.

[0132] Further, in this embodiment, the in-beam exhaust passage 755 is formed inside the central portion of the beam 520 of the housing 120, which is located in the region where the position of the central portion in the device width direction (X direction) overlaps with the load lock chamber 51. The portion of the exhaust passage within the storage exhaust duct 750A, which is located within the overlapping region, is configured as the in-beam exhaust passage 755. Therefore, according to this embodiment, unlike a configuration in which the storage exhaust duct is located on the rear side of the housing 120 in the overlapping region, it is not necessary to move the load lock chamber 51 backward away from the transfer device 20 to avoid interference between the storage exhaust duct and components (e.g., components of the load lock module 50) located below the load lock chamber 51. In addition, since it is not necessary to narrow the storage exhaust duct to shorten a distance from the transfer device 20 to the load lock chamber 51, exhaust capacity via the storage exhaust duct can be ensured. Therefore, according to this embodiment, it is possible to contribute to reducing the footprint of the wafer processing system 1 including the transfer device 20 and the processing apparatus 10, while suppressing damage to the exhaust via the storage exhaust duct.

[0133] Further, in this embodiment, the integrated box 770 connected to the external exhaust mechanism outside the transfer device 20 is provided, and the storage exhaust duct 750 and the transfer space exhaust duct 760 are collectively connected to the external exhaust mechanism via the integrated box 770. Therefore, according to this embodiment, compared to a case where the storage exhaust duct 750 and the transfer space exhaust duct 760 are individually connected to the external exhaust mechanism, it is easy to arrange pipes for connecting the storage exhaust duct 750 and the transfer space exhaust duct 760 to the external exhaust mechanism. As a result, it is possible to contribute to reducing the manufacturing costs.

[0134] Further, the integrated box 770 is accommodated in the space S21 below the upper member 511 that constitutes the column 510 on the rear side. Therefore, it is possible to suppress an increase in the device footprint due to the provision of the integrated box 770.

[0135] Further, in this embodiment, the transfer space S1 and the storage space S11 adjacent to the transfer space S1 are covered together by the housing 120. Therefore, compared to a case

where the transfer space S1 and the storage space S11 are covered by separate housings, it is possible to reduce the number of components, and contribute to reducing manufacturing costs.

[0136] In a configuration in which the storage space S11 is connected to the transfer space S1 in the device width direction unlike this embodiment, there is room for improvement in the following respects regarding maintenance of the transfer robot 110 inside the transfer space S1 and the peripheral components of the transfer space S1, which is performed by an operator accessing the transfer space S1. Specifically, an access route to the transfer space S1 is limited to the rear side of the transfer space S1. In order to access the transfer space S1 from a lateral side, it is necessary to remove components of the storage space S11 (such as the partition plates 600 and the like in this embodiment). According to a size of the transfer robot 110, even when the transfer space S1 is accessed from the rear side, it may not be possible to remove the transfer robot 110 from the housing 120 without disassembling the transfer robot 110. In contrast, in this embodiment, the column 510 having the exhaust passage E formed therein is provided on the rear side (the side of the rear surface 122a), and the storage space S11 is connected to the rear side of the transfer space S1. Therefore, when performing the maintenance described above, the transfer space S1 can be accessed from the lateral side (the side of the side surface 123a), and it is not necessary to remove the components of the storage space S11 when accessing the transfer space S1. Accordingly, this embodiment can contribute to improving maintainability of the transfer device 20.

[0137] Further, in this embodiment, the column 510 having the exhaust passage E formed therein has the exhaust port 700 formed on the side thereof facing the storage space S11 so as to be continuous with the exhaust passage E. Accordingly, a gas flow that passes over the wafers W supported in the storage space S11 and flows along the surfaces of the wafers W can be formed in the storage space S11.

[0138] Further, in this embodiment, the main body 102 further includes the gas supply passage D for supplying a gas to the storage space S11, and at least a portion of the gas supply passage D is formed within the wall 120A of the housing 120. Therefore, according to this embodiment, compared to a case where the gas supply passage D is not formed within the wall 120A of the

housing 120 but is provided separately unlike this embodiment, it is possible to suppress an increase in the number of components and an increase in manufacturing costs.

[0139] In a configuration in which the gas supply passage D and the second FFU 720 are not provided unlike this embodiment, when a portion of the gas blown from the first FFU 260 into the transfer space S1 is caused to flow into the storage space S11 by the exhaust from the exhaust passage E, it may become difficult to form a downflow having a desired intensity within the transfer space S1. Increasing a flow rate of the gas blown from the first FFU 260 can make the downflow intensive. However, there is a limit in increasing this flow rate.

[0140] In contrast, in this embodiment, the main body 102 of the transfer device 20 includes not only the first FFU 260 and the exhaust passage E, but also the second FFU 720 provided separately from the first FFU 260 and configured to blow a gas to be supplied to the storage space S11, and the gas supply passage D configured to supply the gas blown from the second FFU 720 to the storage space S11. Therefore, a gas can be supplied at a required flow rate into the storage space S11 without increasing a flow rate of the gas blown from the first FFU 260. That is, within a range of a flow rate of a gas that can be blown from the first FFU 260, the gas can be supplied to both the transfer space S1 and the storage space S11 at a flow rate necessary to form an appropriate gas flow in these spaces. Therefore, an appropriate gas flow can be formed in both the transfer space S1 and the storage space S11. Accordingly, it is possible to suppress swirling-up of particles in the transfer space S1 and to suppress generation of a corrosive gas from the wafers W supported in the storage space S11.

[0141] By using the vertical articulated arm 230 in the transfer robot 110 as in this embodiment, it is possible to reduce the footprint of the transfer space S1. Specifically, compared to a case where instead of the vertical articulated arm 230, a module is used in which a horizontal arm is moved in the vertical direction and in the device width direction by a lifting body configured to move along a rail extending in the device width direction (X direction), it is possible to shorten a width of the transfer space S1 in the device depth direction (Y direction). However, when the footprint of the transfer space S1 is reduced, an area of the first FFU 260 in a plan view becomes smaller, which may reduce the flow rate of the gas supplied from the first FFU 260 to the

transfer space S1. In this embodiment, even when the footprint of the transfer space S1 is small and the flow rate of the gas supplied from the first FFU 260 to the transfer space S1 is relatively small, the use of the second FFU 720 makes it possible to supply a gas to both the transfer space S1 and the storage space S11 at a flow rate necessary to form an appropriate gas flow in these spaces.

[0142] Further, when the number of wafers W that can be accommodated in the storage space S11 is large, the gas flow rate required for the storage space S11 will increase. Even when the gas flow rate required for the storage space S11 is large, the use of the second FFU 720 as in this embodiment makes it possible to supply a gas to both the transfer space S1 and the storage space S11 at a flow rate necessary to form an appropriate gas flow within these spaces.

[0143] Further, in this embodiment, the storage space S11 is divided into the plurality of regions R. The gas supply passage D includes individual gas supply passages D1 provided for the respective regions R of the storage space S11. Therefore, it is possible to suppress generation, among the regions R, of differences in the flow rate of the gas supplied from the second FFU 720, which is a single gas source for the gas supply passage D, to the respective regions R of the storage space S11 via the gas supply passage D.

[0144] Further, in this embodiment, the main body 102 is provided with the gas supply port 660 that is continuous with the gas supply passage D, and the gas supply port 660 is covered with the baffle 670 having the plurality of through-holes 671. Accordingly, it is possible to suppress uneven distribution, within the storage space S11, of the intensity of the gas flow formed by the gas supplied from the gas supply passage D via the gas supply port 660.

[0145] Further, in this embodiment, the main body 102 is provided with the exhaust port 700 that is continuous with the exhaust passage E, and the exhaust port 700 is covered by the baffle 710 having the plurality of through-holes 711. Accordingly, it is possible to suppress uneven distribution, within the storage space S11, of the intensity of the gas flow formed by the exhaust via the exhaust port 700 and the exhaust passage E.

[0146] Further, in this embodiment, the virtual normal line L1 extending from the gas supply surface 641a, which faces the storage space and has the gas supply port 660, intersects with the

transfer space S1. Therefore, the gas flow formed by the gas supplied from the gas supply port 660 can suppress the gas in the transfer space S1 from flowing into the storage space S11. In addition, the virtual normal line L2 extending from the exhaust surface 510a, which faces the storage space S11 and has the exhaust port 700, intersects with the transfer space S1. The gas supply surface 641a and the exhaust surface 510a are provided to sandwich the wafers W supported in the storage space S1 therebetween in a plan view and to form an inverted V-shape (an inverted V-shape with a gap at a tip thereof). Accordingly, the gas flow formed by the discharge of the gas supplied from the gas supply port 660 via the exhaust port 700 can be supplied to larger regions on the surfaces of the wafers W supported in the storage space S11.

<Modifications>

[0147] In the above example, the first surface provided in the first box 821 may be provided in the second box 822. Further, the first FFU 260 and the second FFU 720 are accommodated in the same accommodation space S2, but they may be accommodated in separate spaces isolated from each other. In the configuration in which the gas discharged from the exhaust passage E is returned to the space where the first FFU 260 is accommodated via the return passage B so as to circulate the gas from the second FFU 720 as in the present embodiment, when the first FFU 260 and the second FFU 720 are accommodated in separate spaces isolated from each other, for example, the following configuration is adopted. That is, the space where the first FFU 260 is accommodated and the space where the second FFU 720 is accommodated are connected by a gas supply pipe.

[0148] In the above example, the exhaust passage E is common to the plurality of regions R of the storage space S11. However, an exhaust passage E may be provided for each region R, and each exhaust passage may be formed within a single column. Alternatively, two exhaust passages may be formed within a column, so that one exhaust passage discharges a gas from some of the regions (e.g., upper three layer regions) and the other exhaust passage discharges a gas from the remaining regions (e.g., lower two layer regions). When a plurality of exhaust passages are formed within a single column, the storage exhaust duct 750 and the fan 800 may

be provided for each exhaust passage. Further, when a plurality of exhaust passages are formed within a single column, for example, the outlet 701 may be provided for each exhaust passage, and the sub-exhaust box 810 may be common to all exhaust passages.

[0149] In the above example, the storage space S11 is connected to the rear side of the transfer space S1. However, the storage space S11 may be connected to the front side of the transfer space S1. In this case, the exhaust passage E is formed in the column on the front side, and the return passage B is formed in the column on the rear side. When the storage space S11 is connected to the rear side of the transfer space S1, it is possible to reduce the device footprint while maintaining the placement number of load ports 101. Further, the storage space S11 provided at one end in the device width direction may differ from the storage space S11 provided at the other end in the device width direction. For example, the number of regions R, i.e., the number of divisions of the storage space S11, may differ between the storage space S11 provided at one end in the device width direction and the storage space S11 provided at the other end in the device width direction.

[0150] In the above example, the gas in the storage space S11 is discharged via the exhaust passage E formed within the column. Alternatively or additionally, the exhaust passage E may be used to discharge a gas in a space which is separate from the transfer space S1 and the accommodation space S2 within the main body 102 and which is different from the storage space S11.

[0151] 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 operative effects of the respective constituent elements in the combinations, as well as other operative effects that will be apparent to those skilled in the art from the description herein.

[0152] Further, 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.

[0153] The following configuration examples also fall within the technical scope of the present disclosure.

(1) A transfer device for loading and unloading substrates to and from a processing apparatus configured to process the substrates, the transfer device including:

a main body including a transfer space in which a transfer robot configured to transfer the substrates is provided, and an upper space provided above the transfer space,

wherein the main body is configured to be capable of supplying a gas in the upper space to the transfer space,

wherein the main body further includes:

a housing constituting the transfer space, the housing including a wall configured to form a front surface to which a load port configured to support a container for accommodating the substrates is connected, a rear surface to which a load lock provided in the processing apparatus is connected, and a pair of side surfaces connecting the front surface and the rear surface in a device depth direction and facing each other in a device width direction, and a plurality of columns connected to the wall;

an exhaust passage formed within the column and configured to discharge a gas in another space, which is separate from the transfer space and the upper space of the main body;

a return passage formed within the column and configured to return at least a gas in the transfer space to the upper space; and

an exhaust box provided inside the housing and configured to be supplied with the gas discharged from the exhaust passage and the gas in the transfer space, and

wherein the return passage is configured to return the gas supplied into the exhaust box back to the upper space.

(2) The transfer device of (1), wherein the main body further includes a main exhaust box configured to guide the gas in the transfer space to the exhaust box,

wherein the exhaust box includes:

a first surface connected to an end surface of the main exhaust box on a side of the exhaust passage and the return passage in a plan view;

a second surface connected to an end surface of the column having the exhaust passage formed therein on a side of the return passage in a plan view;

a third surface connected to an end surface of the column having the return passage formed therein on a side of the exhaust passage in a plan view; and

a hollow first box and a hollow second box provided at different height positions,

wherein the first surface is provided in either the first box or the second box,

wherein the second surface is provided in the first box,

wherein the third surface is provided in the second box, and

wherein the first box and the second box are connected so that hollow portions of the first box and the second box communicate with each other.

(3) The transfer device of (1) or (2), wherein, among the plurality of columns, a column disposed on a side of the rear surface extends downward from an upper end to an inclined portion, the inclined portion extends obliquely downward toward a side of the front surface, and the exhaust passage is formed in the column disposed on the side of the rear surface in conformity with the shape of the column disposed on the side of the rear surface.

(4) The transfer device of any one of (1) to (3), wherein at least one of the column having the exhaust passage formed therein or the exhaust box is provided with a fan configured to guide a gas in the another space into the exhaust passage.

(5) The transfer device of any one of (1) to (4), wherein the exhaust passage is formed inside, among the plurality of columns, a column disposed on a side of the rear surface,

wherein the transfer device further comprises an exhaust duct configured to discharge a gas in the exhaust passage of the column disposed on the side of the rear surface to an outside of the device,

wherein the housing further includes a beam connected to the wall at a lower portion of

the housing on the side of the rear surface,

wherein one end of the exhaust duct is connected from the side of the rear surface to the column disposed on the side of the rear surface,

wherein an in-beam exhaust passage is formed inside a portion of the beam, the portion being located in an overlapping region having a position in the device width direction overlapping with the load lock, and

wherein a portion of an exhaust passage within the exhaust duct located in the overlapping region is configured as the in-beam exhaust passage.

(6) The transfer device of (5), further comprising:

a transfer space exhaust passage provided outside the housing and configured to exhaust the transfer space; and

an integrated box connected to an exhaust mechanism provided outside the transfer device,

wherein the exhaust duct is connected to the integrated box via the in-beam exhaust passage, and the transfer space exhaust passage is connected to the integrated box.

(7) The transfer device of any one of (1) to (6), wherein the another space is a storage space connected to the transfer space and configured to support the substrates.

(8) A circulation method of circulating a gas between a transfer space in which a transfer robot configured to transfer substrates is provided and an upper space provided above the transfer space, in a transfer device for loading and unloading the substrates to and from a processing apparatus configured to process the substrates,

wherein the transfer device includes a main body including the transfer space and the upper space,

wherein the main body includes:

a housing constituting the transfer space, the housing including a wall configured to form a front surface to which a load port configured to support a container for accommodating the substrates is connected, a rear surface to which a load lock provided in the processing apparatus is connected, and a pair of side surfaces connecting

the front surface and the rear surface, and a plurality of columns connected to the wall portion;

an exhaust passage formed within the column and configured to discharge a gas in another space, which is separate from the transfer space and the upper space of the main body; and

a return passage formed within the column and configured to return at least a gas in the transfer space to the upper space, and

wherein a gas in the upper space is supplied to the transfer space, and a gas supplied to an exhaust box provided in the housing and discharged from the exhaust passage and the gas in the transfer space are returned to the upper space via the return passage.

EXPLANATION OF REFERENCE NUMERALS

[0154] 10: processing apparatus, 20: transfer device, 51: load lock chamber, 101: load port, 102: main body, 110: transfer robot, 120: housing, 120A: wall, 121a: front surface, 122a: rear surface, 123a: side surface, 500: column, 510: column, 810: sub-exhaust box, B: return passage, E: exhaust passage, S1: transfer space, S2: accommodation space, S11: storage space, W: wafer

WHAT IS CLAIMED IS:

1. A transfer device for loading and unloading substrates to and from a processing apparatus configured to process the substrates, the transfer device comprising:

a main body including a transfer space in which a transfer robot configured to transfer the substrates is provided, and an upper space provided above the transfer space,

wherein the main body is configured to be capable of supplying a gas in the upper space to the transfer space,

wherein the main body further includes:

a housing constituting the transfer space, the housing including a wall configured to form a front surface to which a load port configured to support a container for accommodating the substrates is connected, a rear surface to which a load lock provided in the processing apparatus is connected, and a pair of side surfaces connecting the front surface and the rear surface in a device depth direction and facing each other in a device width direction, and a plurality of columns connected to the wall;

an exhaust passage formed within the column and configured to discharge a gas in another space, which is separate from the transfer space and the upper space of the main body;

a return passage formed within the column and configured to return at least a gas in the transfer space to the upper space; and

an exhaust box provided inside the housing and configured to be supplied with the gas discharged from the exhaust passage and the gas in the transfer space, and

wherein the return passage is configured to return the gas supplied into the exhaust box back to the upper space.

2. The transfer device of Claim 1, wherein the main body further includes a main exhaust box configured to guide the gas in the transfer space to the exhaust box,

wherein the exhaust box includes:

a first surface connected to an end surface of the main exhaust box on a side of the exhaust passage and the return passage in a plan view;

a second surface connected to an end surface of the column having the exhaust passage formed therein on a side of the return passage in a plan view;

a third surface connected to an end surface of the column having the return passage formed therein on a side of the exhaust passage in a plan view; and

a hollow first box and a hollow second box provided at different height positions,

wherein the first surface is provided in either the first box or the second box,

wherein the second surface is provided in the first box,

wherein the third surface is provided in the second box, and

wherein the first box and the second box are connected so that hollow portions of the first box and the second box communicate with each other.

3. The transfer device of Claim 1 or 2, wherein, among the plurality of columns, a column disposed on a side of the rear surface extends downward from an upper end to an inclined portion, the inclined portion extends obliquely downward toward a side of the front surface, and the exhaust passage is formed in the column disposed on the side of the rear surface in conformity with the shape of the column disposed on the side of the rear surface.

4. The transfer device of Claim 1 or 2, wherein at least one of the column having the exhaust passage formed therein or the exhaust box is provided with a fan configured to guide a gas in the another space into the exhaust passage.

5. The transfer device of Claim 1 or 2, wherein the exhaust passage is formed inside, among the plurality of columns, a column disposed on a side of the rear surface,

wherein the transfer device further comprises an exhaust duct configured to discharge a gas in the exhaust passage of the column disposed on the side of the rear surface to an outside of

the device,

wherein the housing further includes a beam connected to the wall at a lower portion of the housing on the side of the rear surface,

wherein one end of the exhaust duct is connected from the side of the rear surface to the column disposed on the side of the rear surface,

wherein an in-beam exhaust passage is formed inside a portion of the beam, the portion being located in an overlapping region having a position in the device width direction overlapping with the load lock, and

wherein a portion of an exhaust passage within the exhaust duct located in the overlapping region is configured as the in-beam exhaust passage.

6. The transfer device of Claim 5, further comprising:

a transfer space exhaust passage provided outside the housing and configured to exhaust the transfer space; and

an integrated box connected to an exhaust mechanism provided outside the transfer device,

wherein the exhaust duct is connected to the integrated box via the in-beam exhaust passage, and the transfer space exhaust passage is connected to the integrated box.

7. The transfer device of Claim 1 or 2, wherein the another space is a storage space connected to the transfer space and configured to support the substrates.

8. A circulation method of circulating a gas between a transfer space in which a transfer robot configured to transfer substrates is provided and an upper space provided above the transfer space, in a transfer device for loading and unloading the substrates to and from a processing apparatus configured to process the substrates,

wherein the transfer device includes a main body including the transfer space and the upper space,

wherein the main body includes:

a housing constituting the transfer space, the housing including a wall configured to form a front surface to which a load port configured to support a container for accommodating the substrates is connected, a rear surface to which a load lock provided in the processing apparatus is connected, and a pair of side surfaces connecting the front surface and the rear surface, and a plurality of columns connected to the wall;

an exhaust passage formed within the column and configured to discharge a gas in another space, which is separate from the transfer space and the upper space of the main body; and

a return passage formed within the column and configured to return at least a gas in the transfer space to the upper space, and

wherein a gas in the upper space is supplied to the transfer space, and a gas supplied to an exhaust box provided in the housing and discharged from the exhaust passage and the gas in the transfer space are returned to the upper space via the return passage.