

OPENING/CLOSING DEVICE, SCAFFOLD, AND MARINE VESSEL

Technical Field

[0001]

The present invention relates to opening/closing devices, scaffolds, and marine vessels.

This application claims priority based on Japanese Patent Application No. 2015-038252 filed in Japan on February 27, 2015, of which the contents are incorporated herein by reference.

Background Art

[0002]

A marine vessel contains rectangular prismatic cargo tanks in the interior space of the hull for carrying a substance, such as a cryogenic liquid. In such a marine vessel, the interior space of the hull is divided by bulkheads into a plurality of sections in the fore and aft direction to define a plurality of cargo holds in the fore and aft direction. These cargo holds individually contains a cargo tank. That is, the cargo tanks are aligned in the fore and aft direction in the hull.

[0003]

In the above-described marine vessel, clearance between the cargo tanks and the hull and clearance between the cargo tanks and the bulkheads are defined as small as possible to ensure sufficient capacity of the cargo tanks without increasing the size of the hull.

The cargo tanks are provided with thermal insulation on their outer surfaces. The thermal insulation requires regular inspection. Thus, scaffolds for inspection of the thermal insulation are provided around the above-described cargo tanks on the hull and on the bulkheads. The scaffolds are formed extending in the horizontal direction and provided at intervals in the vertical direction. Ladders for a worker to move up and down are provided between the scaffolds. For example, a ladder extending upward from the scaffold disposed uppermost on the bulkhead is connected to an entrance, such as a manhole, disposed in the upper deck.

[0004]

The above-described bulkheads have a so-called plates and beams structure constituted by a plate member and beam members. The plate member is shaped like a plate extending in the vessel width direction and the vertical direction. The beam members protrude toward a side closer to the stern or bow (typically, the stern side) in the fore and aft direction with respect to the plate member and extend in the vertical direction. The beam members have a T-shaped cross section, for example.

The beam members are arranged in the vessel width direction and fixed to the plate member by welding or the like.

[0005]

Patent Document 1 discloses a technology that does not relate to the above-described marine vessels containing cargo tanks. However, Patent Document 1 discloses a technology that provides a scaffold and a ladder for inspection of a hold frame being a structural member of a hold side wall in a bulk carrier.

Citation List

Patent Document

[0006]

Patent Document 1: Japanese Patent No. 4632762B

Summary of Invention

Technical Problems

[0007]

The above-described scaffolds and ladders are often disposed on both the stern side and bow side of the bulkhead.

The scaffolds and ladders disposed on one side, without the protruding beam members, of the stern side and the bow side of the bulkhead are fixed to the plate member. The scaffolds include gaps penetrating vertically through an area where a worker moves up and down the ladder.

The scaffolds disposed on the side without the protruding beam members may have a rescue route for lifting up a worker to the upper deck in an emergency or the like. The rescue route extends in the vertical direction in the cargo hold through the gaps disposed in the scaffolds aligned in the vertical direction. The gaps defining the rescue route are normally closed with hinged permanent stages. A worker can move on the hinged permanent stages.

[0008]

The ladders are disposed in spaces between the plate member and the beam members on one side, with the protruding beam members, of the stern side and the bow side of the bulkhead. The spaces provided with the ladders may be further provided with platforms continuing from the scaffolds and extending toward the plate member to prevent the worker from falling in stepping onto the ladder. These platforms may be configured to be openable/closable with, for example, hinges to ensure the rescue route.

[0009]

With the permanent stages and platforms configured to be openable/closable, it is likely for the worker to forget to close the opening after opening the opening. Thus, the worker is required to always watch his or her step to avoid falling from the gaps. This increases a load on the worker during inspection.

[0010]

An object of the present invention is to provide an opening/closing device, a scaffold, and a marine vessel that can reduce a load on a worker or the like who performs inspection.

Solution to Problem

[0011]

According to a first aspect of the present invention, an opening/closing device closes an opening formed midway along a scaffold. The opening/closing device includes a main portion displaceable between a closed position for closing the opening from above and an open position for opening the opening, the open position being located above the closed position. The opening/closing device further includes a restricting portion extending, when the main portion is in the open position, in a direction intersecting a direction of the ingress to the opening of the user and in a direction along the scaffold to restrict ingress to the opening of the user.

This configuration allows the user to safely move on the main portion when the main portion is in the closed position. When the main portion is in the open position, the restricting portion extends in the direction intersecting a direction of the ingress to the opening of the user and in the direction along the scaffold. Thus, if the user unintentionally attempts the ingress to the opening, for example, the restricting portion comes into contact with the user and allows the user to notice that the main portion is in the open position. This results in a reduction in a load on the user produced by watching his or her step during inspection.

[0012]

According to a second aspect of the present invention, the restricting portion of the opening/closing device according to the first aspect may be provided protruding from a back surface of the main portion.

With this configuration, displacement of the main portion from the closed position to the open position enables such arrangement that the restricting portion protruding from the back surface of the main portion extends in a direction intersecting the direction of the ingress to the opening of the user and in the direction along the scaffold. Thus, the simple configuration can prevent the ingress to the open opening of the user.

[0013]

According to a third aspect of the present invention, the restricting portion of the opening/closing device according to the first or second aspect may be at least partially made from an elastic member.

This configuration allows the restricting portion to be uncaught by elastic deformation even if the restricting portion comes into contact with a surrounding structure in opening of the main portion. Thus, damage to the surrounding structure can be prevented, and the main portion can be open/closed smoothly.

[0014]

According to a fourth aspect of the present invention, the restricting portions of the opening/closing device according to any one of the first to third aspects may be disposed on both sides in an extending direction of the scaffold to interpose the opening therebetween.

This configuration can restrict the ingress of the user even if the user attempts the ingress to the opening from any side in the extending direction of the scaffold extending on both sides of the opening.

[0015]

According to a fifth aspect of the present invention, a scaffold includes: an opening; and the opening/closing device according to any one of the first to fourth aspects, the opening/closing device being capable of opening and closing the opening.

This configuration can close the opening and thus allows the user to move safely. When the opening is open, a rescue route or the like vertically penetrating the scaffold can be readily formed while the ingress to the opening of the user is prevented.

[0016]

According to a sixth aspect of the present invention, a marine vessel includes: a hull provided with a cargo hold formed therein; a bulkhead dividing the cargo hold in a fore and aft direction; and the scaffold according to the fifth aspect, the scaffold being supported by at least the bulkhead.

This configuration eliminates the need for the user to always watch his or her step while moving on the scaffold in inspection of a container structure, such as a cargo tank contained in the cargo hold, from outside. This can reduce a load on the user produced by watching his or her step.

Advantageous Effects of Invention

[0017]

The opening/closing device, scaffold, and marine vessel can reduce a load on a user who performs inspection.

Brief Description of Drawings

[0018]

FIG. 1 illustrates a schematic configuration of a marine vessel according to an embodiment of the present invention.

FIG. 2 is a cross-sectional view of a bulkhead taken along the line II-II in FIG. 1.

FIG. 3 illustrates the bulkhead viewed from the bow side, according to the embodiment of the present invention.

FIG. 4 illustrates the bulkhead viewed from the stern side, according to the embodiment of the present invention.

FIG. 5 is a perspective view of the bulkhead viewed from the bow side, according to the embodiment of the present invention.

FIG. 6 is a perspective view of the bulkhead viewed from the stern side, according to the embodiment of the present invention.

FIG. 7 is a plan view of a movable stage according to the embodiment of the present invention.

FIG. 8 is a side view of the movable stage according to the embodiment of the present invention.

FIG. 9 is a perspective view illustrating the state in which a rescue route is formed according to the embodiment of the present invention.

FIG. 10 is a side view of a first platform according to a first modified example of the embodiment of the present invention.

FIG. 11 is a perspective view of a first scaffold portion according to a second modified example of the embodiment of the present invention.

Description of Embodiments

[0019]

An opening/closing device, a scaffold, and a marine vessel according to one embodiment of the present invention will now be described with reference to the drawings.

FIG. 1 illustrates a schematic configuration of a marine vessel according to the embodiment of the present invention.

The marine vessel 1 in the present embodiment is a liquefied petroleum gas (LPG) carrier that carries LPG. The marine vessel 1 can store LPG in cargo tanks 3. The LPG has a volume reduced through liquefaction by cooling, so that a greater

amount of LPG is carried. Thermal insulation is attached to the outer surfaces of the cargo tanks 3.

[0020]

As illustrated in FIG. 1, the marine vessel 1 includes a hull 2 having a plurality of cargo holds 4 therein. The cargo holds 4 are spaces for containing the cargo tanks 3. The cargo holds 4 are provided in a row in the fore and aft direction. The cargo holds 4 adjacent to each other in the fore and aft direction are partitioned by bulkheads 6 in the fore and aft direction. The cargo holds 4 of the present embodiment are formed below an upper deck 5 of the hull 2. In FIG. 1, the fore and aft direction of the hull 2 is indicated by arrows. An arrow "F" indicates the fore direction, and an arrow "A" indicates the aft direction.

[0021]

FIG. 2 is a cross-sectional view of the bulkhead taken along the line II-II in FIG. 1.

As illustrated in FIG. 2, the bulkhead 6 includes a wall unit 7, a support unit 8, a scaffold unit 9, and a ladder unit 10.

The wall unit 7 includes first wall portions 7A and a second wall portion 7B.

The first wall portions 7A are each shaped like a plate extending in the vessel width direction and the vertical direction.

The second wall portion 7B is shaped like a plate parallel to the first wall portions 7A. The second wall portion 7B is disposed in a position different from those of the first wall portions 7A in the vessel width direction. The second wall portion 7B in the present embodiment is disposed between two first wall portions 7A aligned in the vessel width direction and on the stern side with respect to the first wall portions 7A. In the present embodiment, the distance between the first wall portions 7A and the second wall portion 7B in the fore and aft direction is determined to be equal to the length of first support portions 8A and second support portions 8B, which will be described later, in the fore and aft direction.

[0022]

The support unit 8 is a so-called beam member ensuring rigidity of the bulkhead 6. The support unit 8 includes the first support portions 8A and the second support portions 8B.

[0023]

FIG. 3 illustrates the bulkhead viewed from the bow side, according to the embodiment of the present invention. FIG. 4 illustrates the bulkhead viewed from the stern side, according to the embodiment of the present invention.

As illustrated in FIGS. 2 and 3, the first support portions 8A protrude from wall surfaces 11, facing the stern side, of the first wall portions 7A and are provided

at intervals in the vessel width direction. These first support portions 8A are formed extending along the wall surfaces 11 in the vertical direction. The first support portions 8A each include a main body 13A extending in the fore and aft direction and a tip 14A extending in the vessel width direction, and have a T-shaped cross section. The bases of the main bodies 13A of these first support portions 8A are fixed to the wall surfaces 11 by welding or the like.

[0024]

As illustrated in FIGS. 2 and 4, the second support portions 8B protrude from a wall surface 12, facing the bow side, of the second wall portion 7B and are provided at intervals in the vessel width direction. These second support portions 8B are formed extending along the wall surface 12 in the vertical direction. The second support portions 8B each include a main body 13B extending in the fore and aft direction and a tip 14B extending in the vessel width direction, and have a T-shaped cross section. The bases of the main bodies 13B of these second support portions 8B are fixed to the wall surface 12 by welding or the like. The scaffold unit 9 is omitted in FIGS. 3 and 4 for convenience of illustration in the drawings.

[0025]

In the present embodiment, the above-described second wall portion 7B is connected with the first wall portions 7A through the support unit 8. In the present embodiment, two second support portions 8B, of which the number is sufficiently smaller than the number of the first support portions 8A installed, are provided at intervals in the vessel width direction. Furthermore, the first support portions 8A and second support portions 8B in the present embodiment are provided on a part of the bulkhead 6 in the vertical direction, more specifically, on a part other than a lower part of the bulkhead 6.

[0026]

As illustrated in FIG. 3, wall portions 7C are formed continuing from the second wall portion 7B and surrounding the first support portions 8A from above and below. The wall portions 7C include wall surfaces 16a that face the stern side and are flush with surfaces 17, facing the stern side, of the tips 14A of the first support portions 8A both above and below the first support portions 8A. The wall portions 7C include concave arcuate portions 18 between the first support portions 8A adjacent to each other in the vessel width direction. These arcuate portions 18 form long holes extending in the vertical direction between the tips 14A of the first support portions 8A adjacent to each other in the vessel width direction.

[0027]

As illustrated in FIG. 4, similar to the wall portions 7C, wall portions 7D are formed continuing from the first wall portions 7A and surrounding the second

support portions 8B from above and below. The wall portions 7D include wall surfaces 15a that face the bow side and are flush with surfaces 19, facing the bow side, of the tips 14B of the second support portions 8B both above and below the second support portions 8B. Similar to the wall portions 7C, the wall portions 7D include concave arcuate portions 20 between the second support portions 8B adjacent to each other in the vessel width direction. These arcuate portions 20 also form long holes extending in the vertical direction between the tips 14B of the second support portions 8B adjacent to each other in the vessel width direction.

[0028]

FIG. 5 is a perspective view of the bulkhead viewed from the bow side, according to the embodiment of the present invention. FIG. 6 is a perspective view of the bulkhead viewed from the stern side, according to the embodiment of the present invention.

The scaffold unit 9 is configured so that a worker (user) can walk mainly in the horizontal direction in maintenance, such as inspection of the thermal insulation of the cargo tank 3. The scaffold unit 9 includes first scaffold portions 9A and second scaffold portions 9B.

[0029]

As illustrated in FIGS. 2 and 5, the first scaffold portions 9A are supported by wall surfaces 15, facing the bow side, of the first wall portions 7A and the second support portions 8B. The first scaffold portions 9A are each shaped like a plate long in the vessel width direction and provided protruding horizontally from the first wall portions 7A toward the bow side. The first scaffold portions 9A are provided at predetermined intervals in the vertical direction, that is, in the height direction of the cargo holds 4.

[0030]

As illustrated in FIGS. 2 and 6, the second scaffold portions 9B and the above-described first scaffold portions 9A are provided symmetrically in the fore and aft direction. The second scaffold portions 9B are supported by a wall surface 16 (see FIG. 2), facing the stern side, of the second wall portion 7B and the first support portions 8A. Similar to the first scaffold portions 9A, the second scaffold portions 9B are each shaped like a plate long in the vessel width direction and provided protruding horizontally from the second wall portion 7B toward the stern side. The second scaffold portions 9B are provided at intervals in the vertical direction, that is, in the height direction of the cargo holds 4.

[0031]

These first scaffold portions 9A and second scaffold portions 9B have a width dimension W1 (of approximately 400 mm, for example) determined so that

the worker can move on foot thereon and that the dimension in the fore and aft direction is as small as possible. A small clearance (of approximately 200 mm, for example) in the horizontal direction is ensured between each of the first scaffold portions 9A and second scaffold portions 9B and the cargo tank 3 in the cargo hold 4 where the first scaffold portions 9A and second scaffold portions 9B are installed.

[0032]

The above-described cargo holds 4 include side scaffold portions (not illustrated). The side scaffold portions are fixed to the inner surfaces (not illustrated) of both side walls, extending between the bulkheads 6 adjacent to each other in the fore and aft direction, of the hull 2. The side scaffold portions are each shaped like a plate continuing from the first scaffold portion 9A disposed on the stern side and the second scaffold portion 9B disposed on the bow side in each of the cargo holds 4. The side scaffold portions are provided at intervals in the vertical direction and each extend between the first scaffold portion 9A and the second scaffold portion 9B disposed at the same height. That is, the worker can go around the periphery of the cargo tank 3 by moving on the first scaffold portion 9A, side scaffold portions, and second scaffold portion 9B disposed at the same height.

[0033]

As illustrated in FIGS. 2, 5, and 6, the ladder unit 10 includes first ladder portions 10A and second ladder portions 10B.

As illustrated in FIG. 5, the first ladder portions 10A are provided between the first scaffold portions 9A and the wall surface 12, facing the bow side, of the second wall portion 7B and extend in the vertical direction. The first ladder portions 10A in the present embodiment extend between the first scaffold portions 9A adjacent to each other in the vertical direction so that the worker can move between the first scaffold portions 9A adjacent to each other in the vertical direction. These first ladder portions 10A are each fixed to the main body 13B of the second support portion 8B or the main body 13A of the first support portion 8A adjacent to the second support portion 8B in the vessel width direction, between the first scaffold portions 9A and the wall surface 12, facing the bow side, of the second wall portion 7B.

[0034]

The first ladder portions 10A adjacent to each other in the vertical direction are arranged in mutually different positions in the vessel width direction, in which the first scaffold portions 9A extend. Two neighboring ladder portions 10A in the vertical direction among the first ladder portions 10A in the present embodiment are arranged in the same position in the vessel width direction, in which the first scaffold portions 9A extend. The first ladder portion 10A disposed uppermost

among the first ladder portions 10A in the present embodiment is connected to an opening (not illustrated) formed in the upper deck 5. The worker can go down the first ladder portion 10A from the upper deck 5 through the opening to move onto the first scaffold portion 9A disposed uppermost.

[0035]

As illustrated in FIG. 6, the second ladder portions 10B are provided between the second scaffold portions 9B and the wall surface 11, facing the stern side, of the first wall portion 7A and extend in the vertical direction. Similar to the first ladder portions 10A, the second ladder portions 10B in the present embodiment extend between the second scaffold portions 9B adjacent to each other in the vertical direction so that the worker can move between the second scaffold portions 9B adjacent to each other in the vertical direction. These second ladder portions 10B are each fixed to the main body 13A of the first support portion 8A between the second scaffold portions 9B and the wall surface 11, facing the stern side, of the first wall portion 7A.

[0036]

Similar to the first ladder portions 10A, the second ladder portions 10B adjacent to each other in the vertical direction are arranged in mutually different positions in the vessel width direction, in which the second scaffold portions 9B extend. Two neighboring ladder portions in the vertical direction among the second ladder portions 10B in the present embodiment are arranged in the same position in the vessel width direction, in which the second scaffold portions 9B extend. Furthermore, the second ladder portion 10B disposed uppermost among the second ladder portions 10B in the present embodiment is connected to an opening (not illustrated) formed in the upper deck 5. The worker can go down the second ladder portion 10B from the upper deck 5 through the opening to move onto the second scaffold portion 9B disposed uppermost.

[0037]

The above-described openings formed in the upper deck 5 may be formed individually for the first ladder portion 10A and the second ladder portion 10B, or an opening may be common to both ladder portions. The above-described embodiment has exemplified the configuration in which the first ladder portions 10A are all installed in the same orientation in the vessel width direction with respect to the first support portions 8A and similarly, the second ladder portions 10B are all installed in the same orientation in the vessel width direction with respect to the second support portions 8B. However, the first ladder portions 10A and second ladder portions 10B may be installed in orientations different than the above-described orientations.

[0038]

As illustrated in FIG. 5, first platforms 22 are provided between sections of the first scaffold portions 9A, in the vicinities of which the first ladder portions 10A are disposed, and the wall surface 12, facing the bow side, of the second wall portion 7B. These first platforms 22 are each shaped like a plate continuing from the first scaffold portion 9A. The first platform 22 extends from the first scaffold portion 9A toward the side closer to the second wall portion 7B, in other words, the side closer to the stern. The first platform 22 vertically closes at least part of the space in which the lower portion of each of the first ladder portions 10A is positioned, in other words, the space (opening) defined by two second support portions 8B adjacent to each other in the vessel width direction, the second wall portion 7B, and a first scaffold portion 9A. The worker who uses the first ladder portion 10A can stand on the first platform 22. This configuration allows the worker to readily move between the first scaffold portion 9A and the first ladder portion 10A.

[0039]

As illustrated in FIG. 6, second platforms 23 are provided between sections of the second scaffold portions 9B, in the vicinities of which the second ladder portions 10B are disposed, and the wall surface 11, facing the stern side, of the first wall portion 7A. These second platforms 23 are each shaped like a plate continuing from the second scaffold portion 9B. The second platform 23 extends from the second scaffold portion 9B toward the side closer to the first wall portion 7A, in other words, the side closer to the bow. The second platform 23 vertically closes at least part of the space in which the lower portion of each of the second ladder portions 10B is positioned, in other words, the space defined by two first support portions 8A adjacent to each other in the vessel width direction, the first wall portion 7A, and a second scaffold portion 9B. Similar to the first platform 22, the worker who uses the second ladder portion 10B can stand on the second platform 23. This configuration allows the worker to readily move between the second scaffold portion 9B and the second ladder portion 10B.

[0040]

Handrails, which are not illustrated, extend in the vessel width direction above the first scaffold portions 9A and are fixed to the second support portions 8B. The handrails are disposed in sections except where the first platforms 22 are disposed in the vessel width direction. Similarly, handrails, which are not illustrated, extend in the vessel width direction above the second scaffold portions 9B and are fixed to the first support portions 8A. The handrails are disposed in sections except where the second platforms 23 are disposed in the vessel width direction.

[0041]

As illustrated in FIG. 2, the first scaffold portions 9A in the present embodiment include movable stages 24 (opening/closing devices). The movable stages 24 are provided in the respective first scaffold portions 9A provided at intervals in the vertical direction. These movable stages 24 provided in the first scaffold portions 9A are arranged in the same position in the vessel width direction, in other words, in positions overlapping each other in the vertical direction.

[0042]

FIG. 7 is a plan view of the movable stage according to the embodiment of the present invention. FIG. 8 is a side view of the movable stage according to the embodiment of the present invention.

As illustrated in FIG. 7, the movable stage 24 is disposed at a gap portion (opening) 25 formed in the first scaffold portion 9A. The movable stage 24 includes a stage main portion 26, base portions 27, and handle portions 28.

[0043]

The stage main portion 26 is shaped like a rectangular plate capable of closing the gap portion 25 formed in the first scaffold portion 9A. The stage main portion 26 is attached to the base portions 27 with hinge portions 29 at a side 26a, closer to the first wall portion 7A, of the stage main portion 26. The stage main portion 26 can be controlled, through the hinge portions 29, so as to be in an open position where the gap portion 25 is open and in a closed position where the gap portion 25 is closed.

[0044]

The base portions 27 support the stage main portion 26 from below. The base portions 27 extend from the first wall portion 7A toward the bow side along edges 25a of the gap portion 25 in the vessel width direction. The base portions 27 in the present embodiment are arranged over sides 26b, in the vessel width direction, of the stage main portion 26 in the closed position and the edges 25a, facing the sides 26b, of the gap portion 25. The base portions 27 support sections, in the vicinities of the sides 26b, of the stage main portion 26 and sections, in the vicinities of the edges 25a, of the first scaffold portion 9A from below. Ends 27a on the bow side of the base portions 27 in the present embodiment is arranged closer to the stern side than end edges 9a on the bow side of the first scaffold portion 9A.

[0045]

The handle portions 28 are gripped by the worker when the stage main portion 26 is swung from the closed position to the open position and from the open position to the closed position. The handle portions 28 in the present embodiment are fixed to the stage main portion 26 and protrude from a side 26c on the bow side

of the stage main portion 26 toward the bow side. More specifically, the handle portions 28 are attached to both sides of each stage main portion 26 in the vessel width direction in which the first scaffold portion 9A extends. The handle portions 28 in the present embodiment are formed into a U shape. The ends of the U shapes of the handle portions 28 are fixed to the stage main portion 26.

[0046]

The above-described movable stage 24 further includes restricting portions 30 restricting ingress to the gap portion 25 side of the worker. The restricting portions 30 in the present embodiment include restricting bars 31. When the stage main portion 26 is in the open position, the restricting bars 31 extend in a direction intersecting the direction of the ingress to the gap portion 25 of the worker and in the fore direction along the first scaffold portion 9A. In the present embodiment, the direction of the ingress to the gap portion 25 of the worker refers to the extending direction of the first scaffold portion 9A in which the worker mainly moves (the vessel width direction). The restricting bars 31 may have outer surfaces with a pattern of yellow and black stripes to urge the worker to pay attention.

[0047]

The restricting bars 31 in the present embodiment are shaped like a cylinder and attached to a back surface 32 (see FIG. 8) of the stage main portion 26. More specifically, bases 31a of the restricting bars 31 are fixed in the vicinities of two corners 26d formed by the sides 26b and side 26c on the back surface 32 of the stage main portion 26. That is, the two restricting bars 31 are provided so as to interpose the gap portion 25 therebetween from both sides in the extending direction of the scaffold unit 9. These restricting bars 31 extend in a direction substantially perpendicular to the back surface 32 of the stage main portion 26. Ends 31b of the restricting bars 31 pass the circular arc, indicated by the long dashed double-short dashed line in FIG. 8, about the hinge portions 29 when the movable stage 24 is open/closed. The restricting bars 31 have a length determined so that the circular arc indicated by the long dashed double-short dashed line being the path of the above-described ends 31b does not come into contact with the outer surface of the cargo tank 3.

[0048]

The restricting bars 31 can be made from metal, resin, or the like. Elastic members, such as rubber, that are readily elastic-deformed may be provided on the end 31b sides of the restricting bars 31. The restricting bars 31 provided with such elastic members are advantageous in that the elastic members prevent damage to the outer surface of the cargo tank 3 even if the restricting bars 31 are long enough to come into contact with the cargo tank 3. The major portions other than the bases

31a or the entire portions including the bases 31a of the restricting bars 31 may be made from elastic members. This configuration can reduce breakage of the restricting bars 31.

[0049]

Thus, according to the above-described embodiment, when the stage main portion 26 is in the closed position, the worker can safely move on the stage main portion 26. When the stage main portion 26 is in the open position, the restricting portions 30 extend in the direction intersecting the direction of the ingress to the gap portion 25 side and the direction along the first scaffold portion 9A. Thus, if the worker unintentionally attempts the ingress to the gap portion 25 side, for example, the restricting portions 30 come into contact with the worker and allow the worker to notice that the stage main portion 26 is in the open position. This results in a reduction in a load on the worker produced by watching his or her step during inspection.

[0050]

Furthermore, since the restricting bars 31 protrude from the back surface 32 of the stage main portion 26, only displacement of the stage main portion 26 from the closed position to the open position enables such arrangement that the restricting bars 31 protruding from the back surface 32 of the stage main portion 26 intersect the direction of the ingress to the gap portion 25 of the worker and extend in the direction along the first scaffold portion 9A. Thus, the simple configuration can prevent the ingress to the gap portion 25 of the worker when the gap portion 25 is open.

Furthermore, when the stage main portion 26 is in the closed position, the restricting bars 31 are positioned below the scaffold unit 9, and thus the restricting portions 30 do not hinder the worker from moving.

[0051]

Furthermore, the elastic members provided on the end 31b sides of the restricting bars 31 allow the restricting bars 31 to be uncaught by elastic deformation even if the restricting bars 31 come into contact with a surrounding structure in opening/closing of the stage main portion 26. Thus, damage to the surrounding structure can be prevented, and the stage main portion 26 can be open/closed smoothly.

[0052]

Furthermore, the restricting bars 31 fixed in the vicinities of the two corners 26d formed by the sides 26b and side 26c of the stage main portion 26 can restrict the ingress of the worker even if the worker attempts the ingress to the gap portion 25 side from any side in the extending direction of the first scaffold portion 9A.

[0053]

FIG. 9 is a perspective view illustrating the state in which a rescue route is formed according to the embodiment of the present invention.

With the scaffold unit 9 according to the above-described embodiment, the worker can safely move with the gap portions 25 closed by the movable stages 24. As illustrated in FIG. 9, when the gap portions 25 are open, the rescue route vertically penetrating the scaffold unit 9 can be readily formed while the ingress to the gap portion 25 side of the worker is prevented.

[0054]

In the marine vessel according to the above-described embodiment, the worker who inspects container structures, such as the cargo tanks 3 contained in the cargo holds 4, from outside is not required to always watch his or her step while moving on the scaffold unit 9. This can reduce a load on the worker produced by watching his or her step.

[0055]

First Modified Example of Embodiment

An opening/closing device, a scaffold, and a marine vessel according to a first modified example of the embodiment of the present invention will now be described with reference to the drawings. The first modified example of the embodiment differs from the above-described embodiment in the arrangement of the restricting portions only. Thus, the same parts as the above-described embodiment will be described using the same reference signs with reference to FIGS. 5 and 6, and overlapping descriptions will be omitted.

[0056]

As illustrated in FIG. 5, first platforms 22 disposed in predetermined positions in the vessel width direction among the first platforms 22 are each provided so as to be swung upward through hinges or the like. That is, opening all the first platforms 22 by swinging them upward can form a rescue route penetrating in the vertical direction between the second support portions 8B. This rescue route reaches the bottom of the cargo hold 4 through the inside of the bulkhead 6, which is not illustrated. A worker who is in poor physical condition in the cargo hold 4, for example, can be quickly lifted up through the rescue route from the bottom of the cargo hold 4 to the upper deck 5 with a rope or the like.

[0057]

As illustrated in FIG. 6, similar to the first platforms 22, second platforms 23 disposed in predetermined positions in the vessel width direction among the second platforms 23 are each provided so as to be swung upward through hinges or the like. That is, opening all the swingable second platforms 23 by swinging the second

platforms 23 upward can form a rescue route penetrating in the vertical direction between the first support portions 8A. The first platforms 22 and second platforms 23 differ from each other in the arrangement only. Thus, the first platforms 22 will be described below, whereas descriptions of the second platforms 23 will be omitted. [0058]

FIG. 10 is a side view of the first platform according to the first modified example of the embodiment of the present invention.

As illustrated in FIG. 10, the first platform 22 includes a platform main portion 126, base portions (not illustrated), and handle portions 128. [0059]

The platform main portion 126 is shaped like a rectangular plate capable of closing, in the horizontal direction, a space between the first scaffold portion 9A and the wall surface 12, facing the bow side, of the second wall portion 7B. The platform main portion 126 is attached to the base portions with hinge portions 129, at a base 126a, closer to the first ladder portion 10A, of the platform main portion 126. The platform main portion 126 can be controlled, through the hinge portions 129, so as to be in an open position where the space between the first scaffold portion 9A and the wall surface 12, facing the bow side, of the second wall portion 7B is open and in a closed position where the space between the first scaffold portion 9A and the wall surface 12, facing the bow side, of the second wall portion 7B is closed. Similar to the base portions 27 of the movable stage 24, the base portions (not illustrated) support the platform main portion 126 from below. [0060]

The handle portions 128 are gripped by the worker when the platform main portion 126 is swung from the closed position to the open position and from the open position to the closed position. The handle portions 128 in the present embodiment are fixed to the platform main portion 126. The handle portions 128 protrude from an end 126b of the platform main portion 126 in the vessel width direction, in which the first scaffold portion 9A extends. The handle portions 128 are attached to an end 126b of each platform main portion 126 at intervals in the fore and aft direction. Similar to the above-described handle portions 28, the handle portions 128 in the present embodiment are formed into a U shape. The ends of the U shapes of the handle portions 128 are fixed to the platform main portion 126. [0061]

Similar to the above-described movable stage 24, the first platform 22 includes restricting portions 130 restricting ingress of the worker to the space between the first scaffold portion 9A and the wall surface 12, facing the bow side, of the second wall portion 7B. The restricting portions 130 include restricting bars

131. When the platform main portion 126 is in the open position, the restricting bars 131 extend in a direction intersecting the fore and aft direction and in the vessel width direction along the first scaffold portion 9A. The fore and aft direction is, in other words, the direction of the ingress of the worker to the space between the first scaffold portion 9A and the wall surface 12, facing the bow side, of the second wall portion 7B. Similar to the above-described restricting bars 31, the restricting bars 131 may have outer surfaces with a pattern of yellow and black stripes to urge the worker to pay attention.

[0062]

The restricting bars 131 are shaped like a cylinder and attached to a back surface 132 of the platform main portion 126. These restricting bars 131 extend in a direction substantially perpendicular to the back surface 132 of the platform main portion 126. Ends 131b of the restricting bars 131 pass the circular arc, indicated by the long dashed double-short dashed line in FIG. 10, about the hinge portions 129 when the first platform 22 is open/closed. The restricting bars 131 have a length determined so that the circular arc indicated by the long dashed double-short dashed line being the path of the above-described ends 131b does not come into contact with the main body 13B of the second support portion 8B.

[0063]

Similar to the above-described restricting bars 31, the restricting bars 131 can be made from metal, resin, or the like. Elastic members, such as rubber, that are readily elastic-deformed may be provided on the end 131b sides of the restricting bars 131. The restricting bars 131 provided with such elastic members can prevent damage to the second support portion 8B even if the restricting bars 131 are long enough to come into contact with the second support portion 8B. The major portions other than bases 131a or the entire portions including the bases 131a of the restricting bars 131 may also be made from elastic members. This configuration can reduce breakage of the restricting bars 131.

[0064]

Thus, according to the first modified example of the above-described embodiment, especially when the platform main portion 126 is in the closed position, the worker can step on the platform main portion 126 and safely move onto the first ladder portion 10A.

When the platform main portion 126 is in the open position, the restricting portions 130 extend in the direction intersecting the direction of the ingress of the worker and in the direction along the first scaffold portion 9A. Thus, if the worker unintentionally attempts the ingress to the space between the first scaffold portion 9A and the wall surface 12, facing the bow side, of the second wall portion 7B in an

area where no handrail is provided, for example, the restricting portions 30 come into contact with the worker and can thus prevent the ingress of the worker.

[0065]

Second Modified Example of Embodiment

An opening/closing device, a scaffold, and a marine vessel according to a second modified example of the embodiment of the present invention will now be described with reference to the drawings. The second modified example of the embodiment differs from the above-described embodiment in the support structure of the restricting portions only. Thus, the same parts as the above-described embodiment will be described using the same reference signs, and overlapping descriptions will be omitted.

FIG. 11 is a perspective view of a first scaffold portion according to the second modified example of the embodiment of the present invention.

As illustrated in FIG. 11, similar to the above-described embodiment, the first scaffold portion 9A in the second modified example includes the movable stage 24 (opening/closing device).

[0066]

The movable stage 24 is disposed at the gap portion (opening) 25 formed in the first scaffold portion 9A. Similar to the above-described embodiment, the movable stage 24 includes the stage main portion 26, the base portions 27, the handle portions 28, and the restricting portions 30.

[0067]

The restricting portions 30 in the second modified example include the restricting bars 31, support portions 33, and urging portions 34.

Similar to the above-described embodiment, two restricting bars 31 are provided in the second modified example. Similar to the above-described embodiment, when the stage main portion 26 is in the open position, the restricting bars 31 can be in a restricting position for restricting ingress to the gap portion 25 side of the worker. The restricting bars 31 in the restricting position extend in the direction intersecting the direction of the ingress to the gap portion 25 of the worker and in the fore direction along the first scaffold portion 9A.

[0068]

The support portions 33 support the restricting bars 31 in such a manner that the restricting bars 31 can swing vertically between the restricting position (indicated by the solid lines in FIG. 11) and a withdrawn position (indicated by the long dashed double-short dashed lines in FIG. 11). The withdrawn position refers to a position in which the restricting bars 31 are swung downward from the above-described restricting position. These support portions 33 include swing

shafts 33a extending in the direction intersecting the direction of the ingress of the worker, that is, in the vessel width direction. The support portions 33 are fixed to the back surface 32 of the stage main portion 26. The restricting bars 31 are supported by the support portions 33 to be allowed to swing in the vertical direction. Displacement of the support portions 33 in the direction of the ingress to the gap portion 25 of the worker (in other words, the vessel width direction) is restricted.

[0069]

The urging portions 34 urge the restricting bars 31 to move to the restricting position between the above-described withdrawn position and the restricting position. The urging portions 34 in the present embodiment are attached so as to extend between the restricting bars 31 and the back surface 32 of the stage main portion 26. The urging portions 34 may be any elastic body that can urge the restricting bars 31 to move to the restricting position and are not limited to coil springs illustrated in FIG. 11.

[0070]

The movable stage 24 having this configuration allows the restricting bars 31 to be uncaught by swinging to the withdrawn position against the urging force of the urging portions 34 in opening of the movable stage 24 even if the restricting bars 31 are long enough to come into contact with the cargo tank 3 in opening of the movable stage 24. Thus, damage to the outer surface of the cargo tank 3 can be prevented, and breakage of the restricting bars 31 can be reduced. Furthermore, after the restricting bars 31 are uncaught by swinging to the withdrawn position, the restricting bars 31 automatically return to the restricting position. This can prevent a human error, such as forgetting to return the restricting bar to the restricting position, in comparison with the case in which the restricting bars 31 are manually displaced to the restricting position. Furthermore, a swing of the restricting bars 31 in the direction of the ingress to the gap portion 25 side of the worker is restricted, resulting in more effective prevention of the ingress to the gap portion 25 side of the worker.

[0071]

The present invention is not limited to the above-described embodiments, and includes the above-described embodiments with various modifications added thereto without deviating from the spirit of the present invention. That is, specific shapes, configurations, and the like in the embodiments are merely examples and may be appropriately modified.

[0072]

For example, the above-described embodiments have exemplified the cases in which the restricting bars 31, 131 protrude from the respective back surfaces 32,

132 of the stage main portions 26 and the platform main portions 126. However, the restricting bars 31, 131 may protrude from any position in which the ingress of the worker can be restricted, other than the back surfaces 32, 132. For example, the restricting bars 31, 131 may be disposed adjacent to the first platforms 22, second platforms 23, and movable stages 24 and swung in synchronization with opening/closing of the first platforms 22, second platforms 23, and movable stages 24. Furthermore, the restricting bars 31, 131 may be displaced by motion other than swing in synchronization with opening/closing of the first platforms 22, second platforms 23, and movable stages 24.

[0073]

Furthermore, the shape of the restricting bars 31, 131 is not limited to the above-described embodiments. The restricting bars 31, 131 are only required to extend in a direction intersecting the direction of the ingress of the worker and in the direction along the scaffold unit 9 when the first platforms 22, second platforms 23, and movable stages 24 are in the open position.

[0074]

The above-described embodiments have described the cases in which the opening/closing device and scaffold of the present invention are applied to the marine vessel 1. However, no such limitation is intended, and the opening/closing device and scaffold may be applied to an object other than the marine vessel, for example.

[0075]

An LPG carrier has been exemplified as the marine vessel 1 in the above-described embodiments. However, the marine vessel 1 may store and carry a substance other than LPG in the cargo tanks 3. Furthermore, such a substance is not limited to a low-temperature liquid, such as LPG. The present invention may also be applied to, for example, a marine vessel carrying a high-temperature substance, such as asphalt.

Industrial Applicability

[0076]

The present invention can be applied to an opening/closing device closing an opening formed midway along a scaffold, a scaffold including the opening/closing device, and a marine vessel including the scaffold. The opening/closing device, scaffold, and marine vessel can reduce a load on a user who performs inspection.

Reference Signs List

[0077]

- 1 Marine vessel
- 2 Hull
- 3 Cargo tank
- 4 Cargo hold
- 5 Upper deck
- 6 Bulkhead
- 7 Wall unit
- 7A First wall portion
- 7B Second wall portion
- 8 Support unit
- 8A First support portion
- 8B Second support portion
- 9 Scaffold unit (Scaffold)
- 9A First scaffold portion
- 9a End edge
- 9B Second scaffold portion
- 10 Ladder unit
- 10A First ladder portion
- 10B Second ladder portion
- 11 Wall surface
- 12 Wall surface
- 13A Main body
- 13B Main body
- 14A Tip
- 14B Tip
- 15 Wall surface
- 15a Wall surface
- 16 Wall surface
- 16a Wall surface
- 17 Surface
- 18 Arcuate portion
- 19 Surface
- 20 Arcuate portion
- 22 First platform (Opening/closing device)
- 23 Second platform (Opening/closing device)
- 24 Movable stage (Opening/closing device)
- 25 Gap portion (Opening)
- 25a Edge

26 Stage main portion (Main portion)

26a Side

26b Side

27 Base portion

27a End

28 Handle portion

29 Hinge portion

30 Restricting portion

31 Restricting bar

31a Base

31b End

32 Back surface

33 Support portion

34 Urging portion

126 Platform main portion (Main portion)

126a Base

126b End

128 Handle portion

129 Hinge portion

130 Restricting portion

131 Restricting bar

131a Base

131b End

132 Back surface

Claims

[Claim 1]

An opening/closing device configured to close an opening formed midway along a scaffold, the opening/closing device comprising:

a main portion displaceable between a closed position for closing the opening from above and an open position for opening the opening, the open position being located above the closed position; and

upon the main portion being in the open position, a restricting portion extending in a direction intersecting a direction of ingress to the opening of a user and in a direction along the scaffold to restrict ingress to the opening of the user,

wherein the restricting portion is provided protruding from a back surface of the main portion.

[Claim 2]

The opening/closing device according to claim 1, wherein the restricting portion is at least partially made from an elastic member.

[Claim 3]

The opening/closing device according to claim 1, wherein the restricting portions are disposed on both sides in an extending direction of the scaffold to interpose the opening therebetween.

[Claim 4]

A scaffold comprising:

an opening; and

the opening/closing device according to any one of claims 1 to 3, the opening/closing device being capable of opening and closing the opening.

[Claim 5]

A marine vessel comprising:

a hull provided with a cargo hold formed therein;

a bulkhead dividing the cargo hold in a fore and aft direction; and

the scaffold according to claim 4, the scaffold being supported by at least the bulkhead.