

GATE VALVE USED IN SEMICONDUCTOR APPARATUS, AND MAINTENANCE METHOD THEREOF

Technical Field

5 The present application generally relates to a semiconductor apparatus, and more particularly relates to a gate valve used in the semiconductor apparatus and a maintenance method for the gate valve.

Background

10 Semiconductor apparatuses generally refer to apparatuses for manufacturing or processing semiconductor devices, which comprise, for example, Atomic Layer Deposition (ALD) apparatus and Chemical Vapour Deposition (CVD) apparatus, etc. The above-mentioned semiconductor apparatuses generally comprise at least one vacuum pipelines, and components such as gate valves installed on the vacuum
15 pipelines to control the opening and closing of the vacuum pipelines.

 The gate valve used on the semiconductor apparatus usually consists of a valve box on a vacuum side, a sealing valve plate, and an actuator on an atmospheric side. The valve box is connected to the vacuum pipelines through bolt flanges or vacuum clamps. The routine maintenance for the gate valve requires replacing a sealing ring
20 of the sealing valve plate. For prior gate valves, when performing a maintenance for a valve plate, the entire gate valve needs to be removed from the vacuum pipeline. When pipelines are complex or operating spaces are small, in order to remove the gate valve, it is further needed to detach other components close the gate valve, such as vacuum pipelines near the gate valve, etc. This results in difficulty in disassembly
25 and assembly, high time consumption and low efficiency in apparatus maintenance, and causes a significant disturbance to a dynamic balance of a vacuum system.

Summary

 In one aspect, embodiments of the present application provide a gate valve used
30 in a semiconductor apparatus, comprising: a valve box, which has a channel for connecting a vacuum pipeline in the semiconductor apparatus; an actuator, which has

a connecting flange for connecting the valve box; and a fixing device, which is set on the connecting flange and configured to detachably connect the actuator to the valve box, wherein a detachment direction of the fixing device faces the actuator.

5 In some embodiments, the gate valve further comprises a sealing valve plate, wherein an edge of the sealing valve plate is set with a sealing ring, the sealing valve plate is connected to the actuator, and the actuator is operable to drive the sealing valve plate into the valve box to close the channel, or to drive the sealing valve plate out of the valve box to open the channel.

10 In some embodiments, the gate valve further comprises a jackscrew, wherein the jackscrew is set on an edge side of the connecting flange, which faces the actuator, and is capable of passing through the connecting flange to contact the valve box. In some embodiments, the jackscrew comprises a pair of jackscrews that are symmetrically arranged on the edge side.

15 In some embodiments, the fixing device comprises a plurality of fixing screws set on an edge side of the connecting flange.

In some embodiments, the fixing device comprises a clamp.

20 In some embodiments, the clamp comprises a first clamp portion and a second clamp portion that are generally semi-annular, wherein a first end of the first clamp portion is locked and fixed with a first end of the second clamp portion through a first locking screw, and a second end of the first clamp portion is locked and fixed with a second end of the second clamp portion through a second locking screw.

25 In some embodiments, a first groove is provided on an edge of a portion adjacent to the connecting flange on the valve box, and a second groove corresponding to the first groove is provided on an edge of the connecting flange, a middle part of the first clamp portion, between the first end and the second end of the first clamp portion, is arranged in the first groove, and a middle part of the second clamp portion, between the first end and the second end of the second clamp portion, is arranged in the second groove.

30 In some embodiments, the detachment directions of the first locking screw and the second locking screw face the actuator.

In some embodiments, the clamp comprises two clamps that are symmetrically

arranged on the connecting flange.

In some embodiments, the gate valve further comprises a positioning pin, wherein the positioning pin is set on an edge side of the connecting flange, and passes through the connecting flange to be inserted into a positioning hole on the valve box.

5 In another aspect, embodiments of the present application provide a method for maintaining the gate valve according to any embodiment of the present application, wherein the gate valve is installed on a vacuum pipeline in a semiconductor apparatus, and the method comprises: detaching a fixing device on a connecting flange from an actuator side; and maintaining a connection between a valve box and the vacuum
10 pipeline, while removing the actuator for maintenance.

In some embodiments, the step of removing the actuator comprises removing a sealing valve plate connected to the actuator, wherein an edge of the sealing valve plate is set with a sealing ring.

15 In some embodiments, the method further comprises aligning the actuator with the valve box, and connecting the actuator to the valve box via the fixing device, after completing the maintenance.

In some embodiments, the fixing device comprises a plurality of fixing screws set on an edge side of the connecting flange.

In some embodiments, the fixing device comprises a clamp.

20 In some embodiments, the clamp comprises a first clamp portion and a second clamp portion that are generally semi-annular, a first groove is provided on an edge of a portion adjacent to the connecting flange on the valve box, and a second groove corresponding to the first groove is provided on an edge of the connecting flange, a middle part of the first clamp portion, between a first end and a second end of the first
25 clamp portion, is arranged in the first groove, and a middle part of the second clamp portion, between a first end and a second end of the second clamp portion, is arranged in the second groove, and the step of detaching a fixing device on a connecting flange comprises: loosening a first locking screw that locks and fixes the first end of the first clamp portion with the first end of the second clamp portion, and loosening a second
30 locking screw that locks and fixes the second end of the first clamp portion with the second end of the second clamp portion.

In some embodiments, the clamp comprises two clamps that are symmetrically arranged on the connecting flange.

In some embodiments, the method further comprises separating the actuator from the valve box by rotating a jackscrew set on an edge side of the connecting flange facing the actuator, before removing the actuator,; and returning the jackscrew after completing the maintenance. In some embodiments, the step of rotating a jackscrew comprises synchronously rotating a pair of jackscrews symmetrically arranged on the edge side.

In some embodiments, a positioning pin is used to align the actuator with the valve box, and the positioning pin is set on an edge side of the connecting flange.

The details of one or more embodiments of the present application are set forth in the following drawings and descriptions. Other features, objects and advantages will be apparent from the descriptions, drawings and claims.

Brief Description of the Drawings

The disclosure in this specification refers to and includes the following figures:

Figure 1 is a schematic diagram of the structure of a gate valve in the prior art;

Figure 2 is a simplified cross-sectional view of a gate valve according to some embodiments of the present application;

Figure 3 is a three-dimensional schematic diagram of the gate valve shown in Figure 2;

Figure 3A is a main view of the gate valve shown in Figure 3;

Figure 3B is an upward view of the gate valve shown in Figure 3;

Figure 3C is a left view of the gate valve shown in Figure 3;

Figure 3D is a right view of the gate valve shown in Figure 3;

According to convention, the various features illustrated in diagrams may not be drawn to scale. Therefore, for clarity, the dimension of various features may be arbitrarily increased or decreased. The shapes of components illustrated in diagrams are only exemplary shapes and do not limit the actual shapes of these components.

Additionally, for clarity, the implementations illustrated in the diagrams may be

simplified. Therefore, diagrams may not illustrate all components of a given device or apparatus. Finally, the same reference numbers may be used throughout the specification and drawings to refer to the same features.

Detailed Description of Embodiments

In order to better understand the spirit of the present application, it will be further described below in conjunction with some embodiments of the present application.

The terms "in one embodiment" or "according to one embodiment" used in this specification do not necessarily refer to a same specific embodiment, and the terms "in other (some/certain) embodiments" or "according to other (some/certain) embodiments" used in this specification do not necessarily refer to different specific embodiments. It is intended to comprise, for example, a combination of all or part of the examples and specific embodiments of the claimed theme. The meanings of "up" and "down" referred to in this article, are not limited to the relationship directly presented in the diagrams, they should include descriptions with clear corresponding relationships, such as "left" and "right", or the opposite of "up" and "down". The term "connect" referred to in this article should be understood as encompassing both "direct connect" and "connect via one or more intermediate components". The names of various components used in this specification are for illustrative purposes only, and do not have a limiting effect. Different manufacturers may use different names to refer to components with a same function.

Various implementations of the present application are discussed in detail below. Although specific implementations have been discussed, it should be understood that these implementations are only for purposes of illustration. Those skilled in the relevant art will recognize that other components and configurations may be used without deviating from the spirit and protection scope of the present application. The implementation of the present application may not necessarily comprise all components or steps in the embodiments described in the specification, and the execution order of each step may be adjusted according to actual applications.

Figure 1 is a schematic diagram of the structure of a gate valve 100 in the prior art.

A gate valve 100 is generally composed of a valve box 101 and an actuator 102. The valve box 101 is located on a vacuum side, and may be connected to a vacuum pipeline of a semiconductor apparatus as part of a vacuum piping system. For example, the valve box 101 may have a channel 104, two sections of vacuum pipelines may be connected to the valve box 101 from two ends of the channel 104. The valve box 101 may be connected to the vacuum pipelines through bolt flanges or vacuum clamps.

The actuator 102 is located on an atmospheric side relative to the vacuum side mentioned above. The actuator 102 may be connected to the valve box 101 via screws 103. The actuator 102 is connected to a sealing valve plate (not shown in Figure 1). The actuator 102 is operable to drive the sealing valve plate into the valve box 101 to close the channel 104, or to drive the sealing valve plate out of the valve box 101 to open the channel 104.

As shown in Figure 1, the detachment directions of the screws 103 face the valve box 101, that is, face the vacuum side where the valve box 101 and the vacuum pipelines are located. That is, if the actuator 102 needs to be removed from the valve box 101 for maintenance operations (such as replacing a sealing ring of the sealing valve plate), it is necessary to perform operations on the vacuum side to remove the screws 103. To perform such operations, the valve box 101 needs to be removed from the vacuum pipelines, that is, the entire gate valve 100 needs to be removed from the vacuum pipelines. When involving complex vacuum pipelines or vacuum pipelines with small operating spaces, it is necessary to remove a plurality of components around the gate valve 100 (such as part of vacuum pipelines) so that the gate valve 100 may be removed from the vacuum pipelines. This results in higher time consumptions for both disassembling and assembling of the gate valve and for maintenance for the gate valve, which results in a low efficiency in apparatus maintenance.

In addition, semiconductor apparatus usually requires extremely high apparatus accuracy, and maintenance for the gate valve 100 requires frequent disassembly and assembly of the gate valve and its surrounding components, such action may destroy an original apparatus accuracy and a balance of a vacuum system of the

semiconductor apparatus, which brings adverse effects to the semiconductor apparatus.

The embodiments of the present application provide a gate valve with a different structure, which can solve the above-mentioned problems of conventional gate valves, and can achieve the routine maintenance for a gate valve, such as replacing the sealing ring of the sealing valve plate and other maintenance actions, without disassembling the entire gate valve from the vacuum pipelines.

Figure 2 shows a simplified cross-sectional view of the gate valve 200 according to some embodiments of the present application. Figure 3 is a three-dimensional schematic diagram of the gate valve 200 shown in Figure 2. Figures 3A~3D respectively show a main view, an upward view, a left view and a right view of the gate valve 200 shown in Figure 3.

Referring to Figure 2 and Figure 3C, the gate valve 200 comprises a valve box 201 and an actuator 202. The valve box 201 has a channel 206 for connecting vacuum pipelines in the semiconductor apparatus. The actuator 202 is operable to drive a sealing valve plate 221 into the valve box 201 to close the channel 206 (as the state shown in Figure 2), or to drive the sealing valve plate 221 out of the valve box 201 to open the channel 206. An executive component 210 of the actuator 202 is mechanically connected to the sealing valve plate 221 to drive the sealing valve plate 221. An edge of the sealing valve plate 221 is set with a sealing ring, which may achieve an airtight seal between the sealing valve plate 221 and side wall of the channel 206.

Further referring to Figure 3 and Figure 3A, the actuator 202 has a connecting flange 205, which is used to connect the actuator 202 to the valve box 201. The gate valve 200 further comprises a fixing device, which is set on the connecting flange 205 and configured to detachably connect the actuator 202 to the valve box 201. In the embodiment shown in Figure 3, the fixing device is fixing screws 203. It should be understood that the shapes and dimensions of each component shown in the drawings are for illustrative purposes only, and the implementation of the present application is not limited to the shapes and dimensions shown in the drawings. For example, the connecting flange 205 does not have to be rectangular, and boundaries

211, 213 of the connecting flange 205 and boundaries 212, 214 of the portion of the valve box 201 adjacent the connecting flange 205 may extend beyond boundaries 215, 216 of the actuator 202, etc.

In some embodiments of the present application, a plurality of fixing screws 203 are set on an edge side of the connecting flange 205. For example, as shown in Figure 3A and Figure 3D, the fixing screws 203 may be located at an upper edge side 207 and a lower edge side 208 of the connecting flange 205. In other embodiments, the fixing screws 203 may be located on other edge sides or other positions on the edge side of the connecting flange 205. The fixing screws 203 pass through the connecting flange 205 to connect the valve box 201, for example, coupled to the corresponding threaded holes on the valve box 201. By way of example, the gate valve 200 comprises four fixing screws 203. Those skilled in the art should understand that the gate valve 200 may also comprise any other numbers of fixing screws 203.

As shown in Figure 3 and Figure 3A, unlike the conventional gate valve shown in Figure 1, the detachment direction of the fixing device of the gate valve 200 faces the actuator 202, rather than faces the valve box 201. For example, the head of the fixing screws 203 faces the side of the actuator 202. Therefore, it is possible to perform operations on the atmospheric side to detach the fixing device and remove the actuator, thereby enabling the routine maintenance for the gate valve 200 without disassembling the entire gate valve 200 from the vacuum pipelines. For example, when it is necessary to replace the sealing ring of the sealing valve plate 221, only the actuator 202 and the sealing valve plate 221 connected to it may be removed from the valve box 201, while the valve box 201 is retained on the vacuum pipelines, thereby eliminating the disturbance factors and adverse effects caused by removing the valve box 201 from the vacuum pipelines on the vacuum pipeline system. This is particularly beneficial for complex vacuum pipelines or vacuum pipelines with small operating spaces, so that it can reduce disturbance factors to the vacuum pipelines as much as possible, which helps ensure that the overall precision of semiconductor apparatus and its system will not be destroyed.

In other embodiments of the present application, the fixing device set on the

connecting flange 205 may be a clamp. According to one embodiment, the clamp comprises two separable generally semi-annular clamp portions, each clamp portion comprises a middle part and two ends, wherein a first end of a first clamp portion may be locked and fixed with a first end of a second clamp portion through a first locking screw, and a second end of the first clamp portion may be locked and fixed with a second end of the second clamp portion through a second locking screw. Corresponding grooves may be provided on an edge of the portion of the valve box 201 adjacent to the connecting flange 205 and on an edge of the connecting flange 205 (for example, portions that extend beyond the boundaries 215, 216 of the actuator 202). The middle part of the first clamp portion may be arranged in a groove on the valve box 201, and the middle part of the second clamp portion may be arranged in a groove on the connecting flange 205. The first end of the first clamp portion is locked and fixed with the first end of the second clamp portion by tightening the first locking screw, and the second end of the first clamp portion is locked and fixed with the second end of the second clamp portion by tightening the second locking screw, so that the valve box 201 and the connecting flange 205 may be connected and fixed. The detachment directions of the first locking screw and the second locking screw face the actuator 202, rather than face the valve box 201. For example, the heads of the first locking screw and the second locking screw both face the side of the actuator 202, so that the clamp can be detached by loosening the first locking screw and the second locking screw on the atmospheric side, and then the actuator 202 can be removed. In some embodiments, two clamps may be symmetrically arranged on the connecting flange 205 (for example, symmetrically relative to the center of the cross-section of the connecting flange 205), and both detachment directions of the locking screws on two clamps face the actuator 202. According to the spirit of the present application, fixing devices with other structures may also be used, which may be disassembled by performing operations from the atmospheric side.

In addition, a sealing ring is generally provided between the valve box and the actuator of the gate valve (for example, at the connection surface between the valve box 101 and the actuator 102, and the connection surface between the valve box 201 and the actuator 202). The sealing ring has a certain viscous force due to being pressed

by the valve box and the actuator for a long time. Therefore, when the actuator is detached from the valve box, the viscous force will hinder the separation between the actuator and the valve box, thus bringing an additional disturbance and uncertainty to the vacuum system.

5 In some embodiments of the present application, a jackscrew may be used to solve the above-mentioned problem. As shown in Figures 3 and 3D, the gate valve 200 may comprise a jackscrew 204 set on an edge side of the connecting flange 205, which faces the actuator 202. In some embodiments, as shown in Figure 3D, the gate valve 200 may comprise a pair of jackscrews 204 symmetrically arranged on the edge
10 side of the connecting flange 205 (such as the upper edge side 207 and the lower edge side 208). The pair of jackscrews 204 may be located at any position symmetrical to the center of the cross-section relative to the connecting flange 205. In other embodiments, the gate valve 200 may also comprise other numbers of jackscrews 204.

15 The jackscrews 204 may be rotated from the atmospheric side to pass through the connecting flange 205 and contact the valve box 201, thereby pushing out the actuator 202 and separating it from the valve box 201. Specifically, when disassembling the actuator 202 from the valve box 201 connected to the vacuum pipelines, the jackscrews 204 may be synchronously rotated to smoothly dissipate the
20 viscous force generated by the sealing ring between the valve box 201 and the actuator 202, thereby further avoiding the additional disturbance factors and uncertainty that the viscous force brings to the vacuum system.

 According to some embodiments of the present application, as shown in Figure 3D, the gate valve 200 further comprises a positioning pin 209. The positioning pin
25 209 may be set on an edge side of the connecting flange 205 (such as the upper edge side 207 or the lower edge side 208). The positioning pin 209 may pass through the connecting flange 205 to be inserted into a positioning hole on the valve box 201. The use of the positioning pin 209 can keep the position of the actuator 202 consistent when the actuator 202 is repeatedly assembled and disassembled, thereby avoiding
30 the disturbance to the vacuum pipeline system caused by different positions of the actuator 202 (even slight differences) after each maintenance, which can improve the

maintenance efficiency. Although Figure 3D only shows one positioning pin 209, those skilled in the art should understand that other numbers of positioning pins 209 may be used depending on actual needs (such as requirements of positioning accuracy).

5 The following describes a method for maintaining a gate valve used in a semiconductor apparatus according to some embodiments of the present application, in conjunction with the gate valve 200 shown in Figures 2~3D. Those skilled in the art should understand that the method may also be applied to other gate valves with similar structures.

10 The gate valve 200 may be installed on the vacuum pipelines in a semiconductor apparatus. When the gate valve 200 needs to be maintained (such as replacing the sealing ring of sealing valve plate 221), the fixing screws 203 on the connecting flange 205 may be loosened from the atmospheric side, while maintaining the connection between the valve box 201 and the vacuum pipelines of the
15 aforementioned semiconductor apparatus, the actuator 202 and sealing valve plate 221 may be removed for maintenance.

 In some embodiments, before removing the actuator 202, the jackscrew 204 set on an edge side of the connecting flange 205 facing the actuator 202 may be rotated to separate the actuator 202 from the valve box 201. In order to avoid as much as
20 possible the impact of unbalanced forces on the vacuum system, a pair of jackscrews 204 symmetrically arranged on the edge side may be rotated synchronously.

 After completing the maintenance for the gate valve 200, the actuator 202 may be aligned with the valve box 201, and the fixing screws 203 may be tightened to connect the actuator 202 to the valve box 201. In some embodiments, the positioning
25 pin 209 set on an edge side of the connecting flange 205 may be used to align the actuator 202 with the valve box 201. Before aligning, it is possible to rotate the jackscrews 204 back into the connecting flange 205, as the jackscrews 204 have already been rotated out of the connecting flange 205.

 The description in this specification is provided to enable those skilled in the art to carry out or use the present application. Various modifications to the present
30 application will be readily apparent to those skilled in the art, and the general

principles defined in this specification may be applied to other forms of variation without departing from the spirit or scope of the present application. Therefore, the present application is not limited to the embodiments and designs described in this specification, but is endowed with the widest scope consistent with the principles and novel features disclosed in this specification.

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Claims

1. A gate valve used in a semiconductor apparatus, comprising:

5 a valve box, which has a channel for connecting a vacuum pipeline in the semiconductor apparatus;

an actuator, which has a connecting flange for connecting the valve box; and

a fixing device, which is set on the connecting flange and configured to detachably connect the actuator to the valve box, wherein a detachment direction of the fixing device faces the actuator.

10 2. The gate valve according to claim 1, further comprising a sealing valve plate, wherein an edge of the sealing valve plate is set with a sealing ring, the sealing valve plate is connected to the actuator, and the actuator is operable to drive the sealing valve plate into the valve box to close the channel, or to drive the sealing valve plate
15 out of the valve box to open the channel.

3. The gate valve according to claim 1, further comprising a jackscrew, wherein the jackscrew is set on an edge side of the connecting flange, which faces the actuator, and is capable of passing through the connecting flange to contact the valve box.

20 4. The gate valve according to claim 3, wherein the jackscrew comprises a pair of jackscrews that are symmetrically arranged on the edge side.

5. The gate valve according to claim 1, wherein the fixing device comprises a
25 plurality of fixing screws set on an edge side of the connecting flange.

6. The gate valve according to claim 1, wherein the fixing device comprises a clamp.

30 7. The gate valve according to claim 6, wherein the clamp comprises a first

clamp portion and a second clamp portion that are generally semi-annular, a first end of the first clamp portion is locked and fixed with a first end of the second clamp portion through a first locking screw, and a second end of the first clamp portion is locked and fixed with a second end of the second clamp portion through a second locking screw.

8. The gate valve according to claim 7, wherein a first groove is provided on an edge of a portion adjacent to the connecting flange on the valve box, and a second groove corresponding to the first groove is provided on an edge of the connecting flange, a middle part of the first clamp portion, between the first end and the second end of the first clamp portion, is arranged in the first groove, and a middle part of the second clamp portion, between the first end and the second end of the second clamp portion, is arranged in the second groove.

9. The gate valve according to claim 7, wherein the detachment directions of the first locking screw and the second locking screw face the actuator.

10. The gate valve according to claim 6, wherein the clamp comprises two clamps that are symmetrically arranged on the connecting flange.

11. The gate valve according to claim 1, further comprising a positioning pin, wherein the positioning pin is set on an edge side of the connecting flange, and passes through the connecting flange to be inserted into a positioning hole on the valve box.

12. A method for maintaining the gate valve according to claim 1, wherein the gate valve is installed on a vacuum pipeline in a semiconductor apparatus, and the method comprises:

detaching a fixing device on a connecting flange from an actuator side; and

maintaining a connection between a valve box and the vacuum pipeline, while removing the actuator for maintenance.

13. The method according to claim 12, wherein the step of removing the actuator comprises: removing a sealing valve plate connected to the actuator, wherein an edge of the sealing valve plate is set with a sealing ring.

5 14. The method according to claim 12, further comprising:
aligning the actuator with the valve box, and connecting the actuator to the valve box via the fixing device, after completing the maintenance.

10 15. The method according to claim 12, wherein the fixing device comprises a plurality of fixing screws set on an edge side of the connecting flange.

16. The method according to claim 12, wherein the fixing device comprises a clamp.

15 17. The method according to claim 16, wherein the clamp comprises a first clamp portion and a second clamp portion that are generally semi-annular, a first groove is provided on an edge of a portion adjacent to the connecting flange on the valve box, and a second groove corresponding to the first groove is provided on an edge of the connecting flange, a middle part of the first clamp portion, between a first
20 end and a second end of the first clamp portion, is arranged in the first groove, and a middle part of the second clamp portion, between a first end and a second end of the second clamp portion, is arranged in the second groove,

the step of detaching a fixing device on a connecting flange comprises: loosening a first locking screw that locks and fixes the first end of the first clamp
25 portion with the first end of the second clamp portion, and loosening a second locking screw that locks and fixes the second end of the first clamp portion with the second end of the second clamp portion.

30 18. The method according to claim 16, wherein the clamp comprises two clamps that are symmetrically arranged on the connecting flange.

19. The method according to claim 12, further comprising:

separating the actuator from the valve box by rotating a jackscrew set on an edge side of the connecting flange facing the actuator, before removing the actuator;;
and

5 returning the jackscrew after completing the maintenance.

20. The method according to claim 19, wherein the step of rotating a jackscrew comprises: synchronously rotating a pair of jackscrews symmetrically arranged on the edge side.

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21. The method according to claim 14, wherein a positioning pin is used to align the actuator with the valve box, and the positioning pin is set on an edge side of the connecting flange.