

PURGE APPARATUS AND PURGE METHOD

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to an apparatus for purging a container such as an FOUP (Front Opening Unified Pod), and to a purge method.

Description of the Related Art

[0002] In the semiconductor industry, purge gas such as nitrogen gas or clean dry air is injected into containers such as FOUPs that house wafers for purging the containers. When placing a container onto a load port or the like provided with a purge apparatus, the container is aligned with respect to the load port by means of an alignment member such as a kinematic pin. Then, a nozzle of the load port is brought into close contact with a gas introduction hole of the container, and the purge gas is injected or discharged. The container is not limited to an FOUP for housing wafers but may house other articles such as reticles. Also, the purge apparatus may be provided on a buffer serving as a temporal storage, a stocker having an automated warehouse function, or the like, in addition to load ports.

[0003] The height of the gas introduction hole from the bottom surface of the container varies, and for some shapes of the containers, it is necessary to set the upper end of the nozzle to be higher than the upper end of the alignment member. Further, there is a limitation on the alignment accuracy, when placing the containers onto the load ports or the like from an overhead traveling vehicle, a stacker crane, or the like. Therefore, in some cases, the nozzle catches the bottom portion of the container, and this makes it difficult to align the nozzle by means of the alignment member.

[0004] In order to prevent the nozzle from obstructing the alignment of the container, Patent Literature 1 (JP2011-187539) proposes to elevate and lower the nozzle by means

of an actuator; to lower the nozzle when aligning the container; to raise the nozzle after the alignment; and then to fit the nozzle into the gas introduction hole of the container. The actuator is a bellows or the like that expands and contracts by means of an air pressure cylinder, a motor, or by the pressure of purge gas, for example.

Citation List

Patent Literature

[0005] Patent Literature 1: JP2011-187539

SUMMARY OF THE INVENTION

Problem to be Solved by the Invention

[0006] The actuator to raise and lower the nozzle makes the structure of the purge apparatus complicated, and a problem regarding electrical control arises. Further, the adjustment and maintenance of the actuator, and so on become necessary.

[0007] An object of the present invention is to prevent the nozzle from obstructing the alignment of the container without an actuator.

Means for Solving Problem

[0008] One aspect of the present invention is a purge apparatus for purging by purge gas a container that houses an article and has a gas introduction hole in a bottom portion thereof comprising:

a platform for placing the container thereon; a nozzle protruding upward from the platform and configured to contact the gas introduction hole of the container and to inject purge gas; and an alignment member configured to align the container.

The nozzle is provided within a side surface of a tip portion thereof with a guide surface configured to guide the container and the nozzle is configured to lower an upper surface of the nozzle by a load applied from the container.

[0009] Another aspect of the present invention is a purge method purging by purge gas

a container that houses an article and has a gas introduction hole in a bottom portion thereof: with a purge apparatus comprising:

a platform for placing the container thereon; a nozzle protruding upward from the platform and configured to contact the gas introduction hole of the container and to inject purge gas; and an alignment member configured to align the container.

Said nozzle is provided within a side surface of a tip portion thereof with a guide surface configured to guide the container and to lower an upper surface of the nozzle by a load applied from the container.

The purge method comprising:

a step for guiding the container by means of the guide surface of the nozzle, when the nozzle contacts the container before the alignment member does, lowering the upper surface of the nozzle by the load applied from the container, and bringing the alignment member and the container into contact;

a step for aligning the container by means of the alignment member; and

a step for injecting purge gas from the nozzle into the container.

[0010] According to the present invention,

- in such a case where the nozzle contacts the container before the alignment member does, and the nozzle prevents alignment,

- the guide surface of the nozzle guides the container, and

- the upper surface of the nozzle is lowered by a load applied from the container, and thus the alignment member aligns the container. Therefore, an alignment failure does not occur due to the container catching the nozzle. Also, since an actuator is not necessary, the configuration is simple and electrical control is not required, and maintenance, adjustment, and the like are made easy. In the present specification, the descriptions related to the purge apparatus apply to the purge method as they are.

[0011] Preferably, said alignment member comprises alignment pins fixed to the platform, protruding upward from the platform, and configured to fit into recesses

provided in the bottom portion of the container, and the nozzle is higher than the alignment pins. With this configuration, when the nozzle contacts the bottom portion of the container before the alignment pins do, the container is guided by the guide surface of the nozzle, and simultaneously, the upper surface of the nozzle is lowered, and alignment is performed by means of the alignment pins.

[0012] Preferably, said nozzle is provided with a flat surface on an upper end thereof and is configured to make said flat surface inclined by an offset load applied from the gas introduction hole to said nozzle. Here, if the surface of the gas introduction hole and the flat surface of the upper end of the nozzle are not parallel, a portion of the flat surface of the nozzle contacts the gas introduction hole, and the offset load is applied from the gas introduction hole to the nozzle. This offset load makes the flat surface of the upper end of the nozzle inclined and brings the upper surface into uniform contact with the gas introduction hole without a gap. Therefore, purge gas is prevented from leaking.

[0013] Preferably, said nozzle is further provided at a lower portion thereof with a pedestal and an elastic member that biases the pedestal upward, and the nozzle is configured to be lowered by deformation of the elastic member with application of a load to the elastic member and to make the flat surface of the upper end of the nozzle inclined by deformation of the elastic member with application of the offset load to the elastic member. With this configuration, when the load from the container is applied to the nozzle, the elastic member is compressed and the nozzle is lowered, and further when the offset load is applied to the flat surface of the upper end of the nozzle, the elastic member is non-uniformly compressed and the flat surface inclines. Thus, the flat surface of the upper end of the nozzle and the gas introduction hole of the container fit to each other.

[0014] The nozzle is preferably further provided with a hollow shaft connecting said tip portion having the guide surface and the pedestal, and a ring-shaped elastic spacer

having an L-shaped form in cross section along a radial direction thereof, said platform is provided with a through hole through that said hollow shaft passes and the through hole has a larger diameter than the hollow shaft has, the hollow shaft has a smaller diameter than said tip portion has, and a bottom surface of said tip portion is exposed in a flange shape and surrounds the hollow shaft, said elastic member is positioned between the bottom surface of said tip portion and said platform and biases said tip portion upward, and one side of the L-shaped form of said elastic spacer is located in the through hole, and another side of the L-shaped form is located between the pedestal and a bottom surface of the platform. This simple and small configuration allows the nozzle to be lowered and inclined.

[0015] Preferably, the nozzle is provided with a ring-shaped elastic gasket on the upper end thereof. The gasket is compressed due to the load from the container, and the upper surface of the nozzle is lowered. Also, the gasket deforms so as to fit to the gas introduction hole of the container, and thus prevents purge gas from leaking.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] FIG. 1 is a plan view of a load port according to an embodiment.

FIG. 2 is a front view of a primary part of the load port according to the embodiment.

FIG. 3 is a front view of a primary part of the load port in a state where nozzles have been attached thereto.

FIG. 4 is a plan view of a primary part of the load port, showing a nozzle and its surroundings.

FIG. 5 is a partially-cutaway front view of a primary part of a load port, showing a nozzle according to a modification.

FIG. 6 is a partially-cutaway front view of a primary part of a load port, showing a nozzle according to a second modification.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] The following describes a preferred embodiment for carrying out the present invention. The scope of the present invention shall be determined based on the claims, with reference to the description in the specification and well known arts, and in accordance with the understandings of the skilled man in the art.

Embodiment

[0018] FIGS. 1 to 6 show an embodiment and modifications thereof. FIGS. 1 to 4 show the embodiment. Reference numeral 2 indicates a load port provided with a purge apparatus according to the embodiment. Note that the purge apparatus may be provided on a buffer for temporarily storing a container, a stocker having an automated warehouse function, and so on. The load port 2 is provided with a horizontal reference surface 4 (a platform for placing a container), which supports the bottom surface 26 of an FOUP 20. The container is not limited to an FOUP, but may be other containers having a gas introduction hole for purging therein and configured to be aligned by means of an alignment member of the purge apparatus. The load port 2 is provided with a transfer apparatus 6 that opens the lid of the FOUP 20, takes semiconductor wafers into or out of the FOUP 20 one by one, and transfers them to or from an unshown processing equipment or the like.

[0019] On the horizontal reference surface 4 of the load port 2, purge gas injection nozzles 8 and a discharge nozzle 9 are provided. The discharge nozzle 9 may not be provided. The nozzles 8 and 9 have the same configuration except that their gas flow directions are opposite. In the following, the nozzles 8 will be mainly described, but the same applies to the nozzle 9.

[0020] The nozzles 8 are supplied with purge gas from pipes 10, and the nozzle 9 is connected to an unshown exhaust pipe or the like. On the horizontal reference surface 4, for example, three kinematic coupling pins 12 (hereinafter, pins 12") are provided

and are configured to couple coupling grooves 24 of the container. Types of the alignment member are arbitrary. In the embodiment, the locations at which the alignment members align the container are not important, but it is important that the upper ends of the nozzles 8 and 9 are located higher than the upper ends of the pins 12. Reference numeral 14 indicates an occupation sensor which detects that a FOUP 20 has been placed onto the horizontal reference surface 4 (hereinafter, “reference surface 4”) and is used, for example, for turning the flow of purge gas to the pipes 10 on and off.

[0021] FIG. 2 shows a FOUP 20 in the course of being placed onto the reference surface 4. A top flange 21 of the FOUP 20 is held by a chuck of an elevation platform 22 of an unshown overhead traveling vehicle, and the elevation platform 22 is supported by the overhead traveling vehicle with suspending members such as belts 23. The position of the FOUP 20 varies according to the stopping accuracy of the overhead traveling vehicle, and vibrations of the building and swinging of the belts 23 further vary the position. In order to eliminate the variations, the pins 12 are coupled with the coupling grooves 24 provided in the bottom surface 26 of the FOUP 20. However, since the upper ends of the nozzles 8 and 9 are located higher than the upper ends of the pins 12, the nozzles 8 and 9 may catch nozzle receivers 25, and this makes it difficult to align the nozzles 8 and 9 correctly. Note that the reference numeral 5 indicates a base of the load port 2, and the upper surface thereof is the reference surface 4.

[0022] FIGS. 3 and 4 show the configuration of the nozzles 8 according to the embodiment, and the nozzle 9 has the same configuration. A tapered guide surface 30 becoming thinner at the tip is provided on the upper portion of the nozzle 8, and a flat surface 32 is provided on the upper end of the nozzle 8. Reference numeral 33 indicates a pedestal. A flow channel 34 is provided through the center of the nozzle 8 and is connected to the pipe 10 shown in FIG. 1 via a connector 35. In the embodiment, the upper surface of the pedestal 33 is in direct contact with the bottom surface of the base 5, while an elastic spacer 36 may be provided therebetween. Plural

screw shafts 37 penetrate through the pedestal 33, and the pedestal 33 is biased upward by plural springs 38. Reference numeral 39 indicates screw heads, reference numeral 40 indicates receivers supporting one end of springs 38, and reference numeral 41 indicates nuts.

[0023] The guide margin of the guide surface 30 is determined according to variations of the loading position of the FOUP 20. The guide surface 30 is preferably made of a low-friction material, has a smooth and hard surface so that abrasion dust is not generated, and generates little outgas. For example, stainless steel, PEEK (poly-ether-ether-ketone), polyethylene, polyacetal, and fluororesin are preferable as the material, and a guide surface 30 made of stainless steel coated by fluororesin is particularly preferable. The flat surface 32 is preferably flat and smooth, and a mirror polished flat surface 32 made of stainless steel is particularly preferable. The springs 38 may be replaced with cylindrical elastic members made of synthetic rubber or the like. In the embodiment, the pedestal 33 is biased upward by the springs 38 at plural positions so that the pedestal 33 is able to be lowered within a stroke of the order of several millimeters, the nozzles 8 are able to be inclined according to the surface of a gas introduction hole, and the nozzle 9 is able to be inclined according to the surface of a gas discharge hole.

[0024] The bottom surface 26 of the FOUP 20 is supported by the reference surface 4 and has a gas introduction hole corresponding to the nozzle 8. A nozzle receiver 25 is provided with an unshown gas discharge hole corresponding to the nozzle 9. As shown in FIG. 3, consider a case where the FOUP 20 is lowered with a displacement from the correct position. Then, while the guide surface 30 contacts the nozzle receiver 25 before the pins 12 contact with the coupling grooves 24, the FOUP 20 is guided to the correct position by means of the guide surface 30, and the nozzle 8 is lowered due to the weight of the FOUP 20. Therefore, while the FOUP 20 may catch the nozzles 8 at the beginning, the FOUP 20 is then aligned by means of the pins 12 and

the coupling grooves 24 shown in FIGS. 1 and 2. Further, since the guide surface 30 is made of a low-friction material and is smooth, it has a low friction against the nozzle receivers 25 and so on. Also, due to its hardness, the guide surface 30 generates little amount of abrasion dust.

[0025] When the placement of the FOUP 20 is completed, a portion of the weight of the FOUP 20 is supported by the nozzles 8 and 9, and the remaining weight is supported by the pins 12 and the reference surface 4. If the surfaces of the gas introduction holes 28 are not horizontal, it is difficult for the gas introduction holes 28 to fit the flat surfaces 32. The nozzles 8 and 9 are configured to be lowered and are each supported by springs 38 at plural positions. Therefore, when one portion of the flat surface 32 contacts the gas introduction holes 28, then some of springs 38 are offsetly loaded and are compressed, and the nozzles 8 and 9 swing. In other words, the nozzles 8 and 9 rotate about horizontal axes, and consequently, the flat surfaces 32 are brought into uniform contact with the gas introduction holes 28. At this time, the flat surfaces 32 are inclined relative to the horizontal plane, fill the gaps between the flat surfaces 32 and the gas introduction holes 28 and thus prevent purge gas from leaking.

Furthermore, since the nozzles 8 and 9 are able to be lowered and raised, variations in the height of the nozzles 8 and 9 and variations in the depth of the nozzle receivers 25 are accommodated.

[0026] The embodiment has the following characteristic features.

1) If the FOUP 20 is lowered while being displaced, the FOUP 20 is guided by the guide surfaces 30 of the nozzles 8 and 9, the nozzles 8 and 9 are lowered due to the load of the FOUP 20, the pins 12 are brought into contact with the coupling grooves 24, and thereafter the FOUP 20 is aligned by the pins 12. Therefore, an alignment failure does not occur due to the nozzles 8 and 9 being caught in the nozzle receivers 25 or the like. Also, the FOUP 20 is more reliably guided compared to when guided by pins 12 alone.

2) The flat surfaces 32 are able to be inclined relative to the horizontal plane when offset pressure is applied by the FOUP 28. Therefore, when the surfaces of the gas introduction holes 28 are not horizontal, the flat surfaces 32 and the gas introduction holes 28 are fitted each other, so that purge gas is prevented from leaking.

3) The nozzles 8 and 9 are biased upward and are able to move up and down and to incline (rotate about a horizontal axis). Therefore, when the height of the nozzles 8 and 9 vary, or the depth of the nozzle receivers 25, i.e., the height of the gas introduction holes 28 vary for example, the flat surfaces 32 are brought into close contact with the gas introduction holes 28.

4) A portion of the weight of the FOUP 20 is applied to the nozzles 8 and 9, and, with about the same force, the flat surfaces 32 are biased toward the gas introduction holes 28. Therefore, the flat surfaces 32 and the gas introduction holes 28 are reliably brought into contact with.

5) The above functions are achieved by means of the guide surfaces 30, the flat surfaces 32, the screw shafts 37, and the springs 38, and an actuator is not required.

[0027] In the embodiment, the upper surface of each pedestal 33 is located on the bottom surface side of the base 5. Conversely, the bottom surface of each pedestal 33 may be supported by the upper surface of the base 5 with an elastic member such as a spacer therebetween. The range of movement of the nozzles 8 may be limited by means of fixing members such as screws or pins, and each pedestal 33 may be biased upward by the elastic member. In this case, as well, the elastic members that support the nozzles 8 deform in response to the offset load applied to the flat surfaces 32, and the flat surfaces 32 are brought into close contact with the gas introduction holes of the FOUP.

[0028] According to the embodiment, with respect to the nozzles 8 and 9, the pedestal 33 is supported by springs 38 at plural positions so that the flat surface 32 inclines relative to the horizontal plane according to the gas introduction hole 28. FIG. 5

shows a nozzle 50 according to a modification in which support of the pedestal is simplified. Reference numeral 51 indicates a guide surface, reference numeral 52 indicates a flat surface, and they are respectively the same as the guide surface 30 and the flat surface 32 shown in FIGS. 3 and 4. Reference numeral 54 indicates a hollow shaft, reference numeral 56 indicates a pedestal, and reference numeral 57 indicates a spring, which may be an elastic member such as a cylindrical rubber. Reference numeral 58 indicates an elastic spacer, which is located between the base 5 and the nozzle 58 and is compressed due to the elastic force by the spring 57. Note that the nozzle 50 may be a nozzle for purge gas introduction or a nozzle for purge gas discharge.

[0029] The FOUP is guided by the guide surface 51 and the flat surface 52 is brought into close contact with the gas introduction hole of the FOUP, similarly to the embodiment. If the flat surface 52 is brought into non-uniform contact with the gas introduction hole, the elastic spacer 58 deforms, the nozzle 50 swings, and thus the flat surface 52 is brought into close contact with the gas introduction hole. Therefore, although the nozzle 50 is supported by the spring 57 at one position, the flat surface 52 is able to be inclined relative to the horizontal plane so as to be brought into close contact with the gas introduction hole.

[0030] FIG. 6 shows a nozzle 60 according to a second modification that is applicable to both the purge gas introduction nozzle and the purge gas discharge nozzle.

Reference numeral 61 indicates a guide surface, and reference numeral 62 indicates a ring-shaped elastic gasket made of synthetic rubber or the like, which is fitted into a tip portion of the nozzle 60 made of metal, for example. The upper surface of the gasket 62 has a flat surface 63. Reference numeral 65 indicates a pedestal fixed to the base 5 with screws 66 or the like, for example. Preferably, the guide surface 61 is smooth and hard, has a low friction, and emits little outgas, similarly to the embodiment.

Preferably, the gasket 62 is configured to have excellent sealing properties between the

gas introduction hole, fluoroelastomer rubber, fluororubber sponge, and rubber or sponge made of polyester or polyurethane are preferable as the material, for example.

Further, it is also preferable that the flat surface 63 is flat and has a low surface roughness. Note that the guide surface 61 may be made of the same material as the gasket 62, and the whole upper portion of the nozzle 60 may serve as a gasket.

[0031] The FOUP is guided by means of the guide surface 61, and in order to bring the gas introduction hole and the flat surface 63 into close contact and also in order to lower the flat surface 63, the flat surface 63 and the surrounding area thereof are made of the elastic gasket 62. When the surface of the gas introduction hole is not horizontal, the gasket 62 deforms and is brought into close contact with the gas introduction hole. With respect to the nozzle 60, the flat surface 63 may be lowered within a narrower area range, and therefore, the nozzles 8 and 9 shown in FIGS. 3 and 4 and the nozzle 50 shown in FIG. 5 are more preferable.

List of Reference Numerals

[0032] 2 Load port 4 Horizontal reference surface 5 Base 6 Transfer apparatus
 8, 9 Nozzle 10 Pipe 12 Kinematic coupling pin
 14 Occupation sensor 20 FOUP 21 Top flange
 22 Elevation platform 23 Belt 24 Coupling groove
 25 Nozzle receiver 26 Bottom surface 28 Gas introduction hole
 30 Guide surface 32 Flat surface 33 pedestal 34 Flow channel
 35 Connector 36 Elastic spacer 37 Screw shaft 38 Spring
 39 Head 40 Spring receiver 41 Nut 50 Nozzle
 51 Guide surface 52 Flat surface 54 Hollow shaft 56 pedestal
 57 Spring 58 Elastic spacer 60 Nozzle 61 Guide surface
 62 Gasket 63 Flat surface 65 pedestal 66 Screw

WHAT IS CLAIMED IS:

1. A purge apparatus for purging by purge gas a container that houses an article and has a gas introduction hole in a bottom portion thereof comprising:
a platform for placing the container thereon; a nozzle protruding upward from the platform and configured to contact the gas introduction hole of the container and to inject purge gas; and an alignment member configured to align the container,
wherein said nozzle is provided within a side surface of a tip portion thereof with a guide surface configured to guide the container and the nozzle is configured to lower an upper surface of the nozzle by a load applied from the container.
2. The purge apparatus according to claim 1,
wherein said alignment member comprises alignment pins fixed to the platform, protruding upward from the platform, and configured to fit into recesses provided in the bottom portion of the container, and wherein the nozzle is higher than the alignment pins.
3. The purge apparatus according to claim 1 or 2,
wherein said nozzle is provided with a flat surface on an upper end thereof and is configured to make said flat surface inclined by an offset load applied from the gas introduction hole to said nozzle.
4. The purge apparatus according to claim 3,
wherein said nozzle is further provided at a lower portion thereof with a pedestal and an elastic member that biases the pedestal upward, and
wherein the nozzle is configured to be lowered by deformation of the elastic member with application of a load to the elastic member and to make the flat surface of the upper end of the nozzle inclined by deformation of the elastic member with

application of an offset load to the elastic member.

5. The purge apparatus according to claim 4,

wherein said nozzle is further provided with a hollow shaft connecting said tip portion having the guide surface and the pedestal, and a ring-shaped elastic spacer having an L-shaped form in cross section along a radial direction thereof,

wherein said platform is provided with a through hole through that said hollow shaft passes and the through hole has a larger diameter than the hollow shaft has,

wherein the hollow shaft has a smaller diameter than said tip portion has, and a bottom surface of said tip portion is exposed in a flange shape and surrounds the hollow shaft,

wherein said elastic member is positioned between the bottom surface of said tip portion and said platform and biases said tip portion upward, and

wherein one side of the L-shaped form of said elastic spacer is located in the through hole, and another side of the L-shaped form is located between the pedestal and a bottom surface of the platform.

6. The purge apparatus according to claim 2,

wherein said nozzle is provided with a ring-shaped elastic gasket on the upper end thereof.

7. A purge method purging by purge gas a container that houses an article and has a gas introduction hole in a bottom portion thereof: with a purge apparatus comprising:

a platform for placing the container thereon; a nozzle protruding upward from the platform and configured to contact the gas introduction hole of the container and to inject purge gas; and an alignment member configured to align the container,

wherein said nozzle is provided within a side surface of a tip portion thereof

with a guide surface configured to guide the container and to lower an upper surface of the nozzle by a load applied from the container,

the purge method comprising:

a step for guiding the container by means of the guide surface of the nozzle, when the nozzle contacts the container before the alignment member does, lowering the upper surface of the nozzle by the load applied from the container, and bringing the alignment member and the container into contact;

a step for aligning the container by means of the alignment member; and

a step for injecting purge gas from the nozzle into the container.