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SEALABLE CONTAINER

FIELD OF THE INVENTION

The present invention relates to a sealable container for use in carrying semiconductor wafers in a clean room, and more particularly to a sealable container having a pressure-equalizing mechanism adapted to equalize pressures in the inside and outside of the sealable container when the sealable container is opened.

BACKGROUND OF THE INVENTION

It is most common to manufacture semiconductor devices in a purified atmosphere in a clean room. When semiconductor wafers have to be carried from one process to another process in the clean room, the semiconductor wafers are accommodated in a wafer cassette. The plurality of wafer cassettes are placed in a portable container which is sealable with a lid member so as to prevent dust from collecting on the surfaces of the semiconductor wafers. In recent years, it is further contemplated that the atmosphere in the sealable container be replaced with inert gas such as nitrogen so as to prevent an oxide film from being formed by the natural oxidation of the semiconductor wafers.



However, the prior art of the sealable

container has one trouble. For example, in case that the container is sealed by the rotary movement of the cam member after warmed semiconductor wafers are placed in the sealable container, when the temperature in the sealable container falls to a room temperature, the interior in the sealable container is placed under the influence of negative pressure which causes a difference of pressures between the inside and outside of the sealable container. As a result of that, the lid member of the sealable container is sucked into the main body of the sealable container. So it is impossible to open the lid member even by the reversely rotary movement of the cam member.

The same phenomenon as the lid member is sucked into the main body due to negative pressure in the sealable container also happens under atmospheric pressure changing.

In view of the above-described problems, the primary object of the invention is providing a sealable container which can be easily opened by removal of a lid member and which can be kept airtight as long as the lid member engages the main body of the sealable container. In order to permit easy removal of the lid member, the sealable container in accordance with the present invention

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is provided with a pressure-equalizing mechanism for equalizing pressures in the inside and outside of the sealable container.

SUMMARY OF THE INVENTION

The present invention is the sealable container for accommodating semiconductor wafers, comprises:

a hallow main body having an opening for taking the semiconductor wafers out or into;

a lid member for plugging the opening;

a lock means for locking and releasing the lid member in the opening of the main body; and

a pressure-equalizing mechanism for keeping an interior in the main body airtight or allow an interior in the main body to be communicable with an exterior in co-operation with the lock means.

The pressure-equalizing mechanism opens or closes a vent hole provided in the lid member in co-operation with the lock means. An interior in the main body and the exterior communicate by the vent hole.

The pressure-equalizing mechanism includes a valve for opening or closing the vent hole, which moves according to a deformation of a rocker arm caused by a rotary movement of a cam member included

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in the lock means.

The mode of operation of the pressure-equalizing mechanism is determined by the mode of operation of the lock means so as to block the vent hole when the lock means is in its operative position and so as to allows the interior in the sealable container to be communicable with the exterior through the vent hole when the lock means is in its released position.

The valve comprises

a valve head slidably fitted in an enlarged recess which opens enlargely and continuously from the vent hole toward the rocker arm in the lid member;

an annular seal arranged upon the valve head for sealing the vent hole;

a valve rod extending vertically from the valve head on the opposite side to the annular seal with a smaller diameter than the valve head, which is integrated with the valve head and which extend slidably through an elongated slot longitudinally formed in the aforesaid rocker arm; and

a pair of protuberant stoppers rigidly secured to the valve rod axially apart from each other with a prescribe distance so that the rocker arm may be interposed therebetween.

In anther described embodiment, the valve consists of an elastic material such as rubber and is secured to the rocker arm in such a position as to conform to the position of the vent hole.

More specifically stated, the present invention comprises a pressure-equalizing mechanism adapted to co-operate with the lock means so as to keep the sealable container airtight or allow it to communicate with the exterior, whereby the pressure-equalizing mechanism blocks the vent hole provided in the lid member when the lock means is in its operative position, and the pressure-equalizing mechanism opens the vent hole when the lock means is in released position.

Consequently, the sealable container in accordance with the present invention can be kept airtight when the lock means is in its operative position, and pressures in the inside and outside of the sealable container is equalized by opening the valve which has blocked the vent hole when the lock means is in released position. Thus it will be seen that the pressure-equalizing mechanism substantially facilitates the removal of the lid member.

Moreover, the prior construction that has the lid member and the lock means is still useful since

the present invention has the pressure-equalizing mechanism including the valve for opening or closing the vent hole according to the deformation of the rocker arm caused by the rotary movement of the cam member included in the lock means.

So, the prior sealable container can be easily remodeled without another complicate means different from the rocker arm for opening or closing the vent hole.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a vertical section to help explain the structural construction of an embodiment of the present invention;

Fig. 2 is an enlarged fragmentary sectional elevation to help explain the structural construction of a lock means and a pressure-equalizing mechanism incorporated therein;

Fig. 3 is a perspective view to help explain the structural construction of a cam member and a rocker arm included in the lock means;

Figs. 4(a) to 4(c) are enlarged fragmentary sectional elevations to help explain the operation of the pressure-equalizing mechanism; and

Fig. 5 is an enlarged fragmentary sectional elevation to help explain the structural

construction of a further type of the pressure-equalizing mechanism.

BEST MODES OF OPERATION

[Embodiment 1]

Now we will make reference to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown. Fig. 1 is a vertical section to help explain the structural construction of this embodiment. Fig. 2 is an enlarged fragmentary sectional elevation to help explain the structural construction of a lock means and a pressure-equalizing mechanism incorporated therein. Fig. 3 is a perspective view to help explain the structural construction of a cam member and a rocker arm included in the lock means. Figs. 4(a) to 4(c) are enlarged fragmentary sectional elevations to help explain the operation of the pressure-equalizing mechanism.

Referring now to Fig. 1, a numeral number 5 shows a hollow main body 5 of the sealable container 1 which is a portable type. The hollow main body 5 of the sealable container 1 has an opening 6 and is formed with a peripheral flange 7. A lid member 9 is fitted into the opening 6 with annular seal 8. The lid member 9 has a cavity for accommodating a

lock means 10 and a pressure-equalizing mechanism 11. A numeral number 12 shows a hand-grip 12 on the upper end of the main body 5. A numeral number 13 shows a wafer cassette 13 which accommodates a plurality of semiconductor wafers W and which is placed on the lid member 9 in the sealable container 1. A numeral number 14 shows a gas purge box which has a lifting means 15 for lifting up or down a mounting bracket 15A and which is provided with pipes 16 and 17 preferably extending laterally in opposite directions through the wall of the upper part of the gas purge box 14. A gas tank, that will supply nitrogen or other inert gas under pressure, is connected to the pipe 16, and an exhaust pump is connected to the pipe 17.

As shown in Fig. 2, the lid member 9 is hollow and is confined at the top by a top plate 9A and at the bottom by a bottom plate 9B so as to have a cavity A for accommodating the lock means 10 and the pressure-equalizing mechanism 11. The main parts of the lock means 10 are a cam member 21 and a pair of rocker arms 22, one of these two rocker arms 22 being omitted for the sake of simplicity. As shown in Fig. 3, the cam member 21 is a disc type such as a base member 23 having a center hole 23A and two diametrically opposed side protuberances 24A and 24B

on its surface. The two protuberances 24A and 24B extend with a prescribed width along its circumference of the base member and have inclined portions 24a and 24b respectively.

A pair of diametrically opposed projections 25A and 25B are arranged at a right angle to the protuberances 24A and 24B. Each of the projections 25A and 25B has an oval shape from a top view. As shown in Fig. 2, the cam member 21 is rotatably disposed between the bottom plate 9B and the top plate 9A by means of pins 26 and 27 so as to face the surface of the cam member 21 provided with the protuberance 24A, 24B with the top plate 9A. The means of pins 26 are protruded from center of the bottom plate 9B to the cavity A. The means of pins 27 are protruded from center of the top plate 9A to the cavity A.

The rocker arm 22 is a plate type of one accommodated in the cavity A of the lid member 9 and carries a roller 22a on one end (opposite side to the peripheral flange 7). As shown in Fig. 3, the rocker arm 22 has a gide element 22A protruded from the rocker arm 22 in the same direction as an axis of the roller 22a.

A groove 22B is formed in the gide element 22A, of which contour is one such as a suitable contour

for engagement with the projections 25A and 25B. The roller 22a is allowed to ride on either of the protuberance 24A or 24B when either of the projections 25A or 25B has been engaged with the groove 22B. Thus, as shown in Fig, 2, the rocker arm 22 has a cantilever state by the engagement with the projections 25A or 25B on the com member 2 while the rocker arm 22 at a vicinity of center is regulated so as to keep straight in the cavity A by a lower regulation member 28 carried by the inner surface of the bottom plate 9B. Upon rotating of the cam member 21, the projection 25A or 25B moves along the surface 22b of the groove 22B and thereby allows the rocker arm 22 to move longitudinally. Then the other end of the rocker arm 22 will engage in the groove 30. Further, when the roller 22a of the cam member 21 rotates on the either inclined portion 24a or 24b of the protuberance 24A or 24B, the rocker arm 22 inclines. A numeral number 29 shows a upper regulation member integrally carried by the inner surface of the top plate 9A and facing to the lower regulation member 28. A numeral number 30 shows the groove 30 which opens along the inner surface of the peripheral flange 7 of the sealable container 1. The aforesaid other end of the rocker arm 22 engages in the groove 30. A com shaft 31 is

carried by the mounting bracket 15A of the lifting means 15, which extends to the sealable container 1. The com shaft 31 is connected to the cam member 21 with a spline when the lit member 9 is installed on the mounting bracket 15A. The mounting bracket 15A accommodates a drive means 32 for rotating the cam member 21 by a prescribed angle.

The main parts of the pressure-equalizing mechanism 11 are a vent hole 35 provided in the top plate 9A and a valve 40 adapted to mask the vent hole 35. The vent hole 35 consists of a bore 35A and a larger bore 35B axially and continuously aligned so as to form a shoulder defined at the intersection of the bore 35A and the larger bore 35B. The bore 35A opens toward an inner space of the sealable container 1. The larger bore 35B opens on toward the cavity A of the lit member 9, of which diameter is larger than the bore 35A. A valve head 40A of the valve 40 is slidably fitted in the larger bore 35B. An annular seal 41 is arranged upon the valve head 40A for sealing the vent hole 35. A valve rod 40B is integrally formed with the valve head 40A at the opposite side to the annular seal 41, of which diameter is smaller than the valve head 40A. The valve rod 40B extends toward the bottom plate through an elongated slot 22c in the

rocker arm 22, where the valve rod 40B is slidable in the elongated slot 22c. The elongated slot 22c is longitudinally formed in the rocker arm 22. And a pair of protuberant stoppers 42 and 43 are rigidly secured to the valve rod 40B axially apart from each other with a prescribe distance so that the rocker arm 22 may be interposed therebetween. The stopper 43 touches to the under surface of the rocker arm 22 in Fig. 2, 4(a) or 4(b). A plate type member 44 in Fig. 2 is secured to the under surface of the top plate 9A over the larger bore 35B, which has a center hole such that valve rod 40B may pass through, and the downward movement of the valve head 40A may be limited thereby. A flat spring 45 is secured on the upper surface of the rocker arm 22 at one end side.

There shall now be described one utilization of this embodiment in connection with Figs. 4(a) to 4(c). Let it be supposed at the beginning of the operation that, the lock means 10 is in its released position and the valve 40 is open as shown in Fig. 4(a) so that the interior of the sealable container 1 may be in communication with the exterior through the cavity A of the lid member 9.

To begin with, the atmosphere in the sealable container 1 accommodating a plurality of

semiconductor wafers W is replaced with inert gas (such as nitrogen). It is not always the case with the atmosphere in the sealable container 1. There is one case that the atmosphere in the sealable container 1 is kept in a purified atmosphere without replaced with inert gas.

In order to carry or store these semiconductor wafers W, the lid member 9 engages with the main body 5 of the sealable container 1. In order to make the sealable container 1 airtight, the cam member 21 is rotated through a prescribed angle in Fig.4(a). Then the projection 25A or 25B moves along the surface 22b of the groove 22B as shown in Fig. 3, and thereby the rocker arm 22 is moved in horizontal direction. Then, as shown in Fig. 4(b), the other end of the rocker arm 22 will engage in the groove 30 formed in the peripheral flange 7. During this movement of the rocker arm 22 into the groove 30, the flat spring 45 yieldingly maintains the rocker arm 22 in a substantially horizontal position by placing the rocker arm 22 on the lower regulation member 28. By virtue of this flat spring 45, the movement of the rocker arm 22 into the groove 30 will not be hindered by the edge of the groove 30. Its center of gravity in the rocker arm 22 moves toward the groove 30 together with the

further movement of the rocker arm 22 into the groove 30. Thus the rocker arm 22 comes to be pivotable in a counterclockwise direction about the lower regulation member 28 against the force of the flat spring 45.

Upon further rotary movement of the cam member 21, the roller 22a rotates upward on the either inclined surface 24a or 24b of the protuberance 24A or 24B, as already described with reference to Fig. 3. The rocker arm 22 rises up toward the top plate 9A and deforms around the upper regulation member 29 as a fulcrum. Consequently, one end of the rocker arm 22 provided with the roller 22a is forced upward while the other end of the rocker arm 22 abuts against the bottom face 30a of the groove 30 as shown in Fig. 4(c). A force at the other end of the rocker arm 22 caused by this deformation urges the main body 5 of the sealable container 1 to move toward the bottom plate 9B. As a result of that, a tight engagement between the main body 5 and the top plate 9A with the annular seal 8 interposed therebetween is achieved. And the lock means 10 has been brought into an locking position. On the other hand, one end of the rocker arm 22 has abuted against the stopper 42 of the valve 40 and thereby the valve 40 rises toward the top plate 9A. At

last, the annular seal 41 arranged upon the valve head 40A abuts against the shoulder defined at the intersection of the bore 35A and the larger bore 35B so as to close airtightly the bore 35A. As a result of that, the interior of the sealable container 1 is intercepted from the exterior and an airtightness of the sealable container 1 is achieved.

When the sealable container 1 is opened by removal of the lid member 9, the cam member 21 is driven in the counter direction. Thereby, the roller 22a rotates downward on the inclined surface 24a or 24b of the protuberance 24A or 24B and removes the deformation from the rocker arm 22. The one end of the rocker arm 22 provided with the roller 22a moves towards the bottom plate 9B as shown Fig.4(b) so as to be restored. And then the rocker arm 22 is placed again on the lower regulation member 28. When the cam member 21 further rotates, the projection 25A or 25B moves along the surface 22b of the groove 22B. And then the other end of the rocker arm 22 is disengaged from the groove 30. In the meanwhile the rocker arm 22 abuts against the stopper 43 of the valve 40 and the valve 40 is moved toward the bottom plate 9B by the downward movement of the valve 40. As a result

of that, the bore 35A opens and the interior of the sealable container 1 is communicable with the exterior through the bore 35A, cavity A in the lid member and a gap between the bottom plate 9B and the peripheral flange 7. Consequently, a pressure of the interior in the sealable container 1 and a pressure of the exterior (atmospheric pressure) are instantly equalized. After that, the lid member 9 is removed from the main body 5 of the sealable container 1 and semiconductor wafers W are taken out the sealable container 1.

[Embodiment 2]

Now we will make reference to another embodiment of the present invention. Fig. 5 is an enlarged fragmentary sectional elevation to help explain the structural construction of this embodiment. The same numeral numbers in Fig. 5 as in Fig. 1 to Fig. 4(c) indicate the same parts as in Fig. 1 to Fig. 4(c) respectively.

A pressure-equalizing mechanism 104 incorporated in a sealable container 100 shown in Fig. 5 is a modification of the pressure-equalizing mechanism 11 incorporated in the sealable container 1. A numeral number 101 shows a vent hole 101 provided in the vicinity of center of the top plate

9A (i.e. in the vicinity of the cam member 21). The vent hole 101 opens through the top plate 9A toward both of the interior of the sealable container 100 and the cavity A in the lid member 9. A filter 102 covers the vent hole 101 on a interior side of the sealable container 100. A numeral number 103 shows a valve which is a member of a pressure-equalizing mechanism 104, which consists of an elastic material (such as rubber), and which is fixed on the rocker arm 22 in such a position as corresponding to the position of the vent hole 101. The valve can closes the vent hole 101 with its resilience.

There shall now be described the operation of this embodiment 2 which has the above constriction. The lock means 10 will need no further description since its action is identical with the embodiment 1 hereinabove described in connection with Figs. 4(a) to 4(c). Therefore, especially detailed description will cover the action of the pressure-equalizing mechanism 104.

Semiconductor wafers W in the sealable container 100 are carried or stored after the atmosphere in the sealable container 100 is replaced with inert gas (such as nitrogen) by gas purge box. It is not always the case with the atmosphere in the sealable container 100. There is one case that

the atmosphere in the sealable container 100 is kept in a purified atmosphere without replaced with inert gas.

In order to make the sealable container 100 airtight after the lid member 9 engages the main body 5 of the sealable container 100, the cam member 21 is rotated through a prescribed angle so that the rocker arm 22 may move longitudinally towards the groove 30. After the rocker arm 22 moves longitudinally towards the groove 30, the rocker arm 22 is deformed on the upper regulation member 29 as a fulcrum so that the other end of the rocker arm 22 may abut against the bottom face 30a of the groove 30. The main body 5 of the sealable container 100 is urged to move toward the bottom plate 9B by this deformation of the rocker arm 22. As a result of that, a tight engagement between the main body 5 and the top plate 9A with the annular seal 8 interposed therebetween is achieved and the lock means 10 is brought into an operative position.

On the other hand, the valve 103 rises toward the top plate 9A by the rocker arm 22 at one end side connected with the com member 21. At last, the valve 103 closes airtightly the vent hole 101 with its resilience. As a result of that, the interior of the sealable container 100 is intercepted from

the exterior and an airtightness of the sealable container 100 is achieved.

When the sealable container 100 is opened by removal of the lid member 9, the cam member 21 is driven in the counter direction. Thereby, the deformation is removed from the rocker arm 22. And then the rocker arm 22 is restored and placed again on the lower regulation member 28. The other end of the rocker arm 22 is disengaged from the groove 30.

In the meanwhile, the valve 103 of the pressure-equalizing mechanism 104 is moved toward the bottom plate 9B by the downward movement of the rocker arm 22.

As a result of that, the vent hole 101 opens and the interior of the sealable container 100 is communicable with the exterior through the vent hole 101, cavity A in the lid member 9 and a gap between the bottom plate 9B and the peripheral flange 7. Consequently, a pressure of the interior in the sealable container 1 and a pressure of the exterior (atmospheric pressure) are instantly equalized. After that, the lid member 9 is removed from the main body 5 of the sealable container 100 and semiconductor wafers W are taken out the sealable container 100.

In addition, the above both of embodiments 1

and 2 show the container wherein the valves 40 and 103 of the pressure-equalizing mechanism are moved vertically by the movement of the rocker arm 22 in order to open and close the vent hole. The rocker arm 22 is moved by the horizontally rotary motion of the com member 21. Instead of the above valves 40 and 103, such a valve is applicable, as is moved by a crank mechanism for converting the horizontally rotary motion of the cam member 21 into the vertical motion.

FIELD OF INDUSTRIAL UTILIZATION

The sealable container in accordance with the present invention is especially suited for use in accommodating semiconductor wafers, because this sealable container can be easily opened by a pressure-equalizing mechanism for equalizing pressures in the inside and out side of the sealable container when removing the lid member from the main body of the sealable container and further this sealable container can be kept airtight as long as the lid member engages the main body of the sealable container.

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What is claimed is:

1. A sealable container for accommodating semiconductor wafers, comprises:

a hallow main body having an opening for taking said semiconductor wafers out or into;

a lid member for plugging said opening;

a lock means for locking and releasing said lid member in said opening of said main body; and

a pressure-equalizing mechanism for keeping an interior in said main body airtight or allow an interior in said main body to be communicable with an exterior in co-operation with said lock means.

2. A sealable container as defined in claim 1, wherein

a vent hole is provided in said lid member for letting an interior in said main body and said exterior be in communicable state, and the pressure-equalizing mechanism opens or closes said vent hole in co-operation with said lock means.

3. A sealable container as defined in claim 2, wherein

the pressure-equalizing mechanism includes a valve for opening or closing said vent hole, which moves according to a deformation of a rocker arm caused by a rotary movement of a cam member included in said lock means.

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4. A sealable container as defined in claim 3, wherein

said valve comprises

a valve head slidably fitted in an enlarged recess which opens enlargely and continuously from said vent hole toward said rocker arm in said lid member;

an annular seal arranged upon said valve head for sealing said vent hole;

a valve rod extending vertically from said valve head on said opposite side to said annular seal with a smaller diameter than said valve head, which is integrated with said valve head and which extend slidably through an elongated slot longitudinally formed in said rocker arm; and

a pair of protuberant stoppers rigidly secured to said valve rod axially apart from each other with a prescribe distance so that said rocker arm may be interposed therebetween.

5. A sealable container as defined in claim 3, wherein

said valve consists of an elastic material such as rubber and is secured to said rocker arm in such a position as to conform to said position of said vent hole.

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