

[DESCRIPTION]

[Invention Title]

CHEMICAL SAMPLING APPARATUS

[Technical Field]

An embodiment relates to a chemical sampling apparatus.

[Background Art]

A company that handles chemicals harmful to human bodies, for example, a company, which manufactures chemicals such as a company that manufactures semiconductors, LCDs, OLEDs, medicines, paint, or the like, uses various types of chemicals for a single process or a plurality of unit processes.

In general, the chemicals are supplied to a main storage tank by means of a tank truck or the like, and some of the chemicals stored in the main storage tank are divided and stored in the plurality of sub-storage tanks, such that the chemicals may be sequentially supplied to the single unit process or individually supplied to the plurality of unit processes.

As another example, when the number of chemicals is small or when the tank truck cannot be used because of the nature of the chemicals, the chemicals may be supplied directly to the sub-storage tanks by means of drums, bottles, or the like.

If the chemicals are contaminated in the tank truck, the drum, the bottle, the storage tank, pipes, and the like, defects may occur in the unit process to which the chemicals are supplied.

Therefore, it is necessary to manage a degree of contamination of the chemicals at an appropriate level at a main position on each of the tank trucks, the drum, the bottle, the storage tank, the pipe, and the like. Therefore, a sampling apparatus capable of sampling the chemicals at the main position has been developed.

The sampling apparatus in the related art includes a sampling booth, a plurality of sampling lines respectively connected to a plurality of main positions and configured to supply the chemicals into a sampling bottle accommodated in the sampling booth, and valves respectively installed in the plurality of sampling lines.

An operator may perform the following sampling operation using the sampling apparatus in the related art.

For example, the operator directly opens a cap of the sampling bottle, loads the sampling bottle into the sampling booth, and fills the sampling bottle with the chemicals by operating the valve in the sampling line connected to the main position at which the chemicals are sampled. Further, the operator unloads the sampling bottle filled with the chemicals from the sampling booth, directly closes the cap of the sampling bottle, and transports the sampling bottle to a location for analyzing the degree of contamination of the chemicals.

In general, the sampling operation is mostly performed manually by the operator, as described above.

Therefore, there is a problem in that there is a high likelihood that the chemicals are contaminated during the sampling operation because of the operator's carelessness or the like. Further, there is a problem in that there is a high likelihood that the operator is exposed to the chemicals.

These problems are highly likely to occur during the process in which the operator directly opens or closes the cap of the sampling bottle.

Meanwhile, if the chemicals are contaminated during the sampling operation, the reliability of the result of analyzing the degree of contamination of the chemicals may deteriorate. In addition, it may be inconvenient for the operator to prepare a safety gear with the highest protection grade and wear or take off the safety gear to

protect the operator.

[Disclosure]

[Technical Problem]

An embodiment provides a chemical sampling apparatus that automates a sampling process that was performed manually.

Another embodiment provides a transfer device capable of protecting a drive means from exposure to chemicals or fumes and a chemical sampling apparatus including the same.

Still another embodiment provides a cap opening/closing device capable of automatically opening or closing a cap of a container and a chemical sampling apparatus including the same.

Yet another embodiment provides a chemical sampling apparatus capable of discharging chemicals accommodated in a sampling line before a chemical sampling operation.

The objects to be achieved by the embodiment are not limited to the above-mentioned objects, but also include objects or effects that may be understood from the solutions or embodiments described below.

[Technical Solution]

An embodiment of the present disclosure provides a chemical sampling apparatus including: a casing having an internal space; a sampling line penetrating the casing and configured to supply chemicals to the internal space; a first door configured to open or close a first inlet formed in the casing; a bottle holding unit configured to seat or fix a sampling bottle loaded into the internal space through the first inlet; a cap separating/coupling module configured to separate a cap from the sampling bottle disposed in the internal space or couple the cap to the sampling bottle; and a bottle

transfer unit configured to transfer the bottle holding unit so that the sampling bottle is disposed below a discharge port of the sampling line.

The chemical sampling apparatus may include: a second partition wall configured to divide the internal space into a first-first internal space and a first-second internal space; and a second door configured to open or close a second inlet formed in the second partition wall, in which the first-first internal space is connected to the first inlet, and the sampling line and the cap separating/coupling module are disposed in the first-second internal space.

The bottle holding unit may include first and second bottle holding parts configured to hold the sampling bottle, the bottle transfer unit may include a first bottle transfer part configured to transfer the first bottle holding part in a first direction, and a second bottle transfer part configured to transfer the second bottle holding part in a second direction, the first bottle holding part may be transferred to the cap separating/coupling module through the second inlet, and the second bottle holding part may be transferred from the cap separating/coupling module to the sampling line.

The first direction and the second direction may perpendicularly intersect each other.

The chemical sampling apparatus may include: a first partition wall configured to divide the internal space into a first internal space including the first-first internal space and the first-second internal space and a second internal space disposed below the first internal space, the first partition wall may have a first guide slit extending in the first direction, the first bottle holding part may include a pair of first grippers spaced apart from each other in the first direction, and a first interval adjusting part configured to adjust an interval between the pair of first grippers, the pair of first grippers may be disposed to penetrate the first guide slit, and the first interval adjusting part and the first

bottle transfer part may be disposed in the second internal space.

The chemical sampling apparatus may include: a third partition wall configured to divide the internal space into a first internal space including the first-first internal space and the first-second internal space and a third internal space disposed at one side of the first internal space, the third partition wall may have a second guide slit extending in the second direction, the second bottle holding part may include a pair of second grippers spaced apart from each other in the second direction, and a second interval adjusting part configured to adjust an interval between the pair of second grippers, the pair of second grippers may be disposed to penetrate the second guide slit, and the second interval adjusting part and the second bottle transfer part may be disposed in the third internal space.

The chemical sampling apparatus may include: a plurality of on-off valves respectively installed in the plurality of sampling lines; an input unit configured to receive one of a plurality of chemical supply sources respectively connected to the plurality of sampling lines; and a control unit configured to control the bottle holding unit, the cap separating/coupling module, the bottle transfer unit, the second door, and the on-off valve so that the sampling bottle is charged with the chemicals stored in the chemical supply source inputted from the input unit.

The chemical sampling apparatus may include: a drain module including a plurality of inlet ports corresponding to the plurality of sampling lines; and a drain module transfer unit configured to transfer the drain module to positions below the discharge ports of the plurality of sampling lines.

The control unit may control the drain module transfer unit and the on-off valve so that the chemicals accommodated in the sampling line connected to the chemical supply source inputted from the input unit are discharged to the drain module before the

sampling bottle is charged with the chemicals.

The cap separating/coupling module may include: a cap holding unit configured to hold the cap of the sampling bottle; a cap rotating unit configured to rotate the cap holding unit; and a cap lifting unit configured to transfer the cap holding unit in a vertical direction.

Another embodiment of the present disclosure provides a transfer device including: a partition wall configured to separate a first space and a second space and having a guide slit extending in a first direction; a holding unit extending from the first space to the second space through the guide slit; a transfer part disposed in the second space and configured to transfer the holding unit in the first direction; and a sealing unit configured to close an area of the guide slit through which the holding unit has passed.

A transfer target seated on or fixed to the holding unit may be disposed in the first space.

The holding unit may include a pair of grippers spaced apart from each other in the first direction.

The holding unit may include an interval adjusting part configured to adjust an interval between the pair of grippers. The pair of grippers configured to hold the transfer target may extend to the second space through the guide slit, and the interval adjusting part may be disposed in the second space.

The sealing unit may include a pair of shields coupled to the partition wall and coupled to each other so as to be separable from each other with the guide slit interposed therebetween in a second direction perpendicular to the first direction.

The pair of shields may have different magnetic properties.

One of the pair of shields may have a protrusion extending or provided in plural in the first direction, and the other of the pair of shields may have a groove to which the

protrusion is coupled.

The holding unit may be transferred between the pair of shields.

The holding unit may have a tapered area configured to come into contact with the pair of shields, and a width in the second direction of the tapered area may decrease toward two opposite ends in the first direction of the holding unit.

The holding unit may include a pair of rollers respectively disposed at the two opposite ends in the first direction of the holding unit, and the pair of shields may be coupled to each other again as an interval therebetween decreases while the pair of shields passes between the pair of the rollers.

The sealing unit may include a pair of drums rotatably coupled to the partition wall with the guide slit interposed therebetween in the first direction; a pair of membranes respectively wound around the pair of drums and coupled to the holding unit; and rotational force supply members configured to provide a rotational force to the drums so that the drums rotate in a direction in which the membranes are wound.

The embodiment of the present disclosure may provide a cap opening/closing device including a bottle holding unit on which a container is seated, and a cap separating/coupling module configured to separate a cap from the container and couple the cap to the container. The cap separating/coupling module may include a cap holding unit configured to hold the cap, a cap rotating unit configured to rotate the cap holding unit, and a cap lifting unit configured to move the cap holding unit in a vertical direction.

The cap holding unit may include: a first frame; a plurality of grippers rotatably coupled to the first frame so as to support a lateral surface of the cap; a second frame disposed on the first frame; a plurality of connection links respectively and rotatably coupled to the grippers and the second frame to convert a vertical rectilinear motion of

the second frame into a rotational motion of the grippers; and a frame lifting part coupled to the first frame and configured to transfer the second frame in the vertical direction.

The frame lifting part may include: a cylinder coupled to the first frame and a rotary shaft of the cap rotating unit; and a piston disposed in a first cavity formed in the cylinder, configured to move in the vertical direction by a fluid supplied to the first cavity, and having a first rod that penetrates a lower wall of the cylinder and is coupled to the second frame.

The cap separating/coupling module may include a lifting frame configured to be transferred in the vertical direction by the cap lifting unit, the cap rotating unit may be mounted on the lifting frame, the lifting frame may include a cylinder holder configured to support the cylinder so that the cylinder is rotatable, and the cylinder holder may have first and second fluid ports through which a fluid to be supplied to upper and lower sides of the first cavity flows in and out.

The cylinder may have first and second through-holes fluid-connected to the first cavity. Ring-shaped first and second grooves may be formed in an outer peripheral surface of the cylinder or an inner peripheral surface of the cylinder holder so that the first and second through-holes are respectively fluid-connected to the first and second fluid ports despite the rotational motion of the cylinder.

The cylinder may include a first cylinder area having the first cavity, and a second cylinder area disposed above the first cylinder area and having a second cavity therein. The piston has a second rod that penetrates a partition wall between the first cavity and the second cavity and extends to the second cavity. The first and second through-holes are formed in the second cylinder area and connected to the second cavity. The piston may have therein a first flow path connected to the first through-hole and

extending to an outer peripheral surface of an upper end of the first rod, and a second flow path connected to the second through-hole and extending to an outer peripheral surface of a lower end of the second rod.

Recesses may be formed in lower and upper surfaces of the first cavity and adjoin an outer peripheral surface of the first rod or the second rod.

A stroke of the piston may be smaller than a sum of an outlet diameter of the first through-hole and an inlet diameter of the first flow path.

The cap holding unit may include a plate member disposed below the first frame and coupled to the first frame so as to be movable upward and downward, and a plurality of elastic members interposed between the first frame and the plate member and configured to provide an elastic force to the plate member to maintain a horizontal state of the plate member.

A lower surface of the plate member may be disposed to face an upper surface of the cap held by the plurality of grippers.

The cap lifting unit may be disposed on the casing having a closed space in which the bottle holding unit is disposed. The cap holding unit may extend to the closed space through a through-hole formed in an upper surface of the casing.

The cap separating/coupling module may include a cover provided in the form of a pipe flexible in the vertical direction, configured to surround the cap holding unit, and coupled to the casing and the cylinder holder disposed on the casing.

The chemical sampling apparatus according to the embodiment of the present disclosure may include a casing having an internal space; a sampling line configured to supply chemicals to the internal space of the casing; a bottle transfer unit configured to transfer a sampling bottle so that the sampling bottle is charged with the chemicals discharged from the sampling line; a drain module configured to collect the chemicals

discharged from the sampling line; and a control unit configured to discharge some of the chemicals, discharged from the sampling line, to the drain module before the sampling bottle is charged with the chemicals.

The chemical sampling apparatus may include a drive unit configured to move the drain module to collect the chemicals.

The sampling line may include a discharge port from which the chemical is discharged. The drain module may include an inlet port corresponding to the discharge port.

The drain module may include a housing having the inlet port formed in an upper surface thereof; and a discharge pipe configured to discharge the chemicals, introduced into the internal space of the housing through the inlet port, to the outside of the casing.

The sampling line may be provided in plural, and the plurality of sampling lines is connected to different chemical supply sources. First valves may be respectively installed in the plurality of sampling lines.

The plurality of sampling lines may be connected to one another and thus have a single discharge port.

The plurality of sampling lines may be separated from one another and thus have a plurality of discharge ports. The plurality of discharge ports may be disposed to be spaced apart from one another in a first direction which is a transfer direction of the bottle transfer unit.

The housing may have a plurality of inlet ports corresponding to the plurality of discharge ports. The drain module may be transferred in a second direction that intersects the first direction.

The first direction and the second direction may include the horizontal direction.

The second direction may have the vertical direction, and the control unit may control the drive unit so that the discharge port enters the internal space of the housing.

The drain module may include a supply pipe configured to supply a dilute solution to the internal space of the housing; and a second valve installed in the supply pipe. The control unit may control the second valve in conjunction with the first valve so that the chemicals are discharged through the discharge pipe in a state in which the chemicals are mixed with the dilute solution.

The chemical sampling apparatus may include a bottle holding unit configured to seat or fix the sampling bottle and be transferred by the bottle transfer unit. The inlet port may be disposed to be higher than a seating surface of the bottle holding unit on which the sampling bottle is seated.

The chemical sampling apparatus may include a partition wall configured to divide the internal space of the casing into a first space and a third space. The drive unit may include: a transfer device disposed in the third space, configured to transfer the connection member, and having a connection member coupled to the drain module disposed in the first space through a through-hole formed in the partition wall; and a cover coupled to the drain module and the partition wall, configured to surround the connection member, and provided in the form of a flexible pipe.

[Advantageous Effects]

According to the embodiment, most of the operations of the sampling process may be automated. Therefore, it is possible to prevent the contamination of the chemicals during the sampling operation and reduce a risk that the operator is exposed to the chemicals.

According to the embodiment, the space in which the transfer target is disposed is separated from the space in which the drive means such as the transfer part is

disposed. Further, the open area of the guide slit, which is a movement passage for the holding unit, is minimized. Therefore, it is possible to maximally protect the drive means from exposure to the chemicals or fumes.

According to the embodiment, the means for rotating the cap holding unit and transferring the cap holding unit upward or downward is provided. Therefore, it is possible to automate the process of separating the cap from the container or coupling the cap to the container again.

According to the embodiment, the drain module and the sampling bottle are sequentially transferred to the position below the discharge port of the sampling line. Therefore, it is possible to discharge the chemicals, accommodated in the sampling line, through the drain module before the sampling operation.

The various, beneficial advantages and effects of the present disclosure are not limited to the above-mentioned contents and may be more easily understood during the process of describing the specific embodiments of the present disclosure.

[Description of Drawings]

FIG. 1 is a view of a chemical storage facility.

FIG. 2 is a perspective view of a chemical sampling apparatus according to an embodiment of the present disclosure.

FIG. 3 is a perspective view illustrating an interior of a casing illustrated in FIG. 2.

FIG. 4 is a perspective view illustrating a state in which a first vertical partition wall and the casing illustrated in FIG. 3 are removed.

FIG. 5 is a block diagram of a control unit.

FIGS. 6 to 10 are views illustrating a sampling process performed by the chemical sampling apparatus according to the embodiment of the present disclosure.

FIG. 11 is a perspective view of a transfer device including a first bottle holding unit according to the embodiment of the present disclosure.

FIG. 12 is a perspective view of the first bottle holding unit.

FIG. 13 is a cross-sectional view of a tapered area.

FIG. 14 is a view illustrating a modified example of a sealing unit.

FIG. 15 is a view illustrating another modified example of the sealing unit.

FIG. 16 is a perspective view of a second bottle holding unit.

FIG. 17 is a vertical cross-sectional view of a second tapered area.

FIG. 18 is a perspective view of a cap separating/coupling module.

FIG. 19 is an exploded perspective view of FIG. 18.

FIGS. 20 and 21 are views for explaining an operational principle of a cap holding unit.

FIG. 22 is a partial enlarged view of FIG. 20.

FIG. 23 is a partial enlarged view of FIG. 21.

FIG. 24 is a perspective view of a drain module.

FIG. 25 is an exploded perspective view of FIG. 24.

FIG. 26A is a front view of the drain module.

FIG. 26B is a view illustrating a first modified example of the drain module.

FIGS. 26C and 26D are views illustrating a second modified example of the drain module.

FIG. 27 is a block diagram illustrating a modified example of the control unit.

[Best Mode]

Hereinafter, an embodiment of the present disclosure will be described with reference to the accompanying drawings.

However, the technical spirit of the present disclosure is not limited to some

embodiments described herein but may be implemented in various different forms. One or more of the constituent elements in the embodiments may be selectively combined and substituted for use within the scope of the technical spirit of the present disclosure.

In addition, unless otherwise specifically and explicitly defined and stated, the terms (including technical and scientific terms) used in the embodiments of the present disclosure may be construed as the meaning which may be commonly understood by the person with ordinary skill in the art to which the present disclosure pertains. The meanings of the commonly used terms such as the terms defined in dictionaries may be interpreted in consideration of the contextual meanings of the related technology.

In addition, the terms used in the embodiments of the present disclosure are for explaining the embodiments, not for limiting the present disclosure.

In the present specification, unless particularly stated otherwise, a singular form may also include a plural form. The expression "at least one (or one or more) of A, B, and C" may include one or more of all combinations that can be made by combining A, B, and C.

In addition, the terms first, second, A, B, (a), and (b) may be used to describe constituent elements of the embodiments of the present disclosure.

These terms are used only for the purpose of discriminating one constituent element from another constituent element, and the nature, the sequences, or the orders of the constituent elements are not limited by the terms.

Further, when one constituent element is described as being 'connected', 'coupled', or 'attached' to another constituent element, one constituent element may be connected, coupled, or attached directly to another constituent element or connected, coupled, or attached to another constituent element through still another constituent

element interposed therebetween.

In addition, the expression "one constituent element is provided or disposed above (on) or below (under) another constituent element" includes not only a case in which the two constituent elements are in direct contact with each other, but also a case in which one or more other constituent elements are provided or disposed between the two constituent elements. The expression "above (on) or below (under)" may mean a downward direction as well as an upward direction based on one constituent element.

FIG. 1 is a view of a chemical storage facility.

Referring to FIG. 1, a chemical storage facility 1 may include an ACQC (automatic clean quick coupler) unit 2, a first chemical storage tank 3, a chemical distribution device 4, and a plurality of second chemical storage tanks 5 and 6.

The ACQC unit 2 may transfer chemicals, supplied from a tank truck, to the first chemical storage tank 3. The chemical distribution device 4 may divide some of the chemicals stored in the first chemical storage tank 3 and supply the chemicals to the plurality of second chemical storage tanks 3 and 4.

A chemical sampling apparatus 10 may be connected to the plurality of chemical storage tanks 3, 5, and 6 through a plurality of sampling lines L1, L2, and L3.

In the present embodiment, the configuration in which the sampling lines L1, L2, and L3 are connected to the chemical storage tanks has been described, but the present disclosure is not necessarily limited thereto. The sampling lines L1, L2, and L3 may be connected to all types of chemical supply sources, such as a tank truck, a drum, a bottle, a storage tank, a pipe, and the like that supply, store, or transfer the chemicals.

In addition, the three sampling lines L1, L2, and L3 are illustrated, but the present disclosure is not necessarily limited thereto. The number of sampling lines

may be one, two, or four or more in accordance with the number of chemical supply sources.

An on-off valve V and a pump P may be installed in each of the plurality of sampling lines L1, L2, and L3.

The pump P serves to transfer the chemicals through the sampling lines L1, L2, and L3, but the present disclosure is not necessarily limited thereto. A gas supply device may be provided to transfer the chemicals from the chemical supply source to the sampling lines L1, L2, and L3 by supplying a gas, e.g., nitrogen or air to the chemical supply source.

A casing 100, which constitutes the chemical sampling apparatus 10, may be disposed on the chemical distribution device 4, but the present disclosure is not necessarily limited thereto.

FIG. 2 is a perspective view of the chemical sampling apparatus according to the embodiment of the present disclosure, FIG. 3 is a perspective view illustrating an interior of the casing illustrated in FIG. 2, and FIG. 4 is a perspective view illustrating a state in which a first vertical partition wall and the casing illustrated in FIG. 3 are removed.

Referring to FIGS. 2 to 4, the chemical sampling apparatus 10 according to the embodiment of the present disclosure may include the casing 100, a bottle holding unit 200, a cap separating/coupling module 300, a bottle transfer unit 250. The chemical sampling apparatus 10 may further include a drain module 500 and a drain module transfer unit 600.

The casing 100 has an internal space, and a first inlet 101 connected to the internal space.

For example, the first inlet 101 may be opened or closed by a first door 103

hingedly coupled to the casing 100.

Therefore, an operator may close the first inlet 101 after loading a sampling bottle B into the internal space of the casing 100 through the first inlet 101.

The sampling bottle B may be loaded into the internal space of the casing 100 in a state in which a cap C is coupled to the sampling bottle B.

The internal space of the casing 100 may be separated into a first-first internal space A1-1, a first-second internal space A1-2, a second internal space A2, and a third internal space A3 by a plurality of partition walls 110, 120, and 130.

The plurality of partition walls 110, 120, and 130 may include a first partition wall 110 extending in a horizontal direction, and second and third partition walls 120 and 130 extending in a vertical direction. The first partition wall 110, the second partition wall 120, and the third partition wall 130 are each coupled and fixed to the casing 100.

The first-first internal space A1-1 may be a space defined by an inner surface of the casing 100, an upper surface of the first partition wall 110, and one surface of the second partition wall 120. The first-first internal space A1-1 may be separated from the first-second internal space A1-2 by the second partition wall 120.

The first inlet 101 may be formed in a sidewall of the casing 100 that adjoins the first-first internal space A1-1.

The first-second internal space A1-2 may be a space defined by the inner surface of the casing 100, the upper surface of the first partition wall 110, the other surface of the second partition wall 120, and one surface of the third partition wall 130. The plurality of sampling lines L1, L2, and L3 and the cap separating/coupling module 300 may be disposed in the first-second internal space A1-2. Therefore, a chemical sampling operation and a cap separating/coupling operation may be performed in the

first-second internal space A1-2.

A plurality of vent holes 105 may be formed in a sidewall of the casing 100 that adjoins the first-second internal space A1-2.

An exhaust module 107 may be coupled to the plurality of vent holes 105. The exhaust module 107 may discharge chemical fumes, generated in the first-second internal space A1-2, to a chemical purification facility (not illustrated) or the like.

The exhaust module 107 may include a blower fan, but the present disclosure is not necessarily limited thereto.

The second internal space A2 may be a space defined by the inner surface of the casing 100, a lower surface of the first partition wall 110, and one surface of the third partition wall 130. The second internal space A2 may be separated from the first-second internal space A1-2 by the first partition wall 110.

The third internal space A3 may be a space defined by the inner surface of the casing 100 and the other surface of the third partition wall 130. The third internal space A3 may be separated from the first-second internal space A1-2 by the third partition wall 130. The third internal space A3 may be a space separated from the second internal space A2, but the present disclosure is not necessarily limited thereto. The third internal space A3 may be a space connected to the second internal space A2.

A second inlet 121 is formed in the second partition wall 120. The second inlet 121 is a passageway through which the sampling bottle B loaded into the first-first internal space A1-1 may be transferred to the first-second internal space A1-2.

For example, the second inlet 121 may be opened or closed by a second door 123 hingedly coupled to the second partition wall 120.

Therefore, the first-first internal space A1-1 may serve as a buffer space that inhibits external foreign substances from being introduced into the first-second internal

space A1-2 or inhibits chemical fumes, which are generated in the first-second internal space A1-2 during the sampling operation, from being discharged to the outside when the first door 103 is opened.

The plurality of sampling lines L1, L2, and L3 may penetrate the casing 100, e.g., an upper wall of the casing 100 so that discharge ports of the plurality of sampling lines L1, L2, and L3 are disposed in the first-second internal space A1-2.

The bottle holding unit 200 may hold the sampling bottle B. The bottle transfer unit 250 may transfer the bottle holding unit 200.

The bottle holding unit 200 may include a first bottle holding part 210 and a second bottle holding part 220. The bottle transfer unit 250 may include a first bottle transfer part 251 and a second bottle transfer part 252.

The first bottle holding part 210 may hold the sampling bottle B loaded into the first-first internal space A1-1.

The first bottle transfer part 251 may transfer the first bottle holding part 210 in an X-direction. The X-direction (first direction) may be a horizontal direction.

The sampling bottle B, which is held by the first bottle holding part 210 in the first-first internal space A1-1, may pass through the second inlet 121 and be transferred to the cap separating/coupling module 300 in the first-second internal space A1-2 by the first bottle transfer part 251.

The second bottle holding part 220 may hold the sampling bottle B transferred to a position below the cap separating/coupling module 300 in the state in which the sampling bottle B is held by the first bottle holding part 210.

The second bottle transfer part 252 may transfer the second bottle holding part 220 in a Y-direction. The Y-direction (second direction) may be a horizontal direction that is parallel to or intersects the X-direction. For example, the X-direction and the Y-

direction may perpendicularly intersect each other. Therefore, a maximum width of the casing 100 may be minimized.

The sampling bottle B held by the second bottle holding part 220 may be transferred by the second bottle transfer part 252 and disposed below the discharge ports of the plurality of sampling lines L1, L2, and L3.

The first bottle holding part 210 may be separated from the sampling bottle B before the sampling bottle B is transferred by the second bottle transfer part 252. The second bottle holding part 220 may be separated from the sampling bottle B before the sampling bottle B is transferred by the first bottle transfer part 251.

Therefore, it is possible to prevent the operator's body from coming into contact with the second bottle holding part 220 that may be contaminated by scattering or overflowing chemicals during the process of charging the sampling bottle B with the chemicals discharged from the sampling lines L1, L2, and L3.

The cap separating/coupling module 300 is coupled to an upper surface of the casing 100. The cap separating/coupling module 300 may extend to the internal space of the casing 100, specifically, the first-second internal space A1-2 through a through-hole formed in the upper surface of the casing 100.

The cap separating/coupling module 300 may separate the cap C from the sampling bottle B and couple the cap C to the sampling bottle B. In this case, the sampling bottle B may be held by the first bottle holding part 210 and/or the second bottle holding part 220.

The drain module 500 may have inlet ports to introduce the chemicals into the internal space of the drain module 500.

The inlet ports of the drain module 500 may correspond in number and arrangement to the discharge ports of the plurality of sampling lines L1, L2, and L3.

That is, the number of inlet ports formed in the drain module 500 may be equal to the number of discharge ports of the plurality of sampling lines L1, L2, and L3. The plurality of inlet ports formed in the drain module 500 may be disposed at the same interval as the discharge ports of the plurality of sampling lines L1, L2, and L3.

For example, when the sampling lines L1, L2, and L3 each have the discharge port and thus the number of discharge ports is equal to the number of sampling lines L1, L2, and L3, the inlet ports of the drain module 500 may be equal in number to the sampling lines L1, L2, and L3.

As another example, when the plurality of sampling lines L1, L2, and L3 are connected as one line and thus only the single discharge port is disposed in the casing 100, the number of inlet ports of the drain module 500 may be smaller than the number of sampling lines L1, L2, and L3. In this case, the number of sampling positions of the sampling bottle B may decrease to one. Therefore, a size of the casing 100 may be reduced, and an effect of reducing manufacturing and management costs may be expected by miniaturizing the drain module 500 and simplifying the process of transferring the sampling bottle B.

The drain module transfer unit 600 may transfer the drain module 500 so that the plurality of inlet ports of the drain module 500 is disposed immediately below the discharge ports of the plurality of sampling lines L1, L2, and L3.

For example, the drain module transfer unit 600 may transfer the drain module 500 in the X-direction, but the present disclosure is not necessarily limited thereto. The drain module transfer unit 600 may transfer the drain module 500 in a Z-direction. The Z-direction (third direction) may be a vertical direction that perpendicularly intersects the X-direction and the Y-direction. In the latter case, a maximum lower position of the drain module 500 may be disposed to be lower than the second bottle

holding part 220.

FIG. 5 is a block diagram of a control unit, and FIGS. 6 to 10 are views illustrating a sampling process performed by the chemical sampling apparatus according to the embodiment of the present disclosure.

Referring to FIG. 5, the chemical sampling apparatus 10 may include an input unit 700 and a control unit 710.

The input unit 700 may receive information on the chemical storage tanks for collecting the chemicals from the operator or the like.

The operator may use the input unit 700 and select one of the plurality of chemical storage tanks 3, 5, and 6, e.g., the first chemical storage tank 3 as a sampling target.

The input unit 700 may include a touch screen, but the present disclosure is not necessarily limited thereto.

The control unit 710 may control the bottle holding unit 200, the cap separating/coupling module 300, the bottle transfer unit 251, the second door 123, and the on-off valves V installed in the sampling lines L1, L2, and L3 so that the sampling bottle is charged with the chemicals stored in the chemical storage tanks 3, 5, and 6, e.g., the first chemical storage tank 3 designated by the input unit 700. Further, the control unit 710 may control the drain module transfer unit 600 and the on-off valves V so that the chemicals accommodated in the sampling lines L1, L2, and L3 connected to the chemical storage tanks 3, 5, and 6 designated by the input unit 700, e.g., the sampling line L1 connected to the first chemical storage tank 3 designated by the input unit 700 are discharged to the drain module 500 before the sampling bottle B is charged with the chemicals.

A sampling process and a control logic of the control unit 710 will be described

below in detail with reference to the drawings.

Referring to FIGS. 6 to 10, the operator may input a command for unlocking the first door 103 through the input unit 700. When the command for unlocking the first door 103 is inputted, the control unit 710 may control a door locking device 720 to unlock the first door 103.

When the first door 103 is unlocked, the operator may open the first door 103, place the sampling bottle B on the first bottle holding part 210 disposed in the first-first internal space A1-1, and then close the first door 103.

The sampling bottle B may be loaded and unloaded in the state in which the cap C is coupled to the sampling bottle B. Therefore, it may be sufficient that the operator just wears a safety gear with a general protection grade instead of a safety gear with the highest protection grade.

When a command for locking the first door 103 is inputted through the input unit 700, the control unit 710 may control the door locking device 720 to lock the first door 103.

However, the present disclosure is not necessarily limited thereto. The control unit 710 may lock the first door 103 depending on a sensing value of a door sensor (not illustrated) that detects whether the first door 103 is closed.

The control unit 710 may maintain the locked state of the first door 103 until the sampling bottle B is unloaded by the operator after the sampling operation is ended and the cap C is coupled to the sampling bottle B.

As illustrated in FIG. 6, the control unit 710 may control the first bottle holding part 210 to hold the sampling bottle B while changing the state of the first door 103 to the locked state.

Next, the operator may use the input unit 700 and select one chemical storage

tank for collecting the chemicals. The control unit 710 may open the on-off valve V installed in the sampling line L1 connected to the chemical storage tank, e.g., the first chemical storage tank 3 for collecting the chemicals for a preset time and may operate the pump P, thereby discharging the chemicals, accommodated in the corresponding sampling line L1, to the drain module 500.

In this case, the control unit 710 may control the on-off valve installed in the supply pipe as described above so that the on-off valve installed in the supply pipe operates in conjunction with the on-off valve V installed in the sampling line L1.

The chemicals accommodated in the sampling line L1 need to be discharged to the drain module 500 because the chemicals accommodated in the sampling line L1 stagnate and form sediment when a predetermined time elapses and the chemicals are highly likely to be contaminated through the opened discharge ports. The drain operation may improve the reliability in analyzing the degree of contamination of the chemicals.

Next, as illustrated in FIG. 7, the control unit 710 may control the drain module transfer unit 600 to transfer the drain module 500 in the X-direction. The control unit 710 may open the second door 123 and then control the first bottle transfer part 251 to transfer the sampling bottle B to a position below the first-second internal space A1-2, specifically, the cap separating/coupling module 300. The control unit 710 may close the second door 123 and control the second bottle holding part 220 to hold the sampling bottle B. The control unit 710 may control the cap separating/coupling module 300 to separate the cap C from the sampling bottle B.

However, but the present disclosure is not necessarily limited thereto. The control unit 710 may perform the operation of draining the chemicals using the drain module 500 simultaneously with the operation of separating the cap C or after the

operation of separating the cap C. Alternatively, the cap C may be separated as the second bottle holding part 220 rotates in the state in which the cap separating/coupling module 300 holds the cap C.

Next, as illustrated in FIG. 8, the control unit 710 may separate the first bottle holding part 210 from the sampling bottle B and then control the second bottle transfer part 252 to transfer the sampling bottle B to the position below the discharge port of the sampling line L1. The control unit 710 may charge the sampling bottle B with the chemicals stored in the first chemical storage tank 3 by opening the on-off valve V installed in the sampling line L1 and operating the pump P for a preset time. However, the present disclosure is not necessarily limited thereto. The control unit 710 may charge the sampling bottle B with the chemicals by moving the sampling line L1 to a position above the sampling bottle B in the state in which the second bottle holding part 220 is fixed.

When some of the chemicals overflow during the operation of charging the sampling bottle B with the chemicals, a chemical detection sensor (not illustrated) installed on the first partition wall 110 or the second bottle holding part 220 may detect the overflow, and the control unit 710 may stop the sampling process and raise an alarm depending on a sensing value of the chemical detection sensor.

Next, as illustrated in FIG. 9, the control unit 710 may control the second bottle transfer part 252 to transfer the sampling bottle B to the position below the cap separating/coupling module 300. The control unit 710 may control the first bottle holding part 210 to hold the sampling bottle B. The control unit 710 may control the cap separating/coupling module 300 to couple the cap C to the sampling bottle B. The control unit 710 may separate the cap holding unit 310 from the cap C and move the cap holding unit 310 upward to return the cap holding unit 310 to an original position. In

this case, the control unit 710 may control the drain module transfer unit 600 to return the drain module 500 to an original position. Alternatively, the cap C may be coupled as the second bottle holding part 220 rotates in the state in which the cap separating/coupling module 300 holds the cap C.

Next, as illustrated in FIG. 10, the control unit 710 may separate the second bottle holding part 220 from the sampling bottle B, open the second door 123, and control the first bottle transfer part 251 to transfer the sampling bottle B to the first-first internal space A1-1. Further, the control unit 710 may close the second door 123, separate the first bottle holding part 210 from the sampling bottle B, and control the door locking device 720 to unlock the first door 103.

Meanwhile, a chemical sensor (not illustrated) for measuring the concentration of chemical fumes may be disposed in the first-first internal space A1-1.

When the concentration of chemical fumes detected by the chemical sensor is equal to or more than a preset value, the control unit 710 may maintain the locked state of the first door 103 and operate the exhaust module 107 until the concentration of the chemical fumes becomes less than the preset value.

When the first door 103 is unlocked, the operator may open the first door 103 and then unload the sampling bottle B. The operator may put the sampling bottle B into a storage container such as a vinyl bag and transport the sampling bottle B to the location for analyzing the degree of contamination of the chemicals.

When the first door 103 is closed, the control unit 710 may change the state of the first door 103 to the locked state.

FIG. 11 is a perspective view of a transfer device including the first bottle holding part according to the embodiment of the present disclosure, and FIG. 12 is a perspective view of the holding part illustrated in FIG. 11.

Referring to FIGS. 11 and 12, the transfer device according to the embodiment of the present disclosure may include the first partition wall 110, the first bottle holding part 210, the transfer part 251, and a sealing unit 400.

The first partition wall 110 may separate a first space above the first partition wall 110 and a second space below the first partition wall 110. For example, the first partition wall 110 may be coupled to the casing (not illustrated) and divide the internal space of the casing into the first space and the second space.

The first partition wall 110 may be provided in the form of a plate extending in the X-direction and the Y-direction, but the present disclosure is not necessarily limited thereto. The Y-direction (second direction) may be a direction perpendicular to the X-direction (first direction). The Y-direction may be the horizontal direction or the vertical direction.

A guide slit 111 may be formed in the first partition wall 110.

The guide slit 111 may penetrate the first partition wall 110 in the Z-direction and extend in the X-direction. The Z-direction (third direction) may be a direction perpendicular to the X-direction and the Y-direction.

The first bottle holding part 210 may hold the transfer target, e.g., the sampling bottle B that accommodates the chemicals.

However, the present disclosure is not necessarily limited thereto. The sampling bottle B may be simply seated or fixed to the first bottle holding part 210.

The first bottle holding part 210 may include a pair of grippers 210a and an interval adjusting part 223.

The pair of grippers 210a may be disposed to be spaced apart from each other in the X-direction. An interval between the pair of grippers 210a in the X-direction may be adjusted by the interval adjusting part 223.

The gripper 210a may include a seating portion 211 on which the sampling bottle B is seated, lateral support portions 213 configured to support a lateral surface of the sampling bottle B, and an arm 215 extending from the seating portion 211 or the lateral support portion 213 to the interval adjusting part 223.

The seating portion 211 and the lateral support portions 213 may be disposed in the first space, whereas the arm 215 may extend from the first space to the second space through the guide slit 111. Therefore, the sampling bottle B held by the seating portion 211 and the lateral support portions 213 may be disposed in the first space. However, the interval adjusting part 223 and a drive means such as the transfer part 251 to be described below may be disposed in the second space and protected from exposure to the chemicals or fumes.

The transfer part 251 may transfer the first bottle holding part 210 in the X-direction.

The transfer part 251 and/or the interval adjusting part 223 may include a pneumatic or hydraulic cylinder, but the present disclosure is not necessarily limited thereto. The transfer part 251 and/or the interval adjusting part 223 may include various drive means such as a motor.

The transfer part 251 may be coupled to the first bottle holding part 210 through a bottle lifting part 253.

The transfer part 251 may transfer the bottle lifting part 253 in the X-direction, and the bottle lifting part 253 may transfer the first bottle holding part 210 in the Z-direction.

The first bottle holding part 210 may be moved downward by the bottle lifting part 253 after the first bottle holding part 210 is separated from the sampling bottle B before the sampling bottle B is transferred by the second bottle transfer part 252.

The transfer part 251 and the bottle lifting part 253 may each include a hydraulic or pneumatic cylinder, but the present disclosure is not necessarily limited thereto.

The transfer part 251 and the bottle lifting part 253 may be disposed in the second internal space A2. Therefore, it is possible to prevent the drive devices such as the transfer part 251 and the bottle lifting part 253 from being exposed to the chemicals and minimize corrosion caused by the exposure to the chemicals.

The sealing unit 400 may close an area of the guide slit 111 through which the first bottle holding part 210 passes.

Therefore, the remaining area of the guide slit 111, except for an area of the guide slit 111 in which the first bottle holding part 210 is disposed, may be closed by the sealing unit 400, such that it is possible to maximally inhibit the chemicals or fumes from moving through the guide slit 111.

The sealing unit 400 may include a pair of first shields 410.

The pair of first shields 410 may be disposed at positions spaced apart from each other in the Y-direction and coupled to the first partition wall 110. The guide slit 111 may be disposed between the pair of first shields 410.

Therefore, the arm 215 of the first bottle holding part 210 may be moved between the pair of first shields 410.

The pair of first shields 410 may be separably coupled to each other.

To this end, the pair of first shields 410 may have different magnetic properties.

For example, one of the pair of first shields 410 may include an N-pole permanent magnet, and the other of the pair of first shields 410 may include an S-pole permanent magnet.

Therefore, the pair of first shields 410 may be coupled to each other by a

magnetic force to close the guide slit 111. The arm 215 of the first bottle holding part 210 may move along the guide slit 111 while separating the pair of first shields 410. The pair of first shields 410, which is separated from each other by the arm 215, may be coupled to each other again by the magnetic force after the arm 215 passes through a portion between the pair of first shields 410.

The pair of first shields 410 may be made of a flexible material, but the present disclosure is not necessarily limited thereto.

FIG. 13 is a cross-sectional view of a tapered area illustrated in FIG. 12.

Referring to FIGS. 12 and 13, the arm 215 may include a tapered area 215a that comes into contact with the pair of first shields 410.

The tapered area 215a may have a cross-sectional shape having a width in the Y-direction that decreases toward two opposite ends in the X-direction of the first bottle holding part 210.

Therefore, the pair of first shields 410 may be easily separated from each other when the arm 215 moves, and the pair of first shields 410 may maximally come into close contact with the arm 215.

The gripper 210a may include a pair of rollers 217 coupled to the arm 215 so as to be rotatable about rotary shafts formed in the Z-direction.

For example, a bracket 217a may be coupled to the arm 215, and the pair of rollers 217 may be rotatably coupled to the bracket 217a.

The pair of rollers 217 may be disposed on each of the two opposite ends in the X-direction of the first bottle holding part 210.

The pair of rollers 217 may be disposed to be spaced apart from each other in the Y-direction. An interval between the pair of first shields 410 may decrease while the pair of first shields 410 passes between the pair of rollers 217. Therefore, the pair

of first shields 410 may maximally come into close contact with the arm 215, and the pair of rollers 217 may assist the operation of coupling the pair of first shields 410 again.

FIG. 14 is a view illustrating a modified example of the sealing unit.

Referring to FIGS. 12 and 14, the sealing unit 400 may include a pair of second shields 420.

Like the pair of first shields 410, the pair of second shields 420 may be disposed at positions spaced apart from each other in the Y-direction and coupled to the first partition wall 110. The guide slit 111 may be disposed between the pair of second shields 420.

Therefore, the arm 215 of the first bottle holding part 210 may be moved between the pair of second shields 420.

The pair of second shields 420 may be separably coupled to each other.

To this end, a protrusion 421 extending in the X-direction may be formed on one of the pair of second shields 420, and a groove 423 to which the protrusion 421 is coupled may be formed in the other of the pair of second shields 420.

Therefore, when the protrusion 421 is inserted into the groove 423, the pair of second shields 420 may close the guide slit 111. The arm 215 of the first bottle holding part 210 may move along the guide slit 111 while separating the pair of second shields 420. The pair of second shields 420, which is separated from each other by the arm 215, may be coupled to each other again as the protrusion 421 is inserted into the groove 423 after the arm 215 passes through a portion between the pair of second shields 420.

However, the present disclosure is not necessarily limited thereto. A plurality of protrusions 421 may be disposed in the X-direction.

The pair of second shields 420 may be made of a flexible material, but the

present disclosure is not necessarily limited thereto.

An interval between the pair of second shields 420 may decrease while the pair of second shields 420 passes between the pair of rollers 217 rotatably coupled to the arm 215. Therefore, the pair of rollers 217 may press the pair of second shields 420 and assist the insertion of the protrusion 421 into the groove 423.

FIG. 15 is a view illustrating another modified example of the sealing unit.

Referring to FIG. 15, the sealing unit 400 may include a pair of drums 430, a pair of membranes 440, and rotational force supply members 450.

The pair of drums 430 may be disposed at positions spaced apart from each other in the X-direction and rotatably coupled to the first partition wall 110. The guide slit 111 may be disposed between the pair of drums 430.

For example, the pair of drums 430 may be disposed at two opposite ends in the X-direction of the guide slit 111.

The membranes 440 may be wound around the drums 430 and coupled to the arms 215 of the first bottle holding part 210 by means of a fastening member such as a bolt, a bonding agent, or the like.

The membranes 440 may be provided on the guide slit 111 and disposed in parallel with the first partition wall 110.

The rotational force supply member 450 may provide a rotational force to the drum 430 so that the drum 430 rotates in the direction in which the membrane 440 is wound.

Therefore, when the first bottle holding part 210 is transferred by the transfer part 251, the membrane 440 disposed rearward from the first bottle holding part 210 is unwound from the drum 430, but the membrane 440 disposed forward from the first bottle holding part 210 is wound around the drum 430 by the rotational force supply

member 450. Therefore, the remaining area of the guide slit 111, except for the area of the guide slit 111 in which the first bottle holding part 210 is disposed, may be kept closed by the pair of membranes 440.

The rotational force supply member 450 may include an elastic member, e.g., a spring coupled to the first partition wall 110 and a rotary shaft of the drum 430.

However, the present disclosure is not necessarily limited thereto. The rotational force supply member 450 may include a control motor or the like for providing a rotational force to the drum 430 to provide preset tension to the membrane 440.

FIG. 16 is a perspective view of the second bottle holding part, and FIG. 17 is a vertical cross-sectional view of a second tapered area.

Referring to FIGS. 4, 16, and 17, the second bottle holding part 220 may include a pair of second grippers 221 and a second interval adjusting part 223.

The pair of second grippers 221 may be disposed to be spaced apart from each other in the Y-direction. The second interval adjusting part 223 adjusts an interval between the pair of second grippers 221 in the Y-direction so that the pair of second grippers 221 holds the sampling bottle B or separates the sampling bottle B.

The second interval adjusting part 223 may include a hydraulic or pneumatic cylinder, but the present disclosure is not necessarily limited thereto.

The second gripper 221 may include a second seating portion 221a on which the sampling bottle B is seated, a second lateral support portion 221b configured to support a lateral surface of the sampling bottle B, and a second arm 221c extending in the X-direction from the second interval adjusting part 223 to the second lateral support portion 221b.

The second arm 221c may be disposed to penetrate a second guide slit 131

formed in the third partition wall 130.

The second guide slit 131 may penetrate the third partition wall 130 in the X-direction and extend in the Y-direction to guide the movement in the Y-direction of the second bottle holding part 220.

The second seating portion 221a and the second lateral support portion 221b of the second bottle holding part 220 may be disposed in the first-second internal space A1-2, whereas the second interval adjusting part 223 may be disposed in the third internal space A3. Therefore, it is possible to prevent the drive device such as the second interval adjusting part 223 from being exposed to the chemicals and minimize corrosion caused by the exposure to the chemicals.

Meanwhile, a pair of second shields 411 may be coupled to the third partition wall 130.

The pair of second shields 411 may be disposed to face each other with respect to the second guide slit 131 and made of a flexible material. The pair of second shields 411 may include permanent magnets having different magnetic properties.

For example, one second shield 411 may include an N-pole permanent magnet, and the other second shield 411 may include an S-pole permanent magnet.

The pair of second shields 411 may be coupled to each other by a magnetic force to close the second guide slit 131. The second arm 221c may move along the second guide slit 131 while separating the pair of second shields 411. The pair of second shields 411, which is separated from each other, may be coupled to each other again by the magnetic force after the second arm 221c passes through a portion between the pair of second shields 411. Therefore, it is possible to inhibit the inflow or outflow of the chemicals or chemical fumes through the second guide slit 131.

The second gripper 221 may include a pair of second rollers 221d coupled to

the second arm 221c so as to be rotatable about rotary shafts formed in the X-direction.

For example, a second bracket 221e may be coupled to the second arm 221c, and the pair of second rollers 221d may be rotatably coupled to the second bracket 221e.

The pair of second rollers 221d may be disposed to be spaced apart from each other in the Z-direction and disposed to be spaced apart from the second arm 221c in the Y-direction. The pair of second shields 411 may be disposed between the pair of second rollers 221d. Therefore, the pair of second rollers 221d may assist the operation of coupling the pair of second shields 411 again, such that an area in which the pair of second shields 411 is separated from each other may be minimized to an area in which the second arm 221c is disposed.

The second arm 221c may include a second tapered area 221f that comes into contact with the pair of second shields 411.

The second tapered area 221f may have a vertical cross-sectional shape having a width in the Z-direction that increases as the distance from the pair of second rollers 221d increases in the Y-direction. Therefore, the pair of second shields 411 may maximally come into close contact with the second arm 221c and minimize an open area of the second guide slit 131 in cooperation with the pair of second rollers 221d.

The second bottle transfer part 252 may be coupled to the third partition wall 130 and transfer the second bottle holding part 220 in the Y-direction.

The second bottle transfer part 252 may include a servo motor, but the present disclosure is not necessarily limited thereto.

The second bottle transfer part 252 may be disposed in the third internal space A3. Therefore, it is possible to prevent the drive device such as the second bottle transfer part 252 from being exposed to the chemicals and minimize corrosion caused by the exposure to the chemicals.

FIG. 18 is a perspective view of the cap separating/coupling module, FIG. 19 is an exploded perspective view of FIG. 18, FIGS. 20 and 21 are views for explaining an operational principle of the cap holding unit, FIG. 22 is a partial enlarged view of FIG. 20, and FIG. 23 is a partial enlarged view of FIG. 21.

Referring to FIGS. 18 to 21, the cap separating/coupling module 300 may include the cap holding unit 310, a cap rotating unit 320, and a cap lifting unit 330 and may further include a lifting frame 340 and/or a cover 350.

The cap holding unit 310 may hold the cap C. To this end, the cap holding unit 310 may include a first frame 311, a plurality of grippers 312, a second frame 313, a plurality of connection links 314 and a frame lifting part 315 and may further include a plate member 318 and a plurality of elastic members 319.

The plurality of grippers 312 may be rotatably coupled to the first frame 311 so as to support a lateral surface of the cap C.

The second frame 313 may be disposed in a horizontal plate area of the first frame 311 and transferred in the vertical direction, i.e., the Z-direction by the frame lifting part 315.

The number of connection links 314 may be equal to the number of grippers 312, for example, may be three. The connection links 314 may each be rotatably coupled to the gripper 312 and the second frame 313. The vertical rectilinear motion of the second frame 313 may be converted into the rotational motion of the gripper 312 by the connection link 314.

For example, as illustrated in FIG. 20, the plurality of grippers 312 rotates forward so that grip surfaces thereof move away from one another when the second frame 313 moves upward, such that the plurality of grippers 312 may be separated from the cap C. As illustrated in FIG. 21, the plurality of grippers 312 rotates reversely so

that the grip surfaces thereof move close to one another when the second frame 313 moves downward, such that the plurality of grippers 312 may hold the cap C.

The frame lifting part 315 may be coupled to the first frame 311 and transfer the second frame 313 in the Z-direction.

The frame lifting part 315 may include a pneumatic cylinder, but the present disclosure is not necessarily limited thereto. The frame lifting part 315 may include other lifting means such as a hydraulic cylinder.

The plate member 318 may be disposed below the first frame 311 and coupled to the first frame 311 so as to be vertically movable.

The plurality of elastic members 319 may be interposed between the first frame 311 and the plate member 318 and provide an elastic force to the plate member 318 so that the plate member 318 is kept in the horizontal state.

For example, the plurality of elastic members 319 may be disposed to be spaced apart from one another in the horizontal direction.

A lower surface of the plate member 318 may be disposed to face an upper surface of the cap C held by the plurality of grippers 312.

Therefore, it is possible to inhibit the cap holding unit 310 from being damaged by a collision with the sampling bottle B or the cap C when the cap holding unit 310 moves upward or downward. Further, it is possible to change the state of the sampling bottle B to the upright state even though the sampling bottle B is partially inclined.

The cap rotating unit 320 may be mounted on the lifting frame 340 and rotate the cap holding unit 310, e.g., the frame lifting part 315 about a rotation axis in the Z-direction.

The cap rotating unit 320 may include a servo motor, but the present disclosure is not necessarily limited thereto.

The cap lifting unit 330 may transfer the lifting frame 340 in the Z-direction, i.e., the vertical direction.

Therefore, the cap holding unit 310, together with the lifting frame 340, may also be transferred in the Z-direction by the cap lifting unit 330.

In addition, the cap holding unit 310 may be moved downward by the cap lifting unit 330 and then hold the cap C. Further, the cap holding unit 310 may be rotated and moved upward by the cap rotating unit 320 and the cap lifting unit 330 and separate the cap C from the sampling bottle B. The process of coupling the cap C to the sampling bottle B may be performed in the reverse order.

The cap lifting unit 330 may be coupled to an upper surface of the casing 100. The frame lifting part 315, the cap rotating unit 320, and the cap lifting unit 330 may be disposed outside the casing 100. The frame lifting part 315 may extend to the first-second internal space A1-2 through a through-hole formed in an upper wall of the casing 100. It is possible to prevent the drive device such as the cap rotating unit 320 and the cap lifting unit 330 from being exposed to the chemical fumes and minimize corrosion caused by the exposure to the chemical fumes.

The cap lifting unit 330 may include a pneumatic cylinder, but the present disclosure is not necessarily limited thereto.

The lifting frame 340 may include a cylinder holder 341 configured to support a cylinder 316 constituting the frame lifting part 315 so that the cylinder 316 is rotatable.

For example, the frame lifting part 315 may include the cylinder 316 and a piston 317.

The cylinder 316 may be coupled to the first frame 311 and a rotary shaft of the cap rotating unit 320 and rotated by the cap rotating unit 320.

The cylinder 316 may include a first cylinder area 316a, and a second cylinder

area 316b disposed above the first cylinder area 316a.

A first cavity C1 may be formed in the first cylinder area 316a, a second cavity C2 may be formed in the second cylinder area 316b, and the piston 317 may be disposed in the first cavity C1.

The piston 317 may include a first rod 317a penetrating a lower wall of the cylinder 316 and coupled to the second frame 313, and a second rod 317b penetrating a partition wall between the first cavity C1 and the second cavity C2 and extending to the second cavity C2. The first rod 317a may protrude from a lower surface of the piston 317, and the second rod 317b may protrude from an upper surface of the piston 317.

The piston 317 may be moved in the vertical direction by a fluid supplied into the first cavity C1.

To this end, the cylinder holder 341 may have first and second fluid ports 341a and 341b to which a fluid supply line (not illustrated) is coupled. The first and second fluid ports 341a and 341b may extend to an inner peripheral surface of the cylinder holder 341. The second cylinder area 316b may have first and second through-holes 316b-1 and 316b-2 extending from an outer peripheral surface of the second cylinder area 316b to the second cavity C2. A first flow path 317a-1 may be formed in the piston 317 and connected to the first through-hole 316b-1. The first flow path 317a-1 may extend to an outer peripheral surface of an upper end of the first rod 317a. A second flow path 317b-1 may be formed in the piston 317 and connected to the second through-hole 316b-2. The second flow path 317b-1 may extend to an outer peripheral surface of a lower end of the second rod 317b.

The fluid injected through the first fluid port 341a may be supplied to a lower side of the first cavity C1 sequentially through the first through-hole 316b-1, the first flow path 317a-1, and a first through flow path 317a-2. Therefore, the piston 317 may

move upward or downward.

The fluid injected through the second fluid port 341b may be supplied to an upper side of the first cavity C1 sequentially through the second through-hole 316b-2, the second flow path 317b-1, and the second through flow path (317b-2). Therefore, the piston 317 may move downward.

A ring-shaped first groove 316b-3 and a ring-shaped second groove 316b-4 may be formed in an outer peripheral surface of the second cylinder area 316b.

The first and second grooves 316b-3 and 316b-4 maintain the first and second through-holes 316b-1 and 316b-2 to be respectively connected to the first and second fluid ports 341a and 341b when the cylinder 316 rotates.

However, the present disclosure is not necessarily limited thereto. The first and second grooves 316b-3 and 316b-4 may be formed in an inner peripheral surface of the cylinder holder 341.

Recesses R may be formed in lower and upper surfaces of the first cavity C1 and adjoin outer peripheral surfaces of the first rod 317a or a second rod 317b.

Therefore, even though the piston 317 reaches a height equal or adjacent to a height of the lower or upper surface of the first cavity C1, the first flow path 317a-1 or the second flow path 317b-1 may be kept connected to the first cavity C1.

The cover 350 may be coupled to the upper surface of the casing 100 and the cylinder holder 341 and provided in the form of a flexible pipe to surround the through-hole formed in the casing 100. The frame lifting part 315 may be disposed in the cover 350. For example, the cover 350 may be a corrugated pipe.

Therefore, it is possible to inhibit the inflow or outflow of the chemical fumes through the through-hole of the casing 100.

Referring to FIGS. 22 and 23, despite the upward or downward movement of

the piston 317, the first through-hole 316b-1 formed in the cylinder 316 may be kept connected to the first flow path 317a-1 formed in the piston 317, and the second through-hole 316b-2 formed in the cylinder 316 is kept connected to the second flow path 317b-1 formed in the piston 317.

To this end, a stroke of the piston 317, i.e., an interval in the Z-direction between a top dead center (see FIG. 20) and a bottom dead center (see FIG. 21) of the piston 317 may be smaller than a sum of an outlet diameter d_1 of the first through-hole 316b-1 and an inlet diameter d_2 of the first flow path 317a-1 and smaller than a sum of an outlet diameter d_3 of the second through-hole 316b-2 and an inlet diameter d_4 of the second flow path 317b-1.

FIG. 24 is a perspective view of the drain module, FIG. 25 is an exploded perspective view of FIG. 24, and FIG. 26A is a front view of the drain module.

Referring to FIGS. 24 and 25, the drain module 500 may include a housing 510 having a single inlet port 510a or a plurality of inlet ports 510a formed in an upper surface thereof, and a discharge pipe 520 and a supply pipe 530 connected to the housing 510.

As described above, the plurality of inlet ports 510a may correspond in number and arrangement to the plurality of sampling lines L1, L2, and L3.

The chemicals collected in the internal space of the housing 510 through the inlet port 510a of the housing 510 may be discharged to the outside of the casing 100, e.g., to a chemical purification facility (not illustrated) and the like through the discharge pipe 520.

A dilute solution, e.g., water may be supplied to the internal space of the housing 510 through the supply pipe 530. To this end, the supply pipe 530 may be connected to a dilute solution supply device (not illustrated) disposed outside the casing

100.

The discharge pipe 520 and the supply pipe 530 may each be provided in the form of a flexible tube (flexible tube) and be coupled to the through-hole formed in the sidewall of the casing 100.

A second valve V2 (see FIG. 27) may be installed in the supply pipe 530, and the second valve V2 may be controlled by the control unit 710 (see FIG. 27) so as to operate in conjunction with first valves V1 installed in the sampling lines L1, L2, and L3.

For example, the first valves V1 installed in the sampling lines L1, L2, and L3 may be opened for a preset time so that the chemicals accommodated in the sampling lines L1, L2, and L3 are discharged to the drain module 500 before the sampling bottle B is charged with the chemicals. In this case, the second valve V2 installed in the supply pipe 530 may also be opened. Therefore, the sampling bottle B may be filled with the chemicals stored in the chemical storage tank after the chemicals accommodated in the sampling lines L1, L2, and L3 are discharged to the drain module 500. The chemicals collected in the drain module 500 may be mixed with the dilute solution and then discharged in a dilute state. Meanwhile, the second valve V2 installed in the supply pipe 530 is closed when a preset time elapses after the first valves V1 installed in the sampling lines L1, L2, and L3 are closed, such that a cleaning operation of discharging the chemicals remaining in the drain module 500 may be performed.

However, the present disclosure is not necessarily limited thereto. Depending on the chemical properties, the second valve V2 may be opened for a preset time after the first valve V1 is closed, or the second valve V2 may be kept closed before and after the first valve V1 is closed. For example, when the chemical is an undiluted sulfuric

acid solution, the mixture of the undiluted sulfuric acid solution and the water generates excessive heat, which may adversely affect the entire apparatus.

The transfer unit 600 may include the transfer device, e.g., a pneumatic cylinder 610 and a cover 620. However, the present disclosure is not necessarily limited thereto, and the transfer device may include a hydraulic cylinder, a motor, or the like.

The pneumatic cylinder 610 may be coupled to the third partition wall 130 and disposed in the third space, i.e., the third internal space A3. A piston rod 610a, i.e., a connection member of the pneumatic cylinder 610 may extend through the through-hole formed in the third partition wall 130 and be coupled to the housing 510 disposed in the first space, i.e., the first internal space, specifically, the first-second internal space A1-2. Therefore, it is possible to prevent the drive device such as the pneumatic cylinder 610 from being exposed to the chemical fumes and minimize corrosion caused by the exposure to the chemical fumes.

The cover 620 may inhibit the inflow or outflow of the chemical fumes through the through-hole formed in the third partition wall 130.

The cover 620 may be provided in the form of a flexible pipe, e.g., a corrugated pipe. Two opposite ends of the cover 620 may be coupled to the third partition wall 130 and the housing 510, and the piston rod 610a may extend through the cover 620.

Referring to FIG. 26A, the inlet port 510a of the housing 510 may be disposed to be higher than a seating surface of the second bottle holding part 220 on which the sampling bottle B is seated.

For example, a height h_1 from an upper surface of the housing 510 to the discharge ports of the sampling lines L1, L2, and L3 may be smaller than a height h_2 from the seating surface of the second bottle holding part 220 to the discharge ports of the sampling lines L1, L2, and L3. The upper surface or the inlet port 510a of the

housing 510 may be disposed at substantially the same height as an opening of an upper end of the sampling bottle B.

Therefore, it is possible to minimize a chemical drop distance from the discharge ports of the sampling lines L1, L2, and L3 to the inlet port 510a of the housing 510 and minimize the scattering of the chemicals.

FIG. 26B is a view illustrating a first modified example of the drain module, and FIGS. 26C and 26D are views illustrating a second modified example of the drain module.

The configurations of the drain module 500 and the sampling lines L1, L2, and L3 may be variously modified. Referring to FIG. 26B, the sampling lines L1, L2, and L3 may be spaced apart from the drain module 500 at predetermined intervals in the vertical direction. Therefore, the second bottle holding part 220 may freely move between the drain module 500 and the sampling lines L1, L2, and L3.

In this case, a size of the inlet port 510a may be appropriately adjusted so that the chemicals discharged from the sampling lines L1, L2, and L3 may be introduced into the drain module 500 without scattering. Alternatively, the cover having the inlet port may be omitted. This configuration is advantageous in that a drive unit may be omitted.

Referring to FIG. 26C, the sampling lines L1, L2, and L3 may be moved upward or downward by a separate drive unit. This configuration may minimize the chemical drop distance as the sampling lines L1, L2, and L3 move downward when the chemical is discharged, thereby inhibiting the scattering.

In addition, as illustrated in FIG. 26D, when the chemicals are completely discharged, the sampling lines L1, L2, and L3 may move upward, and the second bottle holding part 220 may move between the drain module 500 and the sampling lines L1,

L2, and L3.

However, the present disclosure is not necessarily limited thereto. The drain module 500 may move upward or downward in the state in which the sampling lines L1, L2, and L3 are fixed. Alternatively, all the sampling lines L1, L2, and L3 and the drain module 500 may move upward or downward. Alternatively, the chemicals may be collected while the sampling lines L1, L2, and L3 and/or the drain module 500 move forward or rearward. Any configuration may be applied without limitation as long as the drain module 500 may collect the chemicals without limiting the movement of the second bottle holding part 220.

The embodiments have been described above, but the embodiments are just illustrative and not intended to limit the present disclosure. It can be appreciated by those skilled in the art that various modifications and alterations, which are not described above, may be made without departing from the intrinsic features of the present disclosure. For example, the respective constituent elements specifically described in the embodiments may be modified and then carried out. Further, it should be interpreted that the differences related to the modifications and applications are included in the scope of the present disclosure defined by the appended claims.

[CLAIMS]

[Claim 1]

A chemical sampling apparatus comprising:

a casing having an internal space;

a plurality of sampling lines penetrating the casing and configured to supply chemicals to the internal space;

a plurality of on-off valves respectively installed in the plurality of sampling lines;

a first door configured to open or close a first inlet formed in the casing;

a bottle holding unit configured to seat or fix a sampling bottle loaded into the internal space through the first inlet;

a cap separating/coupling module configured to separate a cap from the sampling bottle disposed in the internal space or couple the cap to the sampling bottle;

a bottle transfer unit configured to transfer the bottle holding unit so that the sampling bottle passes the cap separating/coupling module and then is disposed below a discharge port of the sampling line;

a drain module for collecting chemicals discharged from the plurality of sampling lines; and

a control unit controlling the plurality of on-off valves to discharge a portion of the chemicals into the drain module before the chemicals are filled into the sampling bottle.

[Claim 2]

The chemical sampling apparatus of claim 1, comprising:

a second partition wall configured to divide the internal space into a first-first internal space and a first-second internal space; and

a second door configured to open or close a second inlet formed in the second

partition wall,

wherein the first-first internal space is connected to the first inlet, and the sampling line and the cap separating/coupling module are disposed in the first-second internal space.

[Claim 3]

The chemical sampling apparatus of claim 2, wherein the bottle holding unit comprises first and second bottle holding parts configured to hold the sampling bottle,

wherein the bottle transfer unit comprises a first bottle transfer part configured to transfer the first bottle holding part in a first direction, and a second bottle transfer part configured to transfer the second bottle holding part in a second direction, and

wherein the first bottle holding part is transferred to the cap separating/coupling module through the second inlet, and the second bottle holding part is transferred from the cap separating/coupling module to the sampling line.

[Claim 4]

The chemical sampling apparatus of claim 3, wherein the first direction and the second direction perpendicularly intersect each other.

[Claim 5]

The chemical sampling apparatus of claim 3, comprising:

a first partition wall configured to divide the internal space into a first internal space comprising the first-first internal space and the first-second internal space and a second internal space disposed below the first internal space,

wherein the first partition wall has a first guide slit extending in the first direction,

wherein the first bottle holding part comprises a pair of first grippers spaced apart from each other in the first direction, and a first interval adjusting part configured to adjust an interval between the pair of first grippers, and

wherein the pair of first grippers is disposed to penetrate the first guide slit, and the first interval adjusting part and the first bottle transfer part are disposed in the second internal space.

[Claim 6]

The chemical sampling apparatus of claim 3, comprising:

a third partition wall configured to divide the internal space into a first internal space comprising the first-first internal space and the first-second internal space and a third internal space disposed at one side of the first internal space,

wherein the third partition wall has a second guide slit extending in the second direction,

wherein the second bottle holding part comprises a pair of second grippers spaced apart from each other in the second direction, and a second interval adjusting part configured to adjust an interval between the pair of second grippers, and

wherein the pair of second grippers is disposed to penetrate the second guide slit, and the second interval adjusting part and the second bottle transfer part are disposed in the third internal space.

[Claim 7]

The chemical sampling apparatus of claim 2, comprising:

an input unit configured to receive one of a plurality of chemical supply sources respectively connected to the plurality of sampling lines,

wherein the control unit is configured to control the bottle holding unit, the cap separating/coupling module, the bottle transfer unit, the second door, and the on-off valve so that the sampling bottle is charged with the chemicals stored in the chemical supply source inputted from the input unit.

[Claim 8]

The chemical sampling apparatus of claim 7, comprising:

a drain module transfer unit configured to transfer the drain module to positions below the discharge ports of the plurality of sampling lines,

wherein the drain module comprises a plurality of inlet ports corresponding to the plurality of sampling lines.

[Claim 9]

The chemical sampling apparatus of claim 8, wherein the control unit controls the drain module transfer unit and the on-off valve so that the chemicals accommodated in the sampling line connected to the chemical supply source inputted from the input unit are discharged to the drain module before the sampling bottle is charged with the chemicals.

[Claim 10]

The chemical sampling apparatus of claim 8, wherein the drain module comprises:

a housing having the inlet port in an upper surface thereof; and

a discharge pipe configured to discharge the chemicals, introduced into an internal space of the housing through the inlet port, to the outside of the casing,

wherein the sampling line is provided in plural, and the plurality of sampling lines is respectively connected to different chemical supply sources,

wherein first valves are respectively installed in the plurality of sampling lines, and

wherein the plurality of sampling lines is connected to each other and has a single discharge port.

[Claim 11]

The chemical sampling apparatus of claim 1, wherein the cap separating/coupling module comprises:

- a cap holding unit configured to hold the cap;
- a cap rotating unit configured to rotate the cap holding unit; and
- a cap lifting unit configured to move the cap holding unit in a vertical direction.

[Claim 12]

The chemical sampling apparatus of claim 11, wherein the cap holding unit comprises:

- a first frame;
- a plurality of grippers rotatably coupled to the first frame so as to support a lateral surface of the cap;
- a second frame disposed on the first frame;
- a plurality of connection links rotatably coupled to a part of each of the plurality of grippers and the second frame so that the plurality of grippers is coupled to or separated from the cap by a vertical rectilinear motion of the second frame; and
- a frame lifting part coupled to the first frame and configured to transfer the second frame in the vertical direction.

[Claim 13]

The chemical sampling apparatus of claim 12, wherein the frame lifting part comprises:

- a cylinder coupled to the first frame and a rotary shaft of the cap rotating unit;
- and
- a piston disposed in a first cavity formed in the cylinder, configured to move in the vertical direction by a fluid supplied to the first cavity, and having a first rod that penetrates a lower wall of the cylinder and is coupled to the second frame.

[Claim 14]

The chemical sampling apparatus of claim 13, wherein the cap separating/coupling module comprises a lifting frame configured to be transferred in the vertical direction by the cap lifting unit, and the cap rotating unit is mounted on the lifting frame,

wherein the lifting frame comprises a cylinder holder configured to support the cylinder so that the cylinder is rotatable, and

wherein the cylinder holder has first and second fluid ports through which a fluid to be supplied to upper and lower sides of the first cavity flows in and out.