

[DESCRIPTION]

[Invention Title]

DEVICE AND METHOD FOR AUTOMATICALLY TRANSFERRING  
CHEMICAL CONTAINER

5 [Technical Field]

The present disclosure relates to an apparatus and method for automatic transport of chemical containers, and more particularly, to an apparatus and method for automatic transport of chemical containers, the apparatus and method allowing chemical containers to be easily transported using a forklift that does not require a professional license to operate.

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[Background Art]

Generally, in all companies that use hazardous chemicals, such as pharmaceutical companies, paint companies, and companies that manufacture semiconductors, semiconductor equipment, liquid crystal displays (LCDs), and organic light-emitting diode (OLED) displays, various kinds of chemicals are used, and ways of safely supplying such chemicals are being diversified.

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According to the type, amount of use, and process characteristics of the chemicals, the chemicals are supplied in large quantities by tank lorry vehicles or supplied in small quantities while being held in containers having various volumes ranging from 20 to 1,000 L.

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In general, the chemical containers are packaged in bundles on pallets that are movable by a forklift, a hand lift, or the like and shipped out from chemical manufacturing plants, and when the chemical containers are unloaded using a forklift at an entrance to a factory that uses chemicals, a worker uses a hand lift to take the chemical containers into the factory building.

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Then, the worker wears safety gear and equipment such as chemical-resistant clothing and a gas mask and transfers as many chemical containers that can be mounted on a cart which can be mounted on a chemical supply device.

Then, the worker opens a door of the chemical supply device to mount the  
5 cart, which has the chemical containers mounted thereon, on the chemical supply device. In this case, rollers may be installed on an upper portion of the cart and a floor inside the chemical supply device to allow only the chemical containers to be mounted on the chemical supply device, or the chemical containers may be mounted on an outer portion, instead of the inner portion, of the chemical supply device.

10 Then, the worker connects a coupler with a nozzle to a chemical inlet/outlet of each chemical container inside the chemical supply device. After completing the connection of the coupler, the worker operates a chemical transport pump to transport the chemicals of the chemical containers to the place of use. In this case, the worker may inject nitrogen gas into the chemical containers to transport the  
15 chemicals to the place of use under a predetermined pressure. The chemical containers that are empty due to the chemicals therein being used up through the above process are taken out in the reverse order of the above process.

Since the conventional chemical container transport method requires a worker to manually transport each container accommodating a chemical to the chemical  
20 supply device using a hand lift, a forklift or the like, there is a problem in that the worker's safety is threatened.

Korean Patent Publication No. 10-2017-0017958 has been disclosed as the related art.

Also, when the worker uses a hand lift, a forklift, or the like to transport  
25 chemical containers, in some cases, the chemical containers should be mounted at a

predetermined height or more above the floor. In such a case, in order to mount the chemical containers, the worker lifts a fork (the chemical containers) of the forklift to the predetermined height, operates the forklift forward into a position on which the chemical containers will be mounted, and then lowers the fork to mount the chemical  
5 containers. Then, when the worker operates the forklift rearward, mounting of the chemical containers is completed.

With regards to forklifts that are able to lift the chemical containers to the predetermined height as above, forklifts greater than 3 tons can only be operated by workers who have a professional license, and forklifts less than 3 tons can only be  
10 operated by workers who have completed professional training.

Meanwhile, some electric forklifts can be operated without a professional license, but since the forklift should be operated forward into the position on which the chemical containers will be mounted, and then the chemical containers should be lifted, special electric forklifts with long front-rear and up-down lengths should be  
15 used. However, in this case, there is a limitation in using the forklift in a place with a narrow working space (for example, an indoor space).

[Disclosure]

[Technical Problem]

The present disclosure is directed to providing an apparatus and method for  
20 automatic transport of chemical containers, the apparatus and method allowing even workers who do not have a professional license for forklift operation or who have not completed professional training for forklift operation to easily transport chemical containers.

The present disclosure is also directed to providing an apparatus and method  
25 for automatic transport of chemical containers, the apparatus and method allowing

chemical containers to be transported in a narrow space using a generally-used electric or manual forklift instead of using an electric lift that does not have a lifting/lowering function.

The present disclosure is also directed to providing an apparatus and method  
5 for automatic transport of chemical containers, the apparatus and method allowing chemical containers and pallets, which are shipped out from chemical manufacturing plants, to be transported in bundles without being disassembled to a chemical supply device to prevent damage to the chemical containers and leaking of chemicals to the outside that may occur in a process in which a package of chemical containers is  
10 disassembled and separated.

The present disclosure is also directed to providing an apparatus and method for automatic transport of chemical containers, the apparatus and method capable of automatically supplying a chemical container, of which chemical information is confirmed as that required by a chemical supply device, to the chemical supply  
15 device.

[Technical Solution]

One aspect of the present disclosure provides an apparatus for automatic transport of chemical containers, the apparatus including a lifting/lowering unit configured to lift a chemical container (2) from a first height to a second height and a  
20 controller configured to control driving of the lifting/lowering unit to transport the chemical container (2), which is lifted to the second height, to a chemical supply device (5).

The lifting/lowering unit may include a transport member (121) on which the chemical container (2) is loaded, a transport member driving unit configured to drive  
25 the transport member (121) to transport the chemical container (2), and a

lifting/lowering driving unit configured to lift the transport member (121), on which the chemical container (2) is loaded, from the first height to the second height and then, when the chemical container (2) moves out from the lifting/lowering unit, lower the transport member (121).

- 5           The apparatus may include an input unit (110) configured to transport the chemical container (2) to the lifting/lowering unit in a state in which the chemical container (2) is loaded on the transport member at a height identical to the first height of the lifting/lowering unit.

          An alignment unit configured to align a pallet (3), on which the chemical  
10 container (2) is loaded, to a central portion may be provided on the input unit (110).

          An alignment unit configured to align the pallet (3), on which the chemical container (2) is loaded, to a central portion may be provided on the lifting/lowering unit.

          The alignment unit may include a pair of alignment members configured to  
15 push both side surfaces of the pallet (3) to align the pallet (3) to be parallel to a direction in which the chemical container (2) is transported and may include an alignment driving unit configured to reciprocate the pair of alignment members in directions facing each other.

          The alignment member may have a length in the direction in which the  
20 chemical container (2) is transported and may have at least a portion that comes in surface contact with a side surface of the pallet (3).

          The input unit (110) or the lifting/lowering unit may include a transport member on which the chemical container (2) is loaded and a transport member driving unit configured to drive the transport member so that the chemical container

(2) is transported, and the transport member that comes in contact with a bottom surface of the pallet (3) may be made of a metal material.

The pallet (3) on which the chemical container (2) is loaded may be mounted on an upper portion of a transport member provided on the input unit (110), and a  
5 first stopper (113-1) may be provided adjacent to an inlet of the input unit (110) to prevent the pallet (3) mounted on the upper portion of the transport member from being transported in a direction toward the inlet of the input unit (110).

A second stopper (113-2) may be provided to, when the pallet (3) having the chemical container (2) loaded thereon is mounted on the upper portion of the  
10 transport member provided on the input unit (110), prevent the pallet (3) from deviating from a set position in a direction toward the lifting/lowering unit.

A first sensor (114-1) may be provided adjacent to the inlet of the input unit (110) to, when the pallet (3) having the chemical container (2) loaded thereon enters, sense a front end of the pallet (3), and when the first sensor (114-1) senses the pallet  
15 (3), the controller may operate the second stopper (113-2) to prevent the pallet (3) having the chemical container (2) loaded thereon from deviating from the set position in a direction toward the lifting/lowering unit.

A second sensor (114-2) may be provided adjacent to an outlet of the input unit (110) to, when the pallet (3) having the chemical container (2) loaded thereon  
20 enters and is transported a predetermined distance, sense the front end of the pallet (3), and when the second sensor (114-2) senses the pallet (3), the controller may generate an alarm.

A first sensor (114-1) may be provided on the input unit (110) to, when the pallet (3) having the chemical container (2) loaded thereon is input, sense the front  
25 end of the pallet (3), and when the first sensor (114-1) attempts to sense the front end

of the pallet (3) and then determines that an object to be sensed is not present, the controller may control a shutter (20) provided behind the input unit (110) to be closed.

The input unit (110) may include a plurality of transport members on which  
5 the chemical container (2) is loaded and a transport member driving unit configured to drive the transport members, the transport members may be provided as a plurality of transport members (111a, 111b, 111c) that are spaced apart in a direction perpendicular to a direction in which the chemical container (2) is transported, and wheel rail units (112a, 112b) may be provided between the plurality of transport  
10 members (111a, 111b, 111c) to allow wheels of a forklift, which is configured to load the chemical container (2) on the input unit (110), to enter.

The wheel rail units (112a, 112b) may be provided so that upper surfaces thereof are disposed at a position lower than that of upper ends of the transport members (111a, 111b, 111c).

15 An inspection unit (130) may be provided to inspect chemical information of the transported chemical container (2) that is lifted to the second height by the lifting/lowering unit, and the controller may receive the chemical information from the inspection unit (130) and, when the received chemical information matches information required by the chemical supply device (5), may control the chemical  
20 container (2) to be supplied to the chemical supply device (5).

At least one transport line may be provided to transport the chemical container (2), which is transported from the lifting/lowering unit, to the chemical supply device (5).

The lifting/lowering unit may include the first lifting/lowering unit  
25 configured to lift the chemical container (2) from the first height to the second height

to input the chemical container (2) to be transported to the chemical supply device (5) and a second lifting/lowering unit configured to lower and discharge the chemical container (2) transported from the chemical supply device (5).

The second lifting/lowering unit may be provided on a side portion of the first  
5 lifting/lowering unit, and the lifting/lowering unit may include a first transport line (100) connected to the first lifting/lowering unit and a second transport line (200) disposed to be parallel and adjacent to the first transport line (100) and connected to the second lifting/lowering unit.

A discharge unit that includes a transport member and a transport member  
10 driving unit configured to drive the transport member may be provided to discharge a used chemical container (2) from the chemical supply device (5), and the chemical container (2) may be lowered by the second lifting/lowering unit and then discharged via the discharge unit.

Another aspect of the present disclosure provides a method for automatic  
15 transport of chemical containers, the method including: a) loading a chemical container (2) on a transport member at a first height that is provided on a lifting/lowering unit; b) lifting the transport member having the chemical container (2) loaded thereon to a second height; and c) driving the transport member to transport the chemical container (2), which is lifted to the second height, to a  
20 chemical supply device (5).

The operation a) may include mounting the chemical container (2) on a transport member provided on an input unit and driving the transport member of the input unit to load the chemical container (2) on the transport member of the lifting/lowering unit.

In the mounting of the chemical container (2) on the transport member provided on the input unit, when a first sensor provided adjacent to an inlet of the input unit senses a pallet (3) on which the chemical container (2) is loaded, a second stopper (113-2), which is provided adjacent to an outlet of the input unit, may be controlled to protrude to a central portion of the input unit to a position at which a front end of the pallet (3) is able to be caught at the second stopper (113-2).

In the mounting of the chemical container (2) on the transport member provided on the input unit, when a second sensor provided adjacent to the outlet of the input unit senses the pallet (3) on which the chemical container (2) is loaded, a first stopper (113-1), which is provided adjacent to the inlet of the input unit, may be controlled to protrude to the central portion of the input unit to a position at which a rear end of the pallet (3) is able to be caught at the first stopper (113-1).

After the mounting of the chemical container (2) on the transport member provided on the input unit, an alignment unit may be used to align the pallet (3) having the chemical container (2) loaded thereon to the central portion of the input unit.

The operation c) may include transporting the chemical container (2) to the chemical supply device (5) through a first transport line (100), and a used chemical container (2) may be transported from the chemical supply device (5) to a second lifting/lowering unit, which is provided separately from the lifting/lowering unit, through a second transport line (200), and the chemical container (2) may be lowered by the second lifting/lowering unit and then discharged to the outside.

The operation c) may include transporting the chemical container (2) to the chemical supply device (5) through at least one transport line.

[Advantageous Effects]

According to the present disclosure, even workers who do not have a professional license for forklift operation or who have not completed professional training for forklift operation can easily transport chemical containers.

Also, chemical containers can be transported in a narrow space using a  
5 generally-used electric or manual forklift instead of using an electric lift that does not have a lifting/lowering function.

Also, chemical containers and pallets, which are shipped out from chemical manufacturing plants, can be transported in bundles without being disassembled to a chemical supply device to prevent damage to the chemical containers and leaking of  
10 chemicals to the outside that may occur in a process in which a package of chemical containers is disassembled and separated.

In addition, a chemical container, of which chemical information is confirmed as that required by a chemical supply device, can be automatically supplied to the chemical supply device.

15 [Description of Drawings]

FIG. 1 is a plan view illustrating an apparatus for automatic transport of chemical containers according to the present disclosure.

FIG. 2 is a perspective view illustrating an inlet unit of the apparatus for automatic transport of chemical containers according to the present disclosure.

20 FIG. 3 is a plan view illustrating the inlet unit of the apparatus for automatic transport of chemical containers according to the present disclosure.

FIG. 4 is a plan view illustrating an input unit of the apparatus for automatic transport of chemical containers according to the present disclosure.

FIG. 5 is a view illustrating a state in which chemical containers are transported by a forklift at the inlet unit of the apparatus for automatic transport of chemical containers according to the present disclosure.

FIG. 6 is a view illustrating a state in which chemical containers are input to  
5 the input unit by the forklift at the inlet unit of the apparatus for automatic transport of chemical containers according to the present disclosure.

FIG. 7 is a perspective view illustrating a lifting/lowering unit of the apparatus for automatic transport of chemical containers according to the present disclosure.

10 FIG. 8 is a view illustrating a state in which chemical containers are disposed at a first height in the lifting/lowering unit of the apparatus for automatic transport of chemical containers according to the present disclosure.

FIG. 9 is a view illustrating a state in which the chemical containers are disposed at a second height in the lifting/lowering unit of the apparatus for automatic  
15 transport of chemical containers according to the present disclosure.

**\*\*Description of reference numerals\*\***

|    |                                                             |                       |
|----|-------------------------------------------------------------|-----------------------|
|    | 1: apparatus for automatic transport of chemical containers |                       |
|    | 2: chemical container                                       |                       |
|    | 3: pallet                                                   | 4: forklift           |
| 20 | 5: chemical supply device                                   | 6: pump unit          |
|    | 20: shutter unit                                            | 21: shutter           |
|    | 22: first lamp unit                                         | 23: input unit sensor |
|    | 100: first transport line                                   | 110: input unit       |
|    | 120: first lifting/lowering unit                            | 111: transport member |
| 25 | 112: wheel rail unit                                        | 113-1: first stopper  |

|    |                                      |                                     |
|----|--------------------------------------|-------------------------------------|
|    | 113-2: second stopper                | 114-1: first sensor                 |
|    | 114-2: second sensor                 | 115-1: first alignment driving unit |
|    | 115-2: second alignment driving unit | 116-1: first alignment member       |
|    | 116-2: second alignment member       | 117: second lamp unit               |
| 5  | 120: first lifting/lowering unit     | 130: first inspection unit          |
|    | 200: second transport line           | 210: discharge unit                 |
|    | 220: second lifting/lowering unit    | 230: second inspection unit         |
|    | 300: third transport line            | 310: air shower unit                |
|    | 400: fourth transport line           | 500: transport car rail             |
| 10 | 600: transport car                   |                                     |

#### [Modes of the Invention]

Hereinafter, the present disclosure will be described in detail with reference to the accompanying drawings.

15 An apparatus for automatic transport of chemical containers according to the present disclosure will be described with reference to FIG. 1.

An automatic transport apparatus 1 for chemical containers according to the present disclosure includes an inlet unit 1-1 including a first lifting/lowering unit 120 (see FIG. 2) configured to lift chemical containers 2 from a first height to a second height, one or more transport lines 100, 200, 300, and 400 configured to transport the  
20 chemical containers 2, which are transported from the first lifting/lowering unit 120 in a state of being lifted to the second height, to a chemical supply device 5, and a controller (not illustrated) configured to control driving of the first lifting/lowering unit 120 and the transport lines 100, 200, 300, and 400.

The chemical container 2 is mounted inside the chemical supply device 5 in  
25 a state in which the chemical container 2 is loaded on a pallet 3. When the

chemical container 2 and the pallet 3 are mounted inside the chemical supply device 5, the chemical supply device 5 automatically opens a lid of the chemical container 2 and connects a coupler to the chemical container 2 to allow a chemical accommodated in the chemical container 2 to be supplied to a place of use of the chemical. In this case, the chemical accommodated in the chemical container 2 may be transported to the place of use of the chemical due to being pressed by a transport pump or nitrogen gas. A pump unit 6 including the transport pump may be installed at one side of the chemical supply device 5.

The first lifting/lowering unit 120 is provided on the inlet unit 1-1 to easily transport the chemical container 2 to the chemical supply device 5 using a forklift 4 (see FIG. 2).

Examples of the forklift 4 may include any device, regardless of its name, capable of transporting the chemical container 2, such as a cart, an electric lift, a manual lift, a forklift, a pallet truck, and a hand pallet truck. Also, examples of the forklift 4 not only include vehicles that require a professional license or completion of professional training to operate, but also include any device that can be operated even by workers who do not have a professional license or have not completed professional training.

The first lifting/lowering unit 120 lifts the chemical container 2 transported at the first height by the forklift 4 to the second height and then allows the chemical container 2 to be transported to the chemical supply device 5 via the transport lines 100, 200, 300, and 400.

A first inspection unit 130 configured to inspect chemical information of the chemical container 2 supplied from the inlet unit 1-1 may be provided on the

transport lines 100, 200, 300, and 400, and the controller may be configured to receive the chemical information from the first inspection unit 130.

The one or more transport lines 100, 200, 300, and 400 include a first transport line 100 that is connected to the inlet unit 1-1 and formed in a linear shape.

5        The first transport line 100 defines a path for transporting the pallet 3 on which the chemical container 2 is loaded. For transport of the chemical container 2 and the pallet 3, a transport member may be provided from the start to the end of the first transport line 100.

For example, the transport member may include a plurality of rollers  
10       provided in a longitudinal direction of the first transport line 100 and a roller driving unit configured to rotate the roller. The roller is formed in a cylindrical shape that has a circular cross-section and has a predetermined length in a direction perpendicular to a transport direction. A rotating shaft is inserted to pass through the center of the cylindrical roller in a longitudinal direction thereof, and the rotating  
15       shaft is connected to the roller driving unit.

The pallet 3 on which the chemical container 2 is loaded is mounted on the plurality of rollers, and the chemical container 2 and the pallet 3 are transported along the first transport line 100 due to rotation of the rollers.

Also, the transport member may include a conveyor belt instead of the  
20       rollers or may include a chain block in which a hoist with wheels attached to both sides of a monorail installed on a ceiling moves due to an electric motor.

The transport member may be provided to be able to be driven in a forward direction and a reverse direction to allow two-way transport of the chemical container 2 and the pallet 3, and the transport member may be provided so that two-

way transport of the transport member is possible on all of the transport lines 100, 200, 300, and 400 which will be described below.

Also, although objects being transported along the transport lines 100, 200, 300, and 400 are the chemical container 2 and the pallet 3 that are loaded vertically, hereinafter, for convenience of description, the objects being transported will be referred to as chemical containers 2. However, when description of the pallet 3 is necessary, the objects being transported will be referred to as the chemical containers 2 and the pallet 3.

The inlet unit 1-1 and the first inspection unit 130 may be sequentially provided in this order on the first transport line 100, and the transport member is provided as a plurality of transport members on the inlet unit 1-1 and the first inspection unit 130 in a transport direction to transport the chemical containers 2.

The first inspection unit 130 may inspect chemical information through a unique identifier such as a barcode label or a radio-frequency identification (RFID) tag that is attached to the chemical container 2. The unique identifier attached to the chemical container 2 contains various necessary pieces of production information as well as the name of a chemical. Also, the first inspection unit 130 may inspect a unique identifier such as a barcode label or an RFID tag that is attached to the pallet 3. The unique identifier attached to the pallet 3 also contains various necessary pieces of production information as well as the name of a chemical. The first inspection unit 130 may check the unique identifier, and the controller may check whether the checked chemical information of the chemical container 2 and the pallet 3 corresponds to a chemical required by the chemical supply device 5.

Also, the one or more transport lines 100, 200, 300, and 400 may further include a second transport line 200 disposed adjacent to the first transport line 100 so as to be parallel thereto.

5 An outlet unit 1-2, which is provided on a side portion of the inlet unit 1-1 that is adjacent thereto, and a second inspection unit 230 are sequentially provided in this order on the second transport line 200. The transport member is provided as a plurality of transport members on the outlet unit 1-2 and the second inspection unit 230 in the transport direction to transport the chemical containers 2. In this case, the transport member may be rotated to allow two-way transport of the chemical  
10 container 2 along the second transport line 200.

The outlet unit 1-2 is provided to transport used chemical containers 2 from the chemical supply device 5 through the second transport line 200 and then discharge the chemical containers 2 to the outside.

The outlet unit 1-2 may include a second lifting/lowering unit 220  
15 configured to lower the chemical containers 2, which are transported through the second transport line 200 while being at the second height, to the first height and a discharge unit 210 configured to discharge the chemical containers 2, which are lowered to the first height by the second lifting/lowering unit 220, to the outside using the forklift 4.

20 Meanwhile, when a problem such as a failure occurs in the inlet unit 1-1 or the first transport line 100, it is not possible to input the chemical containers 2 through the inlet unit 1-1. In this case, the outlet unit 1-2 may serve as the inlet unit 1-1, and the chemical containers 2 may be input through the outlet unit 1-2. Conversely, when a problem such as a failure occurs in the outlet unit 1-2 or the

second transport line 200, the chemical containers 2 may be configured to be discharged through the inlet unit 1-1.

The second inspection unit 230 inspects chemical information of the chemical container 2 when the chemical container 2 is input through the outlet unit 1-2. The second inspection unit 230 may have the same configuration as the first inspection unit 130.

A plurality of connection units 140, 150, and 160 may be provided on the first transport line 100 and the second transport line 200 to connect the first transport line 100 and the second transport line 200.

The plurality of connection units 140, 150, and 160 may include first connection units 140 and 240 configured to connect the first inspection unit 130 and the second inspection unit 230, second connection units 150 and 250 provided at positions that correspond to a third transport line 300 which will be described below, and third connection units 160 and 260 that are provided at positions that correspond to a fourth transport line 400 which will be described below, i.e., at end portions of the first transport line 100 and the second transport line 200.

A transport member, such as a roller, may be provided as a plurality of transport members on the first connection unit 140 (first transport line connection unit) of the first transport line 100 and the first connection unit 240 (second transport line connection unit) of the second transport line 200 in a direction perpendicular to a transport direction of the first transport line 100 and the second transport line 200 so that, when the transport members are driven, the chemical containers 2 mounted on the transport members of the first transport line connection unit 140 are transported in a direction toward the second transport line 200 and mounted on the second transport line connection unit 240.

The second connection units 150 and 250 and the third connection units 160 and 260 may also have the same configuration as the first connection units 140 and 240 and may transport the chemical container 2 from the first transport line 100 toward the second transport line 200 or from the second transport line 200 toward the first transport line 100.

When the chemical container 2 is input to the second transport line 200 through the discharge unit 210, the chemical container 2 is inspected by the second inspection unit 230, passes through the first transport line 100 in a width direction thereof through the second connection units 150 and 250, and then is transported to the third transport line 300.

The third transport line 300 is connected perpendicular to the first transport line 100 and is connected to the second connection units 150 and 250.

The fourth transport line 400 is disposed adjacent to an end portion of the first transport line 100 so as to be parallel to the third transport line 300, is connected perpendicular to the first transport line 100, and is connected to the third connection units 160 and 260.

The third transport line 300 and the fourth transport line 400 may also have the transport members provided from a start to an end of each transport line for transport of the chemical containers 2 and the pallet 3.

An air shower unit 310 may be provided on the third transport line 300 to remove foreign matter on the chemical containers 2 and the pallet 3.

One or more buffer units 301, 302, 303, and 304 are provided on the transport lines 300 and 400 to allow the chemical container 2, which passed through the first inspection unit 130, to temporarily wait before being supplied to the chemical supply device 5.

The buffer units 301, 302, 303, and 304 include a first buffer unit 301 and a second buffer unit 302 that are provided on the third transport line 300 and a third buffer unit 303 and a fourth buffer unit 304 that are provided on the fourth transport line 400.

- 5           The first buffer unit 301 and the fourth buffer unit 304 are provided at positions facing each other so as to be adjacent to each other, and the second buffer unit 302 and the third buffer unit 303 are provided at positions facing each other so as to be adjacent to each other.

When the plurality of buffer units 301, 302, 303, and 304 are provided on the  
10   third transport line 300 and the fourth transport line 400, since it is possible to secure a large quantity of chemical containers 2 to be input to the chemical supply device 5, it is possible to immediately meet the demand for chemicals required by the chemical supply device 5.

A chemical container input port 331 is provided between the first buffer unit  
15   301 and the second buffer unit 302 to input the chemical container 2 to the chemical supply device 5. The chemical container input port 331 refers to a position at which the chemical container 2 is input, and a fifth connection unit 330, which will be described below, may serve as the chemical container input port 331.

Also, a chemical container discharge port 341 may be provided to discharge  
20   the chemical container 2, which is discharged from the chemical supply device 5, to the third transport line 300. The chemical container discharge port 341 refers to a position at which the chemical container 2 is discharged, and a sixth connection unit 340, which will be described below, may serve as the chemical container discharge port 341.

Two or more connection units 320 and 420, 330 and 430, and 340 and 440 are provided between the third transport line 300 and the fourth transport line 400 to allow the chemical container 2 to be transported from the third transport line 300 to the fourth transport line 400 or from the fourth transport line 400 to the third  
5 transport line 300.

The two or more connection units 320 and 420, 330 and 430, and 340 and 440 include fourth connection units 320 and 420 configured to connect sides of the third transport line 300 and the fourth transport line 400 that are close to the first transport line 100 and sixth connection units 340 and 440 configured to connect end  
10 portions of the third transport line 300 and the fourth transport line 400 that are far from the first transport line 100.

Meanwhile, when the chemical container 2 is transported along the first to fourth transport lines 100, 200, 300, and 400, the position of the chemical container 2 may be checked in real time by a sensor (not illustrated) provided on the transport  
15 line. In other words, when chemical information of a single chemical container 2 is checked by the first inspection unit 130, since the real-time position of the chemical container 2, of which the chemical information is checked, is sensed by the sensor provided on the transport line, it is also possible to check chemical information of the chemical container 2 temporarily waiting in the buffer units 301, 302, 303, and 304.  
20 Therefore, in order to transport the chemical container 2 required by the chemical supply device 5, chemical information of the chemical container 2 temporarily waiting in the buffer units 301, 302, 303, and 304 may be checked, and the checked chemical container 2 may be input to the chemical supply device 5.

Through an unmanned transport car 600, the chemical container 2 may be input to the chemical supply device 5, or an empty, used chemical container 2 may be discharged from the chemical supply device 5.

To this end, a transport car rail 500 may be provided between the chemical supply device 5 and the third transport line 300 to allow the transport car 600 to reciprocate.

A transport member such as a roller may be provided on the transport car 600 to input the chemical container 2 mounted thereon into the chemical supply device 5 or to discharge the chemical container 2 from inside the chemical supply device 5 to the outside.

A configuration of the inlet unit 1-1 will be described with reference to FIGS. 2 to 9.

Referring to FIGS. 2 and 3, the first lifting/lowering unit 120 configured to lift the chemical container 2 from the first height to the second height is provided on the inlet unit 1-1. Also, the inlet unit 1-1 may further include a pallet input guide 10, a shutter unit 20, and the input unit 110.

A worker loads the chemical containers 2 and the pallet 3 on a fork 4a of the forklift 4 to transport the chemical containers 2 and the pallet 3.

Examples of the forklift 4 include a general electric or manual forklift without a lifting/lowering function that may be operated even by workers who do not have a professional license or who have not completed professional training. Of course, lifts with the lifting/lowering function may also be used.

The pallet input guide 10 is provided as a pair of pallet input guides 10 that are provided to be symmetrical to each other at both sides of a path along which the forklift 4 enters. The pair of pallet input guides 10 are provided such that a distance

therebetween is large near the inlet, through which the forklift 4 enters, and gradually decreases farther from the inlet. Therefore, in a case in which the pallet 3 loaded on the forklift 4 is transported in a state of being eccentrically loaded, or the entry path of the forklift 4 is eccentric, the pallet input guides 10 may guide the pallet 3 to  
5 prevent the pallet 3 from being eccentric to one side.

The shutter unit 20 includes a shutter 21, a first lamp unit 22, and an input unit sensor 23.

The shutter unit 20 may be provided between the pallet input guides 10 and the input unit 110 to block delivery of outside air indoors and prevent pollutants from  
10 entering indoors from the outside.

The shutter 21 may be configured as a windshield shutter and is configured to be opened automatically before the chemical container 2 passes therethrough and to be closed automatically after the chemical container 2 passes therethrough.

Also, the shutter 21 may be configured as a speed door. The speed door  
15 may be configured so that, when the chemical container 2 is located at the center below the shutter 21, the shutter 21 is not closed so as to allow the chemical container 2 to be sensed by a sensor. Alternatively, the speed door may be made of a material that, even when the shutter 21 is closed while the chemical container 2 is located below the shutter 21 and thus collision occurs between the chemical  
20 container 2 and the shutter 21, is not affected by the collision so as to prevent damage to the speed door. Alternatively, the speed door may be configured to be opened automatically when the collision occurs.

Also, the speed door may have an automatic restoration function that allows both side ends of the door to be detached like a zipper when the chemical container 2  
25 moves while the speed door is closed and thus collides with the speed door and to be

attached automatically when the door is opened again. In this way, damage to the door and the chemical container 2 may be prevented.

The first lamp unit 22 generates an alarm to allow a forklift operator to check whether it is possible to input/discharge the chemical container 2. In this case, the  
5 alarm may be generated by emitting light.

For example, the first lamp unit 22 may include a three-color lamp that is able to emit green light, yellow light, and red light. The first lamp unit 22 emitting green light indicates that the chemical container 2 can be input, the first lamp unit 22 emitting yellow light indicates that an abnormality has occurred, and the first lamp  
10 unit 22 emitting red light indicates that the chemical container 2 cannot be input.

In the case in which the first lamp unit 22 emits green light, when a shutter open switch (not illustrated) of the shutter unit 20 is pressed, the shutter 21 is opened. Meanwhile, in the case in which the first lamp unit 22 does not emit green light, the shutter 21 is not opened even when the shutter open switch is pressed.

15 The input unit sensor 23 may, when a worker is sensed during a period other than periods during which the chemical containers 2 are input and discharged using the forklift 4, stop the transport using the transport lines 100, 200, 300, and 400 to improve safety of the worker.

The input unit sensor 23 may include a light emitting unit and a light  
20 receiving unit respectively provided at one side and the other side of the shutter unit 20.

Meanwhile, in the case of inputting the chemical container 2 through the inlet unit 1-1, an input mode switch (not illustrated) may be configured to allow the input of the chemical container 2 when pressed. The input mode switch may be  
25 provided on an input/discharge manipulation panel (not illustrated).

The input unit 110 will be described with reference to FIGS. 2 to 4.

Hereinafter, “forward” refers to an advancing direction in which the chemical containers 2 are transported on the first transport line 100, and “rearward” refers to a direction opposite to the advancing direction in which the chemical  
5 containers 2 are transported on the first transport line 100.

The input unit 110 is a site where the first transport line 100 begins and where the forklift 4 inputs the chemical containers 2 onto the first transport line 100. The input unit 110 is provided in front of the shutter unit 20.

The input unit 110 includes a plurality of transport members 111 on which  
10 the chemical containers 2 are loaded and a transport member driving unit configured to drive the transport members 111.

Examples of the transport member driving unit may include a motor, an air cylinder, and a hydraulic cylinder, but any other device capable of rotating the transport members 111 may be used as the transport member driving unit.

15 The plurality of transport members 111 are provided to be spaced apart at predetermined intervals from the front to the rear in the direction in which the chemical containers 2 are transported.

Also, as a transport member provided at the rear among the transport members 111, a plurality of transport members 111a, 111b, and 111c may be  
20 provided to be spaced apart from each other in a direction perpendicular to the direction in which the chemical containers 2 are transported. That is, a cylindrical transport member that has a length in the direction perpendicular to the transport direction is divided into the plurality of transport members 111a, 111b, and 111c.

Wheel rail units 112a and 112b are provided between the plurality of transport members 111a, 111b, and 111c to allow wheels of the forklift 4, which is configured to load the chemical containers 2 on the input unit 110, to enter.

That is, one wheel rail unit 112a is provided between the transport member  
5 111a at one side and the transport member 111b at the center, and the other wheel rail unit 112b is provided between the transport member 111c at the other side and the transport member 111b at the center.

The wheel rail units 112a and 112b are provided so that upper surfaces thereof are disposed at a position lower than that of upper ends of the transport  
10 members 111a, 111b, and 111c. Consequently, when the forklift 4 loads the chemical containers 2 and the pallet 3 on the upper ends of the transport members 111a, 111b, and 111c, the bottom surface of the pallet 3 comes in contact only with the upper ends of the transport members 111a, 111b, and 111c and does not come in contact with the upper surfaces of the wheel rail units 112a and 112b.  
15 Consequently, when the transport members 111a, 111b, and 111c are rotated, the chemical containers 2 and the pallet 3 advance in a direction toward the first lifting/lowering unit 120.

Also, a height of a floor 12 on which the transport members 111a, 111b, and 111c are provided is lower than a height of a floor 11 adjacent to the inlet through  
20 which the forklift 4 enters, and the transport members 111a, 111b, and 111c are installed on an upper portion of the floor 12 having the lower height. In this case, the height of the upper surfaces of the wheel rail units 112a and 112b may be the same as or similar to the height of the floor 12 adjacent to the inlet.

Alignment units 115-1, 115-2, 116-1, and 116-2 configured to align the pallet 3, on which the chemical containers 2 are loaded, to a central portion may be provided on both side portions of the transport members 111a, 111b, and 111c.

5 The alignment units 115-1, 115-2, 116-1, and 116-2 are provided to, when the chemical containers 2 are transported in a state of being misaligned on the first transport line 100, align the misaligned chemical containers 2. In this case, the alignment units 115-1, 115-2, 116-1, and 116-2 may be configured to align the chemical containers 2 to a central portion of the first transport line 100.

10 The alignment units 115-1, 115-2, 116-1, and 116-2 include a pair of alignment members 116-1 and 116-2 configured to push both side surfaces of the pallet 3, which is loaded on the transport members 111a, 111b, and 111c, toward the central portion to align the pallet 3 to be parallel to the first transport line 100 and a pair of alignment driving units 115-1 and 115-2 configured to reciprocate the pair of alignment members 116-1 and 116-2 in directions facing each other.

15 The pair of alignment members 116-1 and 116-2 include a first alignment member 116-1 provided on one side of the first transport line 100 and a second alignment member 116-2 provided at the other side of the first transport line 100 and are formed as plates that each have a length in a direction of the first transport line 100, the length corresponding to a length of the pallet 3. Also, the alignment  
20 members 116-1 and 116-2 may have at least a portion that comes in surface contact with a side surface of the pallet 3 to improve the alignability of the pallet 3.

The pair of alignment driving units 115-1 and 115-2 include a first alignment driving unit 115-1 configured to provide a driving force for reciprocating motion of the first alignment member 116-1 and a second alignment driving unit 115-2

configured to provide a driving force for reciprocating motion of the second alignment member 116-2.

Due to driving of the alignment driving units 115-1 and 115-2, the alignment members 116-1 and 116-2 reciprocate in the direction perpendicular to the transport  
5 direction.

In the case in which the transport members 111a, 111b, and 111c are formed as rollers, the pallet 3 is transported along the first transport line 100 in a state in which surfaces of the rollers come in contact with the bottom surface of the pallet 3. In this case, for the alignment members 116-1 and 116-2 to push both side surfaces  
10 of the pallet 3 to align the pallet 3, a small frictional force may act between surfaces of the transport members 111a, 111b, and 111c that come in contact with the bottom surface of the pallet 3. To this end, in order to decrease frictional resistance on the surfaces of the transport members 111a, 111b, and 111c that come in contact with the bottom surface of the pallet 3, the transport members 111a, 111b, and 111c may be  
15 made of a metal material, especially a stainless steel material.

Also, the height of the transport members 111 (111a, 111b, and 111c) of the input unit 110 becomes identical to a first height of a transport member 121 provided on the first lifting/lowering unit 120. Consequently, when the transport members 111 (111a, 111b, and 111c) of the input unit 110 are driven to move the chemical  
20 containers 2 and the pallet 3 forward, the chemical containers 2 and the pallet 3 may be mounted on the transport member 121 of the first lifting/lowering unit 120 without a change in the height.

Meanwhile, a first stopper 113-1 may be provided adjacent to an inlet of the input unit 110 to prevent the pallet 3, which is mounted on the transport members

111a, 111b, and 111c, from being transported in a direction toward the inlet of the input unit 110 (that is, rearward).

The first stopper 113-1 is provided as a pair of first stoppers 113-1 at both sides of the transport members 111a, 111b, and 111c, and the pair of first stoppers  
5 113-1 may reciprocate in directions facing each other.

When the chemical containers 2 and the pallet 3 are mounted on the transport members 111a, 111b, and 111c, the first stoppers 113-1 protrude inward, which is a direction in which the first stoppers 113-1 face each other, and are located behind the pallet 3. Consequently, when the forklift 4 moves rearward and the fork  
10 4a is detached from the pallet 3 toward the rear thereof, the pallet 3 may be caught at the first stoppers 113-1 and may be prevented from moving rearward.

A second stopper 113-2 may be provided adjacent to an outlet of the input unit 110 to prevent, when the pallet 3 having the chemical containers 2 loaded thereon is mounted on the transport members 111a, 111b, and 111c of the input unit  
15 110, the pallet 3 from deviating from a set position in a direction toward the first lifting/lowering unit 120.

Like the first stopper 113-1, the second stopper 113-2 is also provided as a pair of second stoppers 113-2 at both sides of the transport members 111 (111a, 111b, and 111c), and the pair of second stoppers 113-2 may reciprocate in directions facing  
20 each other.

When the chemical containers 2 and the pallet 3 are input to the input unit 110 by the forklift 4, the second stoppers 113-2 protrude inward, which is a direction in which the second stoppers 113-2 face each other, and are located in front of the pallet 3. Consequently, when the pallet 3 is mounted on the transport members 111  
25 (111a, 111b, and 111c) by the forklift 4, a front end portion of the pallet 3 is caught

at the second stoppers 113-2, and the pallet 3 may be prevented from deviating from the set position and further moving in the direction toward the first lifting/lowering unit 120 so as to be mounted.

Also, a first sensor 114-1 and a second sensor 114-2 that are configured to  
5 sense the pallet 3 may be respectively provided adjacent to the inlet and the outlet of the input unit 110.

When the pallet 3 having the chemical containers 2 loaded thereon enters the input unit 110, the first sensor 114-1 firstly senses the front end of the pallet 3. Also, when the pallet 3 is mounted on the transport members 111 (111a, 111b, and  
10 111c) and then the forklift 4 moves rearward, since there is no object to be sensed by the first sensor 114-1, the controller may determine that mounting the chemical containers 2 and the pallet 3 on the transport members 111 (111a, 111b, and 111c) has been completed.

Also, in order to allow the pallet 3 having the chemical containers 2 loaded  
15 thereon to be mounted at a set position after being mounted on the transport members 111 (111a, 111b, and 111c) and then being transported a predetermined distance, the second sensor 114-2 senses a front end portion of the pallet 3.

A second lamp unit 117 is provided on a side portion adjacent to the second stopper 113-2. The second lamp unit 117 includes lamps provided for each of a  
20 plurality of colors and allows different colors to be emitted upon each operation to generate an alarm so that a worker may easily check a transport operation.

A configuration of the first lifting/lowering unit 120 will be described with reference to FIG. 7.

The first lifting/lowering unit 120 may include the transport member 121 on  
25 which the chemical containers 2 and the pallet 3 are loaded, a transport member

driving unit configured to drive the transport member 121 to transport the chemical containers 2, and a lifting/lowering driving unit configured to lift the transport member 121, on which the chemical containers 2 and the pallet 3 are loaded, from the first height to the second height and then, when the chemical containers 2 are transported along the transport line and move out from the lifting/lowering unit,  
5 lower the transport member 121.

Like the transport members 111 of the input unit 110, the transport member 121 is formed as a cylindrical roller and is provided as a plurality of transport members 121 in the direction in which the chemical containers 2 are transported.

10 In a state in which the chemical containers 2 are mounted on upper ends of the transport members 121, the transport member driving unit rotates the transport members 121 formed as the cylindrical rollers to transport the chemical containers 2 along the first transport line 100.

In a state in which the chemical containers 2 and the pallet 3 are mounted on  
15 the transport members 121, the lifting/lowering driving unit lifts all of the chemical containers 2, the pallet 3, and the transport members 121 from the first height to the second height.

The first height is the height of the transport members 121 of the first lifting/lowering unit 120 that is identical to the height of the transport members 111  
20 of the input unit 110.

The second height is the height identical to the height of the transport members provided on the transport lines 100, 200, 300, and 400 including the first inspection unit 130.

Meanwhile, the outlet unit 1-2 may be provided on the side portion of the  
25 inlet unit 1-1, and the discharge unit 210 of the outlet unit 1-2 may have the same

configuration as the input unit 110 of the inlet unit 1-1 or include at least some components, including the transport member, in common with the input unit 110 of the inlet unit 1-1. Also, the second lifting/lowering unit 220 of the outlet unit 1-2 may have the same configuration as the first lifting/lowering unit 120 of the inlet unit 1-1 or include at least some components, including the transport member, in common with the first lifting/lowering unit 120 of the inlet unit 1-1.

A method for automatic transport of chemical containers according to the present disclosure will be described with reference to FIGS. 3, 5, 6, 8, and 9.

First, a preparation process for inputting the chemical containers 2 to the inlet unit 1-1 will be described.

A worker loads the pallet 3 having the chemical containers 2 loaded thereon on the fork 4a of the forklift 4, and in a state in which the forklift 4 has arrived in front of the pallet input guide 10, the worker presses the input mode switch provided on the input/discharge manipulation panel. When a state in which a lamp of the input mode switch blinks is reached, the worker maintains the input mode state.

In this state, the worker checks a color of light emitted by the first lamp unit 22, and when the color of light is green, the worker determines that inputting is possible and presses the shutter open switch (not illustrated) of the shutter unit 20 to open the shutter 21. In this case, when the color of light emitted by the first lamp unit 22 is yellow or red, the shutter is not opened even when the worker presses the shutter open switch.

When the shutter 21 is opened, the worker operates the forklift 4 to move forward. In this case, even when the forklift 4 is sensed by the input unit sensor 23, the controller does not determine that an abnormality has occurred and controls to allow inputting to be performed normally.

When the worker operates the forklift 4 to move forward, a state illustrated in FIG. 5 is reached. That is, the chemical containers 2 are loaded on the pallet 3, and the pallet 3 is loaded on the fork 4a of the forklift 4.

When the forklift 4 moves forward further from the state illustrated in FIG. 5,  
5 as illustrated in FIG. 6, the pallet 3 enters a region of the input unit 110.

In the case in which the pallet 3 enters the region of the input unit 110 as above, when the first sensor 114-1 firstly senses the front end of the pallet 3, the pair of second stoppers 113-2 are controlled to protrude inward, which is the direction in which the second stoppers 113-2 face each other.

10 When the forklift 4 moves further forward, the second sensor 114-2 senses the front end of the pallet 3. When the front end of the pallet 3 is sensed by the second sensor 114-2, for example, blue light is emitted from the second lamp unit 117, and in this case, the pair of first stoppers 113-1 protrude inward, which is the direction in which the pair of first stoppers 113-1 face each other.

15 When the first stoppers 113-1 protrude inward, light of a different color from the blue light (for example, white light) is emitted from the second lamp unit 117.

When the worker identifies the blue light and white light emitted from the second lamp unit 117, the worker lowers the fork 4a of the forklift 4 so that the bottom surface of the pallet 3 is mounted on the upper surfaces of the transport  
20 members 111a, 111b, and 111c. In this case, since the heights at which the fork 4a is lifted and lowered are heights at which the pallet 3 is spaced apart from the floor 11 or the upper ends of the transport members 111a, 111b, and 111c and does not come in contact with the floor 11 or the upper ends of the transport members 111a, 111b, and 111c when the forklift 4 moves forward and rearward, the height

difference is significantly smaller than a difference between the first height and the second height.

When the chemical containers 2 and the pallet 3 are mounted on the transport members 111a, 111b, and 111c, the worker operates the forklift 4 rearward. In this case, since the first stoppers 113-1 protrude inward, even when the pallet 3 moves a predetermined distance rearward together with the fork 4a when the fork 4a moves rearward, the pallet 3 is caught at the first stoppers 113-1 and prevented from moving rearward further, and the fork 4a is detached from the pallet 3.

Even when the fork 4a deviates from the pallet 3 due to the rearward movement of the forklift 4, since the fork 4a is at the height that allows the fork 4a to be sensed by the first sensor 114-1, a state in which the first sensor 114-1, which was sensing the pallet 3, senses the fork 4a is maintained.

Then, when the forklift 4 moves further rearward, since the front end portion of the fork 4a deviates from a sensing range of the first sensor 114-1, the controller determines that there is no object to be sensed by the first sensor 114-1.

When, as above, the controller determines that there is no object to be sensed by the first sensor 114-1, the shutter 21 provided behind the input unit 110 is controlled to be closed. When an object is sensed by the input unit sensor 23 in the state in which the shutter 21 is closed, the controller stops the operation of the transport member for transport of the chemical containers 2.

When the shutter 21 is closed, the alignment driving units 115-1 and 115-2 are driven so that the pair of alignment members 116-1 and 116-2 push both side surfaces of the pallet 3 toward the central portion to align the pallet 3.

When the pallet 3 is aligned, the alignment members 116-1 and 116-2 return to their original positions, and the first stoppers 113-1 and the second stoppers 113-2 return to their original positions from the protruding state.

Then, the transport members 111 (111a, 111b, and 111c) of the input unit 110  
5 are driven, and as illustrated in FIG. 8, the chemical containers 2 and the pallet 3 enter the first lifting/lowering unit 120 and are mounted on the transport member 121 of the first lifting/lowering unit 120 that is at the first height.

When the chemical containers 2 and the pallet 3 are mounted on the transport member 121, the lifting/lowering driving unit is driven to lift the transport member  
10 121, on which the chemical containers 2 and the pallet 3 are loaded, to the second height.

When the transport member 121 is lifted to the second height, the transport member driving unit of the first lifting/lowering unit 120 is driven to rotate the transport member 121. In this case, the transport member provided on the first  
15 inspection unit 130 is rotated together.

When the transport member 121 is rotated as above, the chemical containers 2 and the pallet 3 are transported from the first lifting/lowering unit 120 to the first inspection unit 130.

Then, the first inspection unit 130 inspects chemical information of the  
20 chemical containers 2 and the pallet 3 and whether positions of the chemical containers 2 and the pallet 3 are abnormal. When there is no abnormality as a result of the inspection, the chemical containers 2 and the pallet 3 are transported along the first transport line 100, and when an abnormality is found, an alarm is generated so that the worker re-checks the chemical containers 2 and the pallet 3. When, after  
25 re-checking the chemical containers 2 and the pallet 3, the worker decides to return

the corresponding chemical containers 2 and the pallet 3, the chemical containers 2 and the pallet 3 are transported from the first transport line connection unit 140 to the second transport line connection unit 240, transported to the discharge unit 210 along the second transport line 200, and then returned to the forklift 4.

5           In a case in which a portion of the chemical container 2 or the pallet 3 from which an abnormality is found by the first inspection unit 130 is checked and then handled by the worker, when the chemical container 2 or the pallet 3 is re-inspected by the first inspection unit 130 and an abnormality is not found, the chemical container 2 or the pallet 3 is transported along the first transport line 100.

10           The chemical container 2 that is confirmed by the first inspection unit 130 as not having any abnormality is transported to the air shower unit 310 after a transport direction of the chemical container 2 is rotated 90° at the second connection unit 150. In the air shower unit 310, air is ejected for a predetermined amount of time to remove foreign matter on outer portions of the chemical container 2 and the pallet 3.

15           The chemical containers 2 that passed through the air shower unit 310 are transported to any one of the first to fourth buffer units 301, 302, 303, and 304 to wait temporarily.

          When chemicals in the chemical containers 2 input to the chemical supply device 5 are used up, the controller drives the transport members of the third  
20 transport line 300 and the fourth transport line 400 to input the chemical containers 2 waiting in the buffer units 301, 302, 303, and 304 to the chemical supply device 5.

          The fifth connection unit 330 serves as the chemical container input port 331, and when the transport car 600 is located adjacent to the chemical container input port 331, the chemical container 2 present on the fifth connection unit 330 is input  
25 into the chemical supply device 5 through the transport car 600. In this case,

chemical information of the chemical container 2 and the pallet 3 may also be checked in the transport car 600.

When the chemical container 2 is mounted inside the chemical supply device 5, the chemical supply device 5 opens a lid of the chemical container 2 and connects a coupler to the chemical container 2 to supply a chemical accommodated in the chemical container 2 to a place of use of the chemical.

A case in which an empty, used chemical container 2 is discharged from the chemical supply device 5 to the outlet unit 1-2 will be described.

When an empty, used chemical container 2 is transported from the chemical supply device 5, the transport car 600 is disposed in front of the chemical supply device 5, and the empty chemical container 2 is loaded on a transport member of the transport car 600.

The transport car 600 on which the chemical container 2 is loaded moves to positions of the sixth connection units 340 and 440, and the chemical container 2 is transported from the transport car 600 to the sixth connection unit 340 of the third transport line 300 and the sixth connection unit 440 of the fourth transport line 400.

The chemical container 2 is transported along the fourth transport line 400 after a transport direction of the chemical container 2 is switched at the sixth connection unit 440, and then the chemical container 2 is placed on the second transport line 200 through the third connection units 160 and 260. Also, the chemical container 2 is transported along the second transport line 200 after a transport direction of the chemical container 2 is switched at the third connection unit 260, and then the chemical container 2 is transported to the second lifting/lowering unit 220 of the outlet unit 1-2.

When the chemical container 2 and the pallet 3 enter the second lifting/lowering unit 220, the transport member of the second lifting/lowering unit 220 is at the second height. When the chemical container 2 and the pallet 3 are mounted on the transport member of the second lifting/lowering unit 220, the  
5 lifting/lowering driving unit of the second lifting/lowering unit 220 is driven to lower the transport member, on which the chemical container 2 and the pallet 3 are loaded, to the first height.

Then, when the transport member driving unit of the second lifting/lowering unit 220 is driven, the chemical container 2 and the pallet 3 are transported to the  
10 discharge unit 210, and at the discharge unit 210, the worker uses the forklift 4 to discharge the chemical container 2 and the pallet 3.

<Modified embodiment>

Although it has been described above that, in the inlet unit 1-1, the input unit 110 is provided in front of the first lifting/lowering unit 120, the input unit 110 may  
15 not be provided, and only the first lifting/lowering unit 120 may be provided in the inlet unit 1-1. Also, when the input unit 110 is not provided, an alignment unit may be provided in the first lifting/lowering unit 120.

That is, a worker operates the forklift 4 to mount the chemical container 2 and the pallet 3 on the transport member 121 of the first lifting/lowering unit 120,  
20 which is at the first height. Then, the worker uses the alignment unit to push both side surfaces of the pallet 3 toward the central portion to align the pallet 3.

When the aligning is completed, the worker drives the lifting/lowering driving unit to lift the transport member 121, on which the chemical container 2 and the pallet 3 are loaded, to the second height.

Of course, the pallet 3 may be aligned using the alignment unit after the transport member 121, on which the chemical container 2 and the pallet 3 are loaded, is lifted to the second height.

In this case, the alignment unit may be configured to be lifted and lowered  
5 together with the transport member 121 or may be configured to be at a fixed height such that only the transport member 121 is lifted and lowered.

Similar to the above, in the outlet unit 1-2, only the second lifting/lowering unit 220 may be provided, and the discharge unit 210 may not be provided.

Also, although, in the above-described embodiment, the chemical container  
10 2 is transported to the chemical supply device 5 or a used chemical container 2 is discharged from the chemical supply device 5 to the outside through the one or more transport lines 100, 200, 300, and 400, the transport lines 100, 200, 300, and 400 may not be provided.

That is, the chemical container 2 lifted to the second height at the first  
15 lifting/lowering unit 120 may be transported immediately to the chemical supply device 5. Of course, even in this case, the input unit 110 may be provided behind the first lifting/lowering unit 120.

Also, a used chemical container 2 may be transported immediately from the chemical supply device 5 to the second lifting/lowering unit 220. Of course, even  
20 in this case, the discharge unit 210 may be provided behind the second lifting/lowering unit 220.

In this way, even in the modified embodiment, the input unit 110 and the first lifting/lowering unit 120 may be configured to be combined. That is, the first and second stoppers 113-1 and 113-2, the first and second sensors 114-1 and 114-2,  
25 the first and second alignment driving units 115-1 and 115-2, and the first and second

alignment members 116-1 and 116-2 that are provided in the input unit 110 may be provided in the first lifting/lowering unit 120. Also, components provided in the discharge unit 210 may be provided in the second lifting/lowering unit 220.

Exemplary embodiments of the present disclosure have been described  
5 above in detail, but the present disclosure is not limited to the above-described  
embodiments. The present disclosure may be modified and embodied in various  
other ways within the scope of the claims, the detailed description, and the  
accompanying drawings, and such modifications also belong to the present  
disclosure.

10

[CLAIMS]

[Claim 1]

An apparatus for automatic transport of chemical containers, the apparatus comprising:

5           a lifting/lowering unit configured to lift a chemical container (2) from a first height to a second height; and

          a controller configured to control driving of the lifting/lowering unit to transport the chemical container (2), which is lifted to the second height, to a chemical supply device (5);

10           further comprising an input unit (110) configured to transport the chemical container (2) to the lifting/lowering unit in a state in which the chemical container (2) is loaded on the transport member at a height identical to the first height of the lifting/lowering unit, the input unit (110) includes a plurality of transport members on which the chemical container (2) is loaded and a transport member driving unit  
15   configured to drive the transport members;

          the transport members are provided as a plurality of transport members (111a, 111b, 111c) that are spaced apart in a direction perpendicular to a direction in which the chemical container (2) is transported; and

          wheel rail units (112a, 112b) are provided between the plurality of transport  
20   members (111a, 111b, 111c) at a position higher than the bottom (12) of the input unit (110) to allow wheels of a forklift with fork (4a), which is configured to load the chemical container (2) on the input unit (110), to enter; the wheel rail units (112a, 112b) are provided so that upper surfaces thereof are disposed at a position lower than that of upper ends of the transport members (111a, 111b, 111c);

the pallet (3) on which the chemical container (2) is loaded is mounted on an upper portion of a transport member provided on the input unit (110);

when the second sensor (114-2) senses the pallet (3) seated on the upper portion of the transport members (111a, 111b, 111c), a first stopper (113-1), which is  
5 provided adjacent to the inlet of the input unit, protrudes to the central portion of the input unit to a position at which a rear end of the pallet (3) is able to be caught at the first stopper (113-1) and the pallet (3) seated on the upper portions of the transport members (111a, 111b, 111c) is prevented from being transferred in the direction of the entrance of the input unit (110).

10 [Claim 2]

The apparatus of claim 1, wherein the lifting/lowering unit includes a transport member (121) on which the chemical container (2) is loaded, a transport member driving unit configured to drive the transport member (121) to transport the chemical container (2), and a lifting/lowering driving unit configured to lift the  
15 transport member (121), on which the chemical container (2) is loaded, from the first height to the second height and then, when the chemical container (2) moves out from the lifting/lowering unit, lower the transport member (121).

[Claim 3]

The apparatus of claim 1, wherein an alignment unit configured to align a  
20 pallet (3), on which the chemical container (2) is loaded, to a central portion is provided on the input unit (110).

[Claim 4]

The apparatus of claim 1, wherein an alignment unit configured to align the pallet (3), on which the chemical container (2) is loaded, to a central portion is  
25 provided on the lifting/lowering unit.

[Claim 5]

The apparatus of claim 3 or 4, wherein the alignment unit includes:

a pair of alignment members configured to push both side surfaces of the  
pallet (3) to align the pallet (3) to be parallel to a direction in which the chemical  
5 container (2) is transported; and

an alignment driving unit configured to reciprocate the pair of alignment  
members in directions facing each other.

[Claim 6]

The apparatus of claim 5, wherein the alignment member has a length in the  
10 direction in which the chemical container (2) is transported and has at least a portion  
that comes in surface contact with a side surface of the pallet (3).

[Claim 7]

The apparatus of claim 3 or 4, wherein the input unit (110) or the  
lifting/lowering unit includes:

15 a transport member on which the chemical container (2) is loaded; and  
a transport member driving unit configured to drive the transport member so  
that the chemical container (2) is transported,

wherein the transport member that comes in contact with a bottom surface of  
the pallet (3) is made of a metal material.

20 [Claim 8]

The apparatus of claim 1, wherein a second stopper (113-2) is provided to,  
when the pallet (3) having the chemical container (2) loaded thereon is mounted on  
the upper portion of the transport member provided on the input unit (110), prevent  
the chemical container (2) and the pallet (3) from deviating from a set position in a  
25 direction toward the lifting/lowering unit is located.

[Claim 9]

The apparatus of claim 1, wherein:

a first sensor (114-1) is provided adjacent to an inlet of the input unit (110) to, when the pallet (3) having the chemical container (2) loaded thereon enters, sense a  
5 front end of the pallet (3); and

when the first sensor (114-1) senses the pallet (3), the controller operates the second stopper (113-2) to prevent the pallet (3) having the chemical container (2) loaded thereon from deviating from a set position in a direction toward the lifting/lowering unit.

10 [Claim 10]

The apparatus of claim 1, wherein:

a second sensor (114-2) is provided adjacent to an outlet of the input unit (110) to, when the pallet (3) having the chemical container (2) loaded thereon enters and is transported a predetermined distance, sense the front end of the pallet (3); and

15 when the second sensor (114-2) senses the pallet (3), the controller generates an alarm.

[Claim 11]

The apparatus of claim 1, wherein:

a first sensor (114-1) is provided on the input unit (110) to, when the pallet  
20 (3) having the chemical container (2) loaded thereon is input, sense the front end of the pallet (3); and

when the first sensor (114-1) attempts to sense the front end of the pallet (3) and then determines that an object to be sensed is not present, the controller controls a shutter (20) provided behind the input unit (110) to be closed.

25 [Claim 12]

The apparatus of claim 1, wherein:

an inspection unit (130) is provided to inspect chemical information of the transported chemical container (2) that is lifted to the second height by the lifting/lowering unit; and

5           the controller receives the chemical information from the inspection unit (130) and, when the received chemical information matches information required by the chemical supply device (5), controls the chemical container (2) to be supplied to the chemical supply device (5).

[Claim 13]

10           The apparatus of claim 1, wherein at least one transport line is provided to transport the chemical container (2), which is transported from the lifting/lowering unit, to the chemical supply device (5).

[Claim 14]

The apparatus of claim 1, wherein the lifting/lowering unit includes:

15           a first lifting/lowering unit configured to lift the chemical container (2) from the first height to the second height to input the chemical container (2) to be transported to the chemical supply device (5); and

a second lifting/lowering unit configured to lower and discharge the chemical container (2) transported from the chemical supply device (5).

20           [Claim 15]

The apparatus of claim 14, wherein:

the second lifting/lowering unit is provided on a side portion of the first lifting/lowering unit; and

25           the lifting/lowering unit includes a first transport line (100) connected to the first lifting/lowering unit and a second transport line (200) disposed to be parallel and

adjacent to the first transport line (100) and connected to the second lifting/lowering unit.

[Claim 16]

The apparatus of claim 14, wherein:

- 5           a discharge unit that includes a transport member and a transport member driving unit configured to drive the transport member is provided to discharge a used chemical container (2) from the chemical supply device (5); and

            the chemical container (2) is lowered by the second lifting/lowering unit and then discharged via the discharge unit.