Description

The present invention relates to standardized mechanical interface (SMIF) systems for reducing particle contamination and more particularly to transportable containers apparatus which are hermetically sealable.

A standardized mechanical interface (SMIF) has been proposed by the Hewlett-Packard Company as disclosed in U.S. Patents Nos. 4,532,970 and 4,534,389. The purpose of the SMIF system is to reduce particle fluxes onto wafers. This end is accomplished by mechanically ensuring that during transportation, storage and processing of the wafers, the gaseous media (such as air or nitrogen) surrounding the wafers is essentially stationary relative to the wafers and by ensuring that particles from the ambient environment do not enter the immediate wafer environment.

The SMIF system above consists of two parts: (1) a controlled environment including a clean process equipment canopy surrounding the wafer-handling mechanism of each processing machine, and (2) a small, clean box having a quiet internal environment for carrying wafers from processing machine to processing machine.

Systems of the above type are concerned with particle sizes which range from below 0.1 micrometers to above 200 micrometers. Particles with these sizes can be very damaging in semiconductor processing because of the small geometries employed in fabricating semiconductor devices. Typical semiconductor processes today employ geometries which are 1 micrometer and under. Unwanted contamination particles which have geometries measuring greater than 0.1 micrometer substantially interfere with 1 micrometer geometry semiconductor devices. The trend, of course, is to have smaller and smaller semiconductor processing geometries which today in research and development labs approach 0.1 micrometer and below. In the future, geometries will become smaller and smaller and hence smaller and smaller contamination particles become of interest.

In typical processing environments today, "clean rooms" are established in which through filtering and other techniques, attempts are made to remove particles having geometries greater than .03 micrometers and above. There is a need, however, to improve the processing environment. In a clean room, wafers and other semiconductor processing articles are exposed to the full clean room environment. Since different people, different types of equipment and materials are also present in the clean room environment, the clean room cannot be maintained as particle free as desired. It is virtually impossible to maintain clean rooms free of particles of a 0.1 micrometer size and below.

For this reason, systems such as the SMIF system have come under consideration. The proposed SMIF system, however, has some deficiencies. When SMIF boxes become contaminated, it is very difficult to remove small contaminant particles since the force of attraction of small particles to surfaces of the equipment is very high. When small particles become attached to a surface such as a SMIF box, they are not effectively removed by filtration techniques. Circulating and filtering air or other gas within a box does not readily remove the contamination particles which are attracted and held in contact with surfaces. However, whenever an object such as a SMIF box is disturbed, by bumping for example, many small particles are freed from the surface and find their way as contaminants onto any semiconductor or other article which is present in the box. While scrubbing and washing techniques have been developed for removing small particles from equipment and surfaces, these processes tend to be cumbersome and furthermore are not entirely effective.

There have since been sealable transportable containers such as one described in U.S. Patent No. 4,434,891, which discloses a container for a magnetic disc pad eye. That container included a top portion having a screw and therefore requiring manual means to remove the contents from the box interior space.

Previous SMIF concepts have included the principle that the wafers move from the transportable container to the processing equipment through various apparatus by disturbing the least amount of air within the processing equipment. Thus the still air concept has prevaded prior SMIF transportable containers. The advantage of this is that any particulates in the air would not damage semiconductor wafers because the air remained relatively still during the transferring process. While this principle is still valid, it has been found that stagnant air too, has many particles which may also cause damage simply by static attraction. The recognition that stagnant air causes contamination and damage has created a need for active localized filtering of the SMIF box and the environments with which the semiconductor articles are exposed. This recognition is a departure from the previous SMIF concept which employed no active filtering means. The need for active filtering at localized areas and under specific conditions and at desired times has been left to this invention.

In accordance with the above background, there is a need for an improved system which can be standardized and which is effective for reducing contamination using an active filtering system.

The present invention provides a transportable hermetically sealable container for use with processing equipment which has a port plate and a

port door sealably mating thereto, the container being arranged to maintain the cleanliness of articles to be processed by the processing equipment and comprising a box defining an interior space for containing said articles, the box comprising a box top and a box door, the box door having box door latch means for sealably latching the box door to the box top, the box being adapted to be sealably mounted at the port plate of the processing equipment and the box door latch means being adapted to be activated by means associated with the port door when the box is so mounted,

the container being characterized in that the box comprises first conduit means for communicating between the interior space and the environment external to the box, and filtering means arranged to filter gas passing through said first conduit means, and wherein the first conduit means is arranged to be connected to means for moving gas into and out of the box when the box is mounted at the port plate, whereby upon activation of the gas moving means, the interior space may be evacuated or pressurized.

The present invention also provides a transportable container for use with processing equipment which has a port plate and a port door, the container being arranged to maintain the cleanliness of articles to be processed by the processing equipment and comprising a box defining an interior space for containing said articles, the box comprising a box top and a box door, the box door having box door latch means for sealably latching the box door to the box top, the box being adapted to be sealably mounted at the port plate of the processing equipment and the box door latch means (70) being adapted to be activated by means associated with the port door when the box is so mounted,

the container being characterized by comprising an activatable circulating means, which upon activation causes gas within the interior space to circulate, and means within the interior space for trapping particulates in the gas.

Thus there is provided a transportable container which provides a clean environment for articles to be processed and which employs an active filtering system in localized areas to facilitate cleaning of the container and surrounding environments. The container is used particularly in connection with semiconductor processing equipment which also provides a clean environment and which can be cleaned locally as well. The container may also be used to store articles before and after processing. The container is preferably adapted to receive a holder such as a wafer cassette holder for holding one or more articles such as semiconductor wafers.

A principal advantage of this invention is the provision of a sealable transportable container in which the interior environment may be actively filtered as desired. This may be done by alternatively pressurizing and evacuating the container through filter means, or by way of a transportable container in which air may be circulated throughout the interior of the container without opening the container.

An embodiment of this invention provides a system in which the port plate of the processing equipment has an injector/extractor which has localized intelligence such that it can be actuated to either pressurize or evacuate at appropriate times. The system according to a preferred embodiment of the invention also includes means for sensing the quality and pressure of the interior space of the container.

This invention may also be arranged to provide a transportable container which enhances the SMIF still air concept by matching environments as the wafers are transferred from one location to another.

In an embodiment of this invention, the transportable container is used with processing equipment having a port plate and a port door sealably mating to the port plate. When the container first described above is mounted at the port plate, the conduit is connected to structure for moving gases into and out of the box through a filter, whereby, upon activation of the structure for moving gases, the interior space is cleaned by being alternatively evacuated and pressurized.

A preferred embodiment of the transportable container in accordance with this invention includes the box top having conduit means for communicating between the interior space and the port plate of the processing equipment. The port plate in this case includes conduit means for communicating with the box top conduit means and for sealably mating with an injector/extractor which may be activated to alternately pressurize or evacuate the interior space through a filter in the box top conduit means, thereby cleaning the interior space as it is alternately pressurized and evacuated.

In another preferred embodiment, the box door includes the conduit means for communication between the interior space and the port door of the processing equipment which includes conduit means for communication with the box door conduit means and further includes means for sealably connecting an injector/extractor. The box door conduit means includes filtering means, whereby upon activation of the injector/extractor the interior space may be evacuated and pressurized through the filtering means, thereby trapping particles and cleaning the interior space.

Thus, it is an advantage of the present invention that the interior space of the transportable

container may be cleaned while articles are present within the interior space.

It is a further advantage of the invention to be able to pressurize the interior space to match the pressure of the environment of the processing equipment.

It is a further advantage of the invention to be able to activate a pressurization or evacuation activation means for dynamically cleaning the interior space of the container during the processing of the articles.

These and other objects and advantages of the invention will appear more clearly from the following description in which the preferred embodiments of the invention have been set forth in detail in conjunction with the drawings.

Brief Description of the Drawings:

Fig. 1 depicts a prospective view of the SMIF system positioned in use with processing equipment.

Fig. 2 is a schematic representation of one alternative SMIF container in accordance with this invention, shown with the processing equipment of Fig. 1.

Fig. 3 depicts a prospective view of an hermetically sealable container with a port plate having an injector/extractor means, all in accordance with the present invention.

Fig. 4 is a cross sectional view of the embodiment of Fig. 3 of the hermetically sealable container in accordance with this invention taken along lines 4-4 in the direction of the arrows.

Fig. 5 is another elevated side of the container of Fig. 4 illustrating the box latch means.

Figs. 6 and 7 are cross sectional views of another embodiment of the container of Fig. 3 taken along lines 4-4 in the direction of arrows illustrating inflatable sealing means.

Fig. 8 is an exploded perspective view of an alternate embodiment of the container in accordance with this invention.

Fig. 9 is a cross sectional view of the container of Fig. 8 taken along lines 9-9 in the direction of the arrows.

Fig. 10 is an elevated side view of another alternative embodiment of the sealable container in accordance with this invention.

Fig. 11 is a partial sectional enlarged view taken along lines 11-11 in the direction of the arrows illustrating particle collectors.

Fig. 12 illustrates another alternative embodiment of the container in accordance with this invention having a liner.

Fig. 13 illustrates yet another embodiment of a container in accordance with this invention having separate inlet and outlet and a closed to filtering system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS:

Referring to the Drawings, wherein like-reference characters designate like or corresponding parts throughout the several views and referring particularly to Figure 1, there is shown a canopy 10 which is an easily removable shield that covers the wafer handing mechanism of the processing equipment 12. Equipment 12 is a photo resist applicator, mask aligner, inspection station or any similar processing equipment. The canopy 10 is constructed of transparent plastic, such as acrylic or Lexan to facilitate inspection and/or maintenance within the canopy 10. The canopy 10 encloses the handling mechanisms of the processing equipment 12 and a holder 14, such as a wafer cassette holding wafers 16. The environment within the processing equipment is separately maintained and separately cleaned and therefore the equipment 12 need not be installed in a clean room.

Figure 2 shows further details of the apparatus of Figure 1. A container in accordance with this invention, generally shown by the numeral 18 comprises a box 20 mounted on the horizontal surface 22 of canopy 10 by means of a port assembly 24 and specifically, port plate 26. The port assembly 24 further includes a port door 28 and an elevator mechanism 30 that transports a cassette holder 14, containing the integrated circuit wafers 16 from the box 20 into the region beneath the canopy 10. In Figure 2, the port door 28 and a box door 32 are shown in the closed position by the dotted lines. A mover assembly 34 includes a platform 36, a shaft engagement means 38 and a drive motor 40. The platform 36, extending from the elevator assembly 30, carries the port door 28, the box door 32 and the holder 14 in a vertical direction. The platform 36 is attached by engagement means 38 to a vertical guide 42 of elevator assembly 30.

Typically, guide 42 includes a lead screw (not shown) and the drive motor 40 drives a gear (not shown) which engages the lead screw for driving the platform 36 up or down. When the platform 36 is driven to the closed position, the port door 28 closes the port opening in the canopy 10.

In a similar manner, a manipulator assembly shown generally by the numeral 44 is fastened to a platform 46 which has an engagement means 48 for engaging the vertical guide 42. Manipulator assembly 44 includes a manipulator arm 50 and an engagement head 52 adapted to engage holder 14. By vertical operation of the platforms 36 and 46 and by operation of the manipulator assembly 44, the holder 14 is moved from its position on the box door 32 to a position on the equipment station 13

(as shown by the broken lines).

In Figure 3 there is shown an exploded view of a first embodiment of a container and port door assembly in accordance with this invention generally indicated by the numerals 60 and 80, respectively. The container 60 comprises a box 62 which is hermetically sealable. The box 62 can be alternately pressurized or evacuated as will be explained more fully below. The box 62 includes a box top 64 and a box door 66. The port assembly 80 includes a port plate 82 and a port door 84. The port plate 82 is connectable to a coaxial injector/extractor 100 at gas transfer valve 68.

The box door 66 includes box door latch means 70. The port door 84 includes pins 86 for actuating the box door latch means 70 and thereby releasing the box door 66 which contains the wafer 16. In this way, the wafers 16 can be moved by elevator mechanism 30 and mover assembly 34 into the proper position in the processing equipment 12 for processing without the need for human intervention.

In Figure 4, the container 60 is shown in relation to processing equipment 12. The container 60 is designed for sealably mating with the port assembly 80. The box top 64 has a first and second box top sealing surfaces 72 and 74 respectively. The box door 66 has a first box door sealing surface 76 for sealably mating with the first box top sealing surface 72 and thereby making a first seal 73.

The port plate 82 has first and second port plate sealing surfaces 88 and 90 respectively. The first port plate sealing surface 88 sealably mates with the second box top sealing surface 74 making a second seal 75.

The port door 84 has a first port door sealing surface 92 which sealably mates with the second port plate sealing surface 90 thereby making a third seal 77. The box top 64 further includes a conduit means defining a channel 78 between valve 68 and the interior spice 61 of box 62. At one end of the channel 78 is a filtering means 79 for filtering gases passing therethrough. The filtering means 79 comprises a membrane filter which is particularly effective at trapping small particles.

When all the three seals 73, 75 and 77 are made the box 20 interior space 61 may be cleaned by alternatively evacuating and pressurizing the box 20. In order to evacuate the interior space 61, the injector/extractor 100 is activated to withdraw gas from the interior space 61. As the gas is withdrawn, it passes through membrane filter 79, through channel 78 and through a coaxial valve of injector/extractor 100. When a vacuum is created in interior space 61 the process is complete. Using the container of the present invention, a vacuum of between 90-99% has been found possible. After the gas has been cleaned in the interior space 61 it may then be pumped back into the interior space again through filter 79. The membrane filter 79 keeps the particles within it, even upon pressurization.

During pressurization and evacuation of the container 60, it is preferable that the free flow of air be from the front of the wafers to the back of the wafers to cause the least amount of flux onto the wafers 16.

In Fig. 4, the first, second and third seals 73, 75 and 77, respectively, are all made by use of an O-ring. Further in Figure 4 it is shown that the injector/extractor 100 is also sealably inserted within port plate 82 by the use of O-rings 136. In order to minimize cost it has been found that the box 62 should be slightly dome and made of a strong plastic material which can withstand 100 kPa (15 PSI) differential. The injector/extractor 100 is activated through activation means 104 located in the port assembly 80.

In Fig. 5, the box door latch means 70 are shown in detail. The latch means 70 are actuated by port door pins 86 in the same manner as previously described with reference to U.S. Patent serial number 635, 384, which is incorporated herein by reference.

The container in accordance with this invention has the advantage of being able to match environments. The interior space 61 defines a first environment 110 as shown in Fig. 2. A second environment 112 is defined by the interior of the processing equipment 12. A third environment 114 is defined by the space external the container 60 and the processing equipment 12. Prior to the box door 66 being opened, the first environment 110 may be adjusted both as to pressure and as to cleanliness as described above. The second environment 112 may be similarly adjusted when a second injector/extractor 102 is connected to the processing equipment 12. Thus, first and second environments 110 and 112, respectively may then be matched both as to cleanliness and as to pressure. Further when the box door 66 is opened, exposing the wafer 16 to the second environment 112, the pressure and cleanliness may be matched to promote still air transfer of the wafer 16 within the processing equipment 12. Thus the still air wafer concept forth in U.S. Patent Nos. 4,532,970 and 4,534,389 is enhanced by the present invention.

After processing of the wafers 16, the wafers are reinserted into environment 110. The wafers may then be carried in container 60 through third environment 114 without threat of contamination because of the sealed nature of container 60. Thus, the third environment 114 may be contaminated with many particles without adversely affecting the first environment 110 and thereby wafers 16.

The opening of the box door 66 may be synchronized with the evacuation or pressurization of the container 60. It may be desirable for example to pressurize the first and second environments to 100 kPa (15 PSI) prior to the opening of the box door. As explained above the pressure of the environments may be matched using the present invention.

It may be desirable to have the wafers 16 move within the processing equipment with the processing equipment 12 having zero pressure or being in vacuum. Again, environments 110 and 112 may be matched to facilitate still air transfer.

The box top 64 is provided with a sensor 120 which senses both the quality of environment 110 as well as the pressure of environment 110. Similarly, processing equipment 12 is provided with a sensor 122 which senses the pressure and type of environment within the second environment 112. A further discussion of the principles of sensoring the environment 110 is found below with respect to Fig. 13.

In Fig. 13, box 62 is provided with a close4d system 160 for filtering and analyzing having an inlet 164 and outlet 166. Clean air or free N_2 is pumped by pump P into the interior space 61, circulated through conduit tubing 168 and then exhausted through an outlet. A filter 170 for trapping any particles in the interior space 61 is provided at the outlet 166. Additionally the inlet could also have a filter. Each of the inlet 164 and outlet 166 are one-way valves so that unwanted gases can not enter the first environment 110. Closed system 160 includes sensor 172 and 174. The sensors 172 and 174 also include attachment to a source of dry nitrogen when it is desirable to pump nitrogen through the closed system 160. The sensors analyze the gas in interior space 61 both quantitatively and qualitatively. Thus the type of environment including pressure and content can be measured using the container in accordance with this invention.

In Fig 12, the container 60 is shown having a liner 180, similar to the container described with respect to earlier filed patent application Serial No. US 829,447 which is incorporated herein by reference. The liner 180 in the interior space 61. As air in the space 61 is placed in motion it flows through the channel 182 created by the space between the liner 180 and the box top 64. An indentation 184 is provided in the box top 64 creating a further means for directing the air flow in box 62. During injection air follows the general flow indicated by the arrows. Of course upon pressurization, the opposite direction of the arrow would indicate the general air flow. The air flows through a membrane filter 184 seated on top of the liner 180. The filter 184 filters even small particles. The filter 184 is seated on top of the liner 180 so as to provide space between the filter 184 and the box top 64 so that air can flow through that space.

In Figs 2, 6 through 9 there is shown another alternative embodiment of a transportable container 60', in accordance with this invention. The container 60', is shown an exploded view in Fig. 8. This embodiment of the present invention is identical to the earlier described embodiment with respect to Figs. 3 through 5 with the exceptions noted below.

The container 60' comprises a box 62 defining an interior space 61 for containing the wafer 16. The box includes a box top 64 having a slightly domed shape and having walls capable of withstanding a 100 kPa (15 PSI) pressure differential. The box 62 also includes a box door 66 having conduit means 78 for communication between the interior space and the port door 84. The conduit means 78 defines a channel.

The box top 64 has first and second box top sealing surfaces 72 and 74, respectively. The box door 66 has a first box door sealing surface 76 which sealably mates with first box top sealing surface 72 making a first seal 73.

The port plate 82 has first and second port plate sealing surfaces 88 and 90, respectively. The first port plate sealing surface 88 sealably mates with the second box top sealing surface 74 for making a second seal 75. The port door 84 has a first port door sealing surface 92 which sealably mates with second port plate sealing surface 90 for making a third seal 77. The port door 84 further includes conduit means defining a channel 94 for communication between the box door 66 and the second environment 112. The box door 66 has conduit means 95 for communication between the space 97 between the port door 84 and box door 66. Using conduit 95 the space 97 may alternatively be evacuated or pressurized with the environments 110 and 112.

In the embodiment shown in Figs. 2, 6 through 9, the processing equipment 12 includes an injector/extractor 100 connectable through the box door 66. The injector/extractor 100 is connected to the port channel 94 by an umbilical cord 106. The umbilical cord 106 is flexible and moves with the vertical movement of elevator assembly 30 without tangling in the manipulator assembly 50. Similar to earlier embodiment described with respect to Figs. 3 and 4, this embodiment can also be evacuated and pressurized in a similar manner. In this embodiment, the pressure of the container 60' in combination with the mating of injector/extractor valve 101 upon check valve 98 causes the valve to become activated when the pump P (Fig. 2) is in the "on" position. This embodiment therefore defines a passive system of evacuation and pres-

surization as compared with the embodiments described with reference to Figs. 4 and 5, where the pressurization/evacuation occurs by actively switching on the activation means 104.

In Figs. 6 and 7, there is shown an alternate sealing structure for sealing the container 60' against port plate 82. The port plate 82 has an internal grove 83 around its inside perimeter. An inflatable seal 130 fits snugly into9 grove 83. The inflatable seal 130 is connected to a pump (not shown) by conduit 132. After the container 60' has been placed in processing equipment 12, the pump is activated and the seal inflated. To remove the container 60', the seal is deflated and the container 60' released.

In Fig. 10 there is shown another alternative embodiment of a transportable container 60. In this embodiment particle reduction is accomplished by inducing air circulation within container 60 and trapping particles in a particle gathering element in the interior space. The container 60 comprises an hermetically sealable box 140 defining an interior space 141 for containing the wafers 16. The box 140 includes a box top 142 having first and second box top sealing surfaces 144 and 146 respectively. The box top further includes activatable means for circulating fluid within the interior space defining an absorption plate 148. The box top 142 further includes a particle gathering element 150 for filtering the gas activated by the absorption plate 148. As shown by the dotted lines, an additional or alternate particle gathering element may be at the top of box 140. It is preferable to have the particle gathering element 150 located on the side of the box top to promote more effective particle gathering. The box 140 includes a box door 152 which has a first box door sealing surface 154 which sealably mates with first box top sealing surface 144 for making a first seal 156.

The container 60 is similar to the previously disclosed embodiments of a transportable container inasmuch as it is designed to work in conjunction with port assembly 80. Like the previously described embodiments, the port plate 82 has first and second port plate sealing surfaces 88 and 90, respectively. The first port plate sealing surface 88 sealably mates with the second box top sealing surface 146 for creating a second seal 75. The port door 84 has a first port door sealing surface 92 which sealably mates with second port plate sealing surface 90 for making a third seal 77. In operation, the box door opens and closes as described with respect to the earlier embodiments in Figs. 3 through 9.

The absorption plate 148 is heated by direct infrared energy supplied by infrared energy source 158. The infrared energy source is a thermal source which applies heat to the absorption plate 148. The absorption plate 148 in turn heats the interior space 141 at the area closely proximate thereto. The absorption plate 148 is located within the box top 142 and adjacent the box door 152. Thus as the air in the interior space 141 is heated at the bottom, it rises creating a convection current which causes air to circulate through the box top filter 150. It has been found that the absorption plate 148 need only be heated several degrees above the ambient to create this local convection current. As the warmer air rises, it is cooled by the walls of the box top and thereby sustains a continuous circulation. It is expected that circulation rates of several turns per minute can be achieved without raising the temperature of the interior space 141 more than a few degrees above ambient. As the air circulates the particles in the interior space 141 are trapped in the filter 150.

In Fig. 11, the particle gathering element 184 is shown in detail. The element 184 includes fins 186 which gather particles as the air circulates within the box 140. The pins 186 are positioned such that they do not severely interface with the flow of air.

Claims

1. A transportable hermetically sealable container (18, 60) for use with processing equipment (12) which has a port plate (26, 82) and a port door (28, 84) sealably mating thereto, the container (18, 60) being arranged to maintain the cleanliness of articles (16) to be processed by the processing equipment (12) and comprising a box (20, 62) defining an interior space (61) for containing said articles (16), the box (20, 62) comprising a box top (64) and a box door (32, 66), the box door (32, 66) having box door latch means (70) for sealably latching the box door to the box top, the box (20, 62) being adapted to be sealably mounted at the port plate (26, 82) of the processing equipment (12) and the box door latch means (70) being adapted to be activated by means associated with the port door (28, 84) when the box is so mounted,

the container being characterized in that the box (20, 62) comprises first conduit means (78) for communicating between the interior space (61) and the environment external to the box, and filtering means (79, 184) arranged to filter gas passing through said first conduit means (78), and wherein the first conduit means (78) is arranged to be connected to means for moving gas into and out of the box when the box is mounted at the port plate, whereby upon activation of the gas moving means, the interior space (61) may be evacuated or pressurized.

surization as compared with the embodiments described with reference to Figs. 4 and 5, where the pressurization/evacuation occurs by actively switching on the activation means 104.

In Figs. 6 and 7, there is shown an alternate sealing structure for sealing the container 60' against port plate 82. The port plate 82 has an internal grove 83 around its inside perimeter. An inflatable seal 130 fits snugly into9 grove 83. The inflatable seal 130 is connected to a pump (not shown) by conduit 132. After the container 60' has been placed in processing equipment 12, the pump is activated and the seal inflated. To remove the container 60', the seal is deflated and the container 60' released.

In Fig. 10 there is shown another alternative embodiment of a transportable container 60. In this embodiment particle reduction is accomplished by inducing air circulation within container 60 and trapping particles in a particle gathering element in the interior space. The container 60 comprises an hermetically sealable box 140 defining an interior space 141 for containing the wafers 16. The box 140 includes a box top 142 having first and second box top sealing surfaces 144 and 146 respectively. The box top further includes activatable means for circulating fluid within the interior space defining an absorption plate 148. The box top 142 further includes a particle gathering element 150 for filtering the gas activated by the absorption plate 148. As shown by the dotted lines, an additional or alternate particle gathering element may be at the top of box 140. It is preferable to have the particle gathering element 150 located on the side of the box top to promote more effective particle gathering. The box 140 includes a box door 152 which has a first box door sealing surface 154 which sealably mates with first box top sealing surface 144 for making a first seal 156.

The container 60 is similar to the previously disclosed embodiments of a transportable container inasmuch as it is designed to work in conjunction with port assembly 80. Like the previously described embodiments, the port plate 82 has first and second port plate sealing surfaces 88 and 90, respectively. The first port plate sealing surface 88 sealably mates with the second box top sealing surface 146 for creating a second seal 75. The port door 84 has a first port door sealing surface 92 which sealably mates with second port plate sealing surface 90 for making a third seal 77. In operation, the box door opens and closes as described with respect to the earlier embodiments in Figs. 3 through 9.

The absorption plate 148 is heated by direct infrared energy supplied by infrared energy source 158. The infrared energy source is a thermal source which applies heat to the absorption plate 148. The absorption plate 148 in turn heats the interior space 141 at the area closely proximate thereto. The absorption plate 148 is located within the box top 142 and adjacent the box door 152. Thus as the air in the interior space 141 is heated at the bottom, it rises creating a convection current which causes air to circulate through the box top filter 150. It has been found that the absorption plate 148 need only be heated several degrees above the ambient to create this local convection current. As the warmer air rises, it is cooled by the walls of the box top and thereby sustains a continuous circulation. It is expected that circulation rates of several turns per minute can be achieved without raising the temperature of the interior space 141 more than a few degrees above ambient. As the air circulates the particles in the interior space 141 are trapped in the filter 150.

In Fig. 11, the particle gathering element 184 is shown in detail. The element 184 includes fins 186 which gather particles as the air circulates within the box 140. The pins 186 are positioned such that they do not severely interface with the flow of air.

Claims

1. A transportable hermetically sealable container (18, 60) for use with processing equipment (12) which has a port plate (26, 82) and a port door (28, 84) sealably mating thereto, the container (18, 60) being arranged to maintain the cleanliness of articles (16) to be processed by the processing equipment (12) and comprising a box (20, 62) defining an interior space (61) for containing said articles (16), the box (20, 62) comprising a box top (64) and a box door (32, 66), the box door (32, 66) having box door latch means (70) for sealably latching the box door to the box top, the box (20, 62) being adapted to be sealably mounted at the port plate (26, 82) of the processing equipment (12) and the box door latch means (70) being adapted to be activated by means associated with the port door (28, 84) when the box is so mounted,

the container being characterized in that the box (20, 62) comprises first conduit means (78) for communicating between the interior space (61) and the environment external to the box, and filtering means (79, 184) arranged to filter gas passing through said first conduit means (78), and wherein the first conduit means (78) is arranged to be connected to means for moving gas into and out of the box when the box is mounted at the port plate, whereby upon activation of the gas moving means, the interior space (61) may be evacuated or pressurized.

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2. A transportable container according to claim 1 for use with processing equipment (12) the port plate (26, 82) of which is adapted to receive means for moving gas, the first conduit means (78) being arranged to communicate between the interior space (61) and the port plate (20, 82) when the container is mounted at the port plate.

3. A transportable container according to claim 1 in which the first conduit means (78) is arranged to communicate between the interior space (61) and the port door (28, 84) of the processing equipment when the container is mounted at the port plate (26, 82), for use with processing equipment (12) the port door (28, 84) of which comprises second conduit means (94) arranged to communicate with said first conduit means (78) when the container is mounted at the port plate (26, 82), and which comprises third conduit means (106) in communication with the second conduit means (94) for facilitating communication of the interior space (61) with means for moving gas into and out of the interior space (61).

4. A transportable container (60) for use with processing equipment (12) which has a port plate (82) and a port door (84), the container (60) being arranged to maintain the cleanliness of articles (16) to be processed by the processing equipment (12) and comprising a box (140) defining an interior space (141) for containing said articles (16), the box (140) comprising a box top (142) and a box door (152), the box door (152) having box door latch means (70) for sealably latching the box door to the box top, the box (140) being adapted to be sealably mounted at the port plate (82) of the processing equipment (12) and the box door latch means (70) being adapted to be activated by means associated with the port door (84) when the box is so mounted,

the container being characterized by comprising an activatable circulating means (148), which upon activation causes gas within the interior space (141) to circulate, and means within the interior space for trapping particulates in the gas (150).

5. A transportable container according to any preceding claim for use with processing equipment (12), the port plate (26, 82) of which has first and second port plate sealing surfaces (88, 90) and the port door (28, 84) of which has a first port door sealing surface (92) for sealably mating with the second port plate sealing surface (90), the box door (32, 66, 152) having a first box door sealing surface (76), and the box top (64, 142) having a first box top sealing surface (73) for sealably mating with the first box door sealing surface (76) and a second box top sealing surface (74, 146) for sealably mating with the first port plate sealing surface (88).

Patentansprüche

1. Hermetisch abdichtbarer, transportabler Behälter (18, 60) zur Verwendung mit einer Bearbeitungsvorrichtung (12), die eine Durchlaßplatte (26, 82) und eine Durchlaßtür (28, 84) hat, die abdichtbar zueinander passen, wobei der Behälter (18, 60) dazu vorgesehen ist, die Sauberkeit von Gegenständen (16) aufrecht zu erhalten, die von der Bearbeitungsvorrichtung (12) bearbeitet werden, und eine Kapsel (20, 62) enthält, die einen Innenraum (61) zur Aufnahme der Gegenstände (16) bildet, wobei die Kapsel (20, 62) ein Kapseloberteil (64) und eine Kapseltür (32, 66) enthält, und die Kapseltür (32, 66) einen Kapseltürverriegelungsmechanismus (70) zum abdichtbaren Verriegeln der Kapseltür mit dem Kapseloberteil aufweist, und wobei die Kapsel (20, 62) in der Lage ist, abdichtend an der Durchlaßplatte (62, 82) der Bearbeitungsvorrichtung (12) angebracht zu werden und die Kapseltürverriegelungseinrichtung (70) durch eine Einrichtung betätigt werden kann, die mit der Durchlaßtür (28, 84) verbunden ist, wenn die Kapsel auf diese Weise angebracht ist,
wobei der Behälter dadurch gekennzeichnet ist, daß
die Kapsel (20, 62) eine erste Leitungseinrichtung (78) zur Verbindung zwischen dem Innenraum (61) und der Umgebung außerhalb der Kapsel enthält und eine Filtereinrichtung (79, 184) angeordnet ist, um Gas zu filtern, welches durch die erste Leitungseinrichtung (78) strömt, und daß die erste Leitungseinrichtung (78) mit einer Einrichtung zum Bewegen von Gas in die Kapsel und aus der Kapsel verbindbar ist, wenn die Kapsel an der Durchlaßplatte angebracht ist, wobei bei Betätigung der Gasbewegungseinrichtung der Innenraum (61) abgesaugt oder unter Druck gesetzt wird.

2. Transportabler Behälter nach Anspruch 1 zur Verwendung mit der Bearbeitungsvorrichtung (12), deren Durchlaßplatte (26, 82) dazu geeignet ist, eine Einrichtung zur Bewegung von Gas aufzunehmen, wobei die erste Leitungseinrichtung (78) eine Verbindung zwischen dem Innenraum (61) und der Durchlaßplatte (20, 82) herstellt, wenn der Behälter an der

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Durchlaßplatte angebracht ist.

3. Transportabler Behälter nach Anspruch 1, wobei die erste Leitungseinrichtung (78) eine Verbindung zwischen dem Innenraum (61) und der Durchlaßtür (28, 84) der Bearbeitungsvorrichtung herstellt, wenn der Behälter an der Durchlaßplatte (26, 82) angebracht ist, zur Verwendung mit der Bearbeitungsvorrichtung (12), deren Durchlaßtür (28, 84) eine zweite Leitungseinrichtung (94) aufweist, die eine Verbindung mit der ersten Leitungseinrichtung (78) herstellt, wenn der Behälter an der Durchlaßplatte (26, 82) angebracht ist, und eine dritte Leitungseinrichtung (106) in Verbindung mit der zweiten Leitungseinrichtung (94) enthält, um die Verbindung des Innenraums (61) mit der Einrichtung zum Bewegen von Gas in dem Innenraum (61) und aus dem Innenraum zu erleichtern.

4. Transportabler Behälter (60) zur Verwendung mit einer Bearbeitungsvorrichtung (12), die eine Durchlaßplatte (82) und eine Durchlaßtür (84) hat, wobei der Behälter (60) angeordnet ist, um die Sauberheit von Gegenständen (16) aufrecht zu erhalten, die von der Bearbeitungsvorrichtung (12) bearbeitet werden, und eine Kapsel (140) aufweist, die einen Innenraum (141) zur Aufnahme der Gegenstände (16) bildet, wobei die Kapsel (140) ein Kapseloberteil (142) und eine Kapseltür (152) aufweist, und die Kapseltür (152) eine Kapseltürverriegelungseinrichtung (70) zum abdichtbaren Verriegeln der Kapseltür mit dem Kapseloberteil hat, wobei die Kapsel (140) abdichtbar an der Durchlaßplatte (82) der Bearbeitungsvorrichtung (12) befestigbar ist, und die Kapseltürverriegelungseinrichtung (70) durch eine Einrichtung betätigt werden kann, die mit der Durchlaßtür (84) verbunden ist, wenn die Kapsel so angebracht ist,
wobei der Behälter gekennzeichnet ist durch eine aktivierbare Zirkulationseinrichtung (148), die bei ihrer Betätigung Gas innerhalb des Innenraums (141) zirkulieren läßt, und eine Einrichtung in dem Innenraum zum Einfangen von Partikeln in dem Gas (150).

5. Transportierbarer Behälter nach jedem der vorhergehenden Ansprüche zur Verwendung mit der Bearbeitungsvorrichtung (12), deren Durchlaßplatte (26, 82) eine erste und eine zweite Durchlaßplattendichtungsfläche (88, 90) hat und deren Durchlaßtür (28, 84) eine erste Durchlaßtürdichtungsfläche (92) aufweist, die abdichtend mit der zweiten Durchlaßplattendichtungsfläche (90) übereinstimmt, wobei die Kapseltür (32, 66, 152) eine erste Kapseltürdichtungsfläche (76) und das Kapseloberteil (64, 142) eine erste Kapseloberteildichtungsfläche (73) aufweist, die abdichtend mit der ersten Kapseltürdichtungsfläche (76) übereinstimmt und eine zweite Kapseloberteildichtungsfläche (74, 146) abdichtend zu der ersten Durchlaßplattendichtungsfläche (88) paßt.

Revendications

1. Conteneur transportable pouvant être fermé hermétiquement (18, 60), pour utilisation avec un équipement de traitement (12), qui possède une plaque d'entrée (26, 82) et une porte d'entrée (28, 84) adaptée de manière étanche à celle-ci, le conteneur (18, 60) étant conçu pour maintenir la propreté d'articles (16) à traiter par l'équipement de traitement (12) et comprenant une boîte (20, 62) définissant un espace intérieur (61) pour contenir lesdits articles (16), la boîte (20, 62) comprenant un dessus de boîte (64) et une porte de boîte (32, 66), la porte de boîte (32, 66) comportant un moyen de verrouillage de porte de boîte (70) pour verrouiller de manière étanche la porte boîte au dessus de boîte, la boîte (20, 62) étant conçue pour être montée de manière étanche au droit de la plaque de porte (26, 82) de l'équipement de traitement (12), et le moyen de verrouillage de porte de boîte (70) étant conçu pour être actionné par un moyen associé avec la porte d'entrée (28, 84) lorsque la boîte est ainsi montée ;
le conteneur étant caractérisé en ce que la boîte (20, 62) comprend un premier moyen de conduit (78) pour mettre en communication l'espace intérieur (61) et l'environnement externe à la boîte, et un moyen de filtrage (79, 184) disposé de manière à filtrer du gaz passant par ledit premier moyen de conduit (78), et dans lequel le premier moyen de conduit (78) est disposé pour être raccordé à un moyen de déplacement de gaz pour amener du gaz dans la boîte et l'en faire sortir lorsque la boîte est montée au droit de la plaque d'entrée, ce par quoi lors de l'activation du moyen de déplacement de gaz, l'espace intérieur (61) peut être mis sous vide ou mis sous pression.

2. Conteneur transportable selon la revendication 1, pour utilisation avec un équipement de traitement (12) dont la plaque d'entrée (26, 82) est conçue pour recevoir un moyen de déplacement de gaz, le premier moyen de conduit (78) étant disposé pour mettre en communication l'espace intérieur (61) et la plaque d'entrée (20, 82) lorsque le conteneur est monté au

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droit de la plaque d'entrée.

3. Conteneur transportable selon la revendication 1, dans lequel le premier moyen de conduit (78) est disposé pour mettre en communication l'espace intérieur (61) et la porte d'entrée (28, 84) de l'équipement de traitement lorsque le conteneur est monté au droit de la plaque d'entrée (26, 82), pour utilisation avec l'équipement de traitement (12) dont la porte d'entrée (28, 84) comprend un deuxième moyen de conduit (94) disposé pour communiquer avec ledit premier moyen de conduit (78) lorsque le conteneur est monté au droit de la plaque d'entrée (26, 82), et qui comprend un troisième moyen de conduit (106) en communication avec le deuxième moyen de conduit (94) pour faciliter la communication de l'espace intérieur (61) avec le moyen pour amener du gaz dans l'espace intérieur (61) et l'en faire sortir.

4. Conteneur transportable (60), pour utilisation avec un équipement de traitement (12), qui possède une plaque d'entrée (82) et une porte d'entrée (84), le conteneur (60) étant conçu pour maintenir la propreté d'articles (16) à traiter par l'équipement de traitement (12) et comprenant une boîte (140) définissant un espace intérieur (141) pour contenir lesdits articles (16), la boîte (140) comprenant un dessus de boîte (142) et une porte de boîte (152), la porte de boîte (152) comportant un moyen de verrouillage de porte de boîte (70) pour verrouiller de manière étanche la porte boîte au dessus de boîte, la boîte (140) étant conçue pour être montée de manière étanche au droit de la plaque de porte (82) de l'équipement de traitement (12), et le moyen de verrouillage de porte de boîte (70) étant conçu pour être actionné par un moyen associé avec la porte d'entrée (84) lorsque la boîte est ainsi montée ;

le conteneur étant caractérisé en ce qu'il comprend un moyen de circulation (148) pouvant être activé, qui lors de son activation fait que le gaz dans l'espace intérieur (141) circule, et un moyen dans l'espace intérieur pour piéger des particules dans le gaz (150).

5. Conteneur transportable selon l'une quelconque des revendications précédentes, pour utilisation avec un équipement de traitement (12), dont la plaque d'entrée (26, 82) possède des première et seconde surfaces d'étanchéité de plaque d'entrée (88, 90) et dont la porte d'entrée (28, 84) possède une première surface d'étanchéité de porte d'entrée (92) pour s'adapter de manière étanche à la seconde surface d'étanchéité de plaque d'entrée (90), la porte de boîte (32, 66, 152) comportant une première surface d'étanchéité de porte de boîte (76), et le dessus de boîte (64, 142) possédant une première surface d'étanchéité de dessus de boîte (73) pour s'adapter de manière étanche avec la première surface d'étanchéité de porte de boîte (76) et une seconde surface d'étanchéité de dessus de boîte (74, 146) pour s'adapter de façon étanche avec la première surface d'étanchéité de plaque d'entrée (88).

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