DESCRIPTION

VESSEL STRUCTURE

Technical Field

[0001]

The present invention relates to vessel structures including ballast-water treatment apparatuses for treating vessels' ballast water to, for example, eliminate or kill microorganisms contained therein.

Background Art

[0002]

Vessels' ballast water, essential for safety vessel navigation, is seawater or freshwater loaded into ballast tanks to control the attitude of the hull and ensure its stability. The ballast water is pumped and loaded (taken up) into the ballast tanks when the vessel is empty of cargo and is discharged (released) at a loading port as the loading proceeds.

The ballast water, described above, contains various species of microorganisms (aquatic organisms). These microorganisms include minute organisms (e.g., microorganisms such as bacteria and suspended organisms such as plankton), as well as, for example, fish eggs and larvae.

[0003]

Because the ballast water is released at a port (body of water) different from the loading point, the microorganisms transferred together with the ballast water, if they settle in the new environment, might affect the ecosystem of that body of water and economic activities such as fishery. Some of the pathogens transferred together with the ballast water might directly affect human health.

Accordingly, the International Maritime Organization (IMO) is calling for the ratification of a convention concerning the management of microorganisms contained in ballast water, which calls for eliminating or killing microorganisms when ballast water is taken up or released.

[0004]

An apparatus proposed for eliminating or killing microorganisms in ballast water is a liquid-borne-microorganism killing apparatus that passes ballast water through a slit plate provided in a flow channel at a predetermined flow rate or more to destroy and kill liquid-borne microorganisms by means of a shearing phenomenon (abrupt difference in flow rate between different sites) occurring inside the flow disturbed through the slit. Another liquid-borne-microorganism killing apparatus has been proposed that includes front and back slit plates with a shift in slit position that allows microorganisms surviving the shearing

through the front slit plate to be destroyed and killed by means of an impact pressure caused when cavitation bubbles produced by the front slit plate collapse on the back slit plate (see, for example, Patent Document 1).

Patent Document 1:

Japanese Unexamined Patent Application, Publication No. 2003-200156

Disclosure of Invention

[0005]

The above ballast-water treatment apparatuses are required to have high throughputs (e.g., about 7,000 m^3/hr for large oil tankers) because they treat ballast water taken up or released substantially at the same time as cargo handling proceeds. Accordingly, there is a tendency to increase the size of the ballast-water treatment apparatuses themselves, and it is difficult to secure an appropriate installation site for such ballast-water treatment apparatuses in a vessel for the following reasons.

[0006]

(1) It is preferable to install a ballast-water treatment apparatus inboard, rather than outboard, such as on the deck, in view of corrosion resistance against ocean waves and wind and rain in a marine environment because the apparatus is

required to reach a high treatment level involving the use of, for example, electricity or chemicals.

(2) If the ballast-water treatment apparatus is installed inboard, it is desirable to install the apparatus at the bow or stern, rather than in the midship section, in view of, for example, ensuring sufficient cargo-loading capacity and the presence of a hazardous section loaded with combustible cargo.

(3) In a typical vessel design, equipment such as a ballast pump is installed in an engine room at the stern. If the ballast-water treatment apparatus is installed at the bow, therefore, extended piping is needed from an intake port provided near the ballast pump at the stern to the bow.

[0007]

Therefore, there is a demand for a vessel structure that allows a ballast-water treatment apparatus, which will become mandatory, to be installed without the need for a substantial change in hull design and that can readily be applied not only to newly built vessels, but also to existing vessels with some adaptation. That is, there is a demand for a vessel structure that allows many different types of ballast-water treatment apparatuses to be readily installed at an appropriate inboard site in many different types of vessels (particularly, commercial vessels) such as tankers (e.g., LPG carriers, LNG carriers, and oil carriers), cargo ships (e.g., container ships, roll-on/roll-off ships, and general cargo ships), and

specialized vessels (bulk carriers, ore carriers, and car carriers) irrespective of whether they are installed in newly built vessels or existing vessels.

An object of the present invention, which has been made in light of the above circumstances, is to provide a vessel structure that allows many different types of ballast-water treatment apparatuses to be readily installed at an appropriate inboard site in many different types of vessels.

[0008]

To solve the above problems, the present invention employs the following solutions.

A vessel structure according to the present invention includes a ballast-water treatment apparatus for treating ballast water to eliminate or kill microorganisms therein when the ballast water is taken up or released. The ballast-water treatment apparatus is disposed in a steering gear room at the rear of the vessel.

[0009]

Because the ballast-water treatment apparatus is disposed in the steering gear room at the rear of the vessel, this vessel structure allows various ballast-water treatment apparatuses to be readily installed while effectively utilizing the inner space of the vessel without a substantial change in hull structure and shape.

[0010]

In the above vessel structure, the ballast-water treatment apparatus is preferably disposed on a deck provided in an inner space of the steering gear room. This allows various ballast-water treatment apparatuses to be installed while utilizing the inner space of the steering gear room more effectively, that is, utilizing the space effectively in three dimensions.

[0011]

In the above vessel structure, a stern void space such as an aft peak tank is preferably used as a buffer tank of the ballast-water treatment apparatus. This eliminates the need to newly install a buffer tank for a ballast-water treatment apparatus of a type requiring a buffer tank.

[0012]

The above vessel structure of the present invention allows a ballast-water treatment apparatus, which will become mandatory, to be installed without the need for a substantial change in hull design and shape and, additionally, allows many different types of ballast-water treatment apparatuses to be readily installed in many different types of vessels irrespective of whether they are installed in newly built vessels or in existing vessels with some adaptation.

Brief Description of Drawings

[0013]

[FIG. 1] Fig. 1 is an enlarged view of a stern section of a vessel including a ballast-water treatment apparatus as an embodiment of a vessel structure according to the present invention.

[FIG. 2] Fig. 2 is an intake system diagram of the ballast-water treatment apparatus.

[FIG. 3] Fig. 3 is a release system diagram of the ballast-water treatment apparatus.

[FIG. 4] Fig. 4 is a diagram showing an example of the overall configuration of an LNG carrier as an example of a vessel structure.

Explanation of Reference Signs:

[0014]

1: LNG carrier

4: stern section

6: ballast tank

7: accommodation area

8: engine room

9: steering gear room

10: void

12: intake port

12': buffer-tank intake port

13: ballast pump

13': treated-water transfer pump

14: ballast-water piping system

15: treatment-apparatus inlet piping system (including treatment-apparatus vessel connect piping)

16: treatment-apparatus outlet piping system

16': treated-water transfer piping system

17: release port

20: ballast-water treatment apparatus

30: deck

40: draft line

Best Mode for Carrying Out the Invention

[0015]

An embodiment of a vessel structure according to the present invention will now be described with reference to the drawings.

Fig. 4 is a diagram showing the hull structure of an LNG carrier 1 as an example of a vessel structure. This LNG carrier 1 is divided into a bow section 2, a midship section 3, and a stern section 4 in this order from the front of the hull.

The bow section 2 is a section positioned in the front of the LNG carrier 1 in the sailing direction and including, for example, a bow-section store. The midship section 3, disposed behind the bow section 2, has a plurality of (three in the example shown) LNG tanks 5 arranged along the hull axis. The midship section 3 also has a plurality of separated ballast

tanks 6 provided in spaces formed around the bottom of the spherical LNG tanks 5 to the left and right of the hull.

[0016]

As shown in Fig. 1, for example, the stern section 4, disposed behind the midship section 3, includes an accommodation area 7, an engine room 8, a steering gear room 9, and a void 10. In the drawing, reference sign 11 indicates a propeller for vessel propulsion provided at the stern of the LNG carrier 1.

The accommodation area 7 is a space disposed above the front of the stern section 4 and including, for example, a wheelhouse and a crew compartment of the LNG carrier 1.

The engine room 8 is a space disposed below the accommodation area 7 and accommodating various machinery and equipment such as an engine serving as a driving source for the propeller 11 and power generation equipment for generating power used in the LNG carrier 1.

The steering gear room 9 is a space disposed behind the top of the engine room 8 and accommodating, for example, machinery and equipment (steering gear) for driving a rudder (not shown) of the LNG carrier 1.

The void 10, a space formed below or in front of the steering gear room 9, is a narrow space because the vessel width is narrowed at the bottom of the stern section 4. The void 10 is optionally used as, for example, an installation space for

an aft peak tank.

[0017]

A ballast-water treatment apparatus 20 is disposed at an appropriate site in the above LNG carrier 1. The ballast-water treatment apparatus 20 is an apparatus for eliminating or killing various species of microorganisms contained in ballast water loaded into the ballast tanks 6 to control the attitude of the hull and ensure its stability. That is, the ballast-water treatment apparatus 20 is an apparatus in which ballast water, which is taken up into the ballast tanks 6 depending on, for example, the loading conditions and which is released as the amount of cargo loaded is increased, is treated when taken up or released so that it can be released with microorganisms contained therein eliminated or killed, thereby preventing microorganisms inhabiting the vicinity of a port where the water is taken up from being released into another body of water and thus affecting its ecosystem.

[0018]

The above ballast-water treatment apparatus 20 is disposed in the steering gear room 9 of the stern section 4, which forms the rear of the vessel.

The ballast-water treatment apparatus 20 shown in Fig. 1 includes a first treatment unit 21 and a second treatment unit 22. In this case, the first treatment unit 21 and the second treatment unit 22 are a pair of units into which the necessary

treatment capability is divided, and both units are disposed in the steering gear room 9. The type of ballast-water treatment apparatus 20 is not limited to the configuration in which it is divided into the first treatment unit 21 and the second treatment unit 22, and it may be appropriately changed depending on the type of treatment and various conditions.

[0019]

In Fig. 1, reference sign 12 indicates an intake port for ballast water, and 13 indicates a ballast pump. The ballast water taken up through the intake port 12 is supplied into the ballast tanks 6 via a ballast-water piping system 14.

The ballast-water treatment apparatus 20 is coupled via a treatment-apparatus inlet piping system (including treatment-apparatus vessel connect piping) 15 and a treatment-apparatus outlet piping system 16 to the ballast-water piping system 14 for supplying the ballast water taken up through the intake port 12 into the ballast tanks 6.

Figs. 2 and 3 are piping system diagrams showing an example of the configuration of the ballast-water treatment apparatus 20, the ballast-water piping system 14 for supplying ballast water from the intake port 12 into the ballast tanks 6 by operating the ballast pump 13, and the treatment-apparatus inlet piping system (including treatment-apparatus vessel connect piping) 15 and the treatment-apparatus outlet piping system 16 coupling together the ballast-water treatment apparatus 20 and the ballast-water piping system 14. In Figs.

2 and 3, reference sign 17 indicates a release port for the ballast water, V1 to V7 indicate open/close valves, and CV1 indicates a check valve.

[0020]

In the example of the piping system in Figs. 2 and 3, the ballast-water treatment apparatus 20 is configured as a single unit. Fig. 2 illustrates an intake flow, whereas Fig. 3 illustrates a release flow.

When ballast water is taken up, as shown in Fig. 2, the ballast water is taken in through the intake port 12 by operating the ballast pump 13. The ballast water taken in through the intake port 12 flows into the ballast pump 13 via a ballast water pipe 14a, with the open/close valve V1 open, and via a ballast water pipe 14b. The ballast water is pumped by the ballast pump 13 and is supplied into the ballast-water treatment apparatus 20 via the ballast water pipe 14b, which has the check valve CV1, and a treatment-apparatus inlet pipe 15a.

[0021]

The check valve CV1 described above permits only a flow in the direction from the ballast pump 13 toward the ballast-water treatment apparatus 20 (the direction indicated by the arrows shown). When the ballast water is taken up, additionally, the open/close valve V6 provided in the treatment-apparatus inlet pipe 15a is open, whereas the open/close valve

V2, provided in a ballast water pipe 14c, the open/close valve V3, provided in a ballast water pipe 14f, and the open/close valves V4 and V5, provided in a ballast water pipe 14g, are all closed. The ballast water supplied into the ballast-water treatment apparatus 20 is subjected to treatment for eliminating or killing microorganisms contained in the ballast water and is then loaded into the ballast tanks 6 via the open/close valve V7, the treatment-apparatus outlet piping 16, a ballast water pipe 14d, and a ballast water pipe 14e. Accordingly, the ballast water is loaded into the ballast tanks 6 with the microorganisms eliminated or killed.

If the ballast-water treatment apparatus 20 uses a buffer tank, the buffer tank is coupled by replacing the treatment-apparatus outlet piping system 16 with a buffer-tank intake port 12', a treated-water transfer pump 13', and a treated-water transfer piping system 16'; the flow of ballast water is changed only in that portion.

[0022]

Next, referring to Fig. 3, the release of the ballast water will be described. When the ballast water is released, the open/close valves V1, V6, and V7 are changed from being open to being closed, whereas the open/close valves V3, V4, and V5 are changed from being closed to being open.

When the ballast water is released, as shown in Fig. 3, the ballast water is taken in from the ballast tanks 6 by

operating the ballast pump 13. The ballast water taken in from the ballast tanks 6 flows into the ballast pump 13 via the ballast water pipe 14e, via the ballast water pipe 14f, with the open/close valve V3 open, and via the ballast water pipe 14b. The ballast water is pumped by the ballast pump 13 and is released outside from the release port 17 via the ballast water pipe 14b, which has the check valve CV1, and via the ballast water pipe 14g, which has the open/close valves V4 and V5.

[0023]

Thus, if the ballast water is subjected to the treatment for eliminating or killing the microorganisms in the ballast water when taken up, it is possible to assume that substantially no microorganisms inhabit the ballast water loaded into the ballast tanks 6. Accordingly, if the LNG carrier 1, carrying the ballast water, sails to a loading port where the ballast water is released outside as the loading operation proceeds, it does not affect the ecosystem of the body of water around the loading port.

Although the microorganisms are treated with the ballast-water treatment apparatus 20 when the ballast water is taken up in the above description, they may instead be treated when the water is released.

[0024]

The ballast-water treatment apparatus 20 described above

is installed in the steering gear room 9 at the rear of the LNG carrier 1. The ballast-water treatment apparatus 20 is required to have high throughput and is therefore increased in size because it treats ballast water taken up or released as cargo handling proceeds. Accordingly, a large space is required to install the ballast-water treatment apparatus 20. Although the need for such a large installation space currently remains the same, many different conditions (e.g., shape) are demanded of the installation space because there are various types of ballast-water treatment apparatuses 20.

[0025]

A typical vessel such as the LNG carrier 1 has the propeller 11 and the propulsion engine at the rear of the hull. The ballast pump 13 is therefore installed in the engine room 8 at the rear of the hull unless there are exceptional circumstances. Hence, it is desirable to install the ballast-water treatment apparatus 20 near the ballast pump 13 to limit an increase in piping length and piping installation space.

On the other hand, because the steering gear room 9 is adjacent to the engine room 8 and is also located directly above the propeller 11 and the rudder, the steering gear room 9 has a relatively large space as a measure against, for example, vibrations resulting from the operation of such equipment. Hence, a large installation space in which the

ballast-water treatment apparatus 20 can be installed can readily be ensured in the steering gear room 9. That is, the space required to install the ballast-water treatment apparatus 20 can readily be ensured in the steering gear room 9 without a substantial change in hull structure and shape.

[0026]

Specifically, the space in the steering gear room 9 is usually left as a site (space) that is not appropriate for installation of equipment because of the vibration problem described above. The ballast-water treatment apparatus 20, however, can be used in the absence of the above vibrations because it is mainly used while the LNG carrier 1 is anchored or berthed. Focusing on the above vessel structure, the inventors have found that the steering gear room 9 is ideal as the installation site for the ballast-water treatment apparatus 20.

That is, because the ballast water is taken up or released while the vessel is anchored or berthed at a port for cargo handling, the engine for vessel propulsion and the rudder are not driven during the operation of the ballast-water treatment apparatus 20. No consideration is therefore needed as to ambient variations in the steering gear room 9 during the operation of the ballast-water treatment apparatus 20, and the steering gear room 9 is ideal as the installation site for the ballast-water treatment apparatus 20. The

treatment may also be performed during a voyage if necessary; such a case is not out of the question.

[0027]

It might be possible to install the ballast-water treatment apparatus 20 in the engine room 8 from the viewpoint of installing it near the ballast pump 13. In a typical vessel design, however, the interior of the engine room 8 is used as a site for installation of various equipment in view of ease of maintenance and handling unless there are exceptional requirements. Indeed, there is substantially no extra space in the engine room 8 because it is configured in view of ease of passage and operation and only has the minimum space required for installation and maintenance of equipment. Hence, installing the ballast-water treatment apparatus 20 in the engine room 8 would necessitate a substantial change in hull structure and shape, such as changing the hull design so as to make the engine room 8 larger.

In particular, if this approach were applied to an existing vessel, installing the ballast-water treatment apparatus 20 by adapting the engine room 8 would require substantial adaptation to the hull structure. Because such adaptation would involve increased costs and extended working time, the use of the engine room 8 as the installation site for the ballast-water treatment apparatus 20 causes numerous problems and is extremely difficult.

[0028]

The steering gear room 9 is advantageous in view of accessibility for operation etc. because it is close to the crew accommodation area 7 disposed above the engine room 8. From this viewpoint, the steering gear room 9 is suitable as the installation site for the ballast-water treatment apparatus 20.

The steering gear room 9 needs no measure against corrosion due to ocean waves and wind and rain in a marine environment because it is an inboard space. From this point, the steering gear room 9 is suitable as the installation site for the ballast-water treatment apparatus 20.

[0029]

Because the steering gear room 9 has a relatively large upper space above the steering gear, as shown in Fig. 1, for example, the ballast-water treatment apparatus 20 can be installed on a deck 30 formed at, for example, a middle position in the space. Such a configuration allows the inner space of the steering gear room 9 to be effectively utilized in three dimensions. As shown in Fig. 1, for example, this facilitates a divided structure in which the first treatment unit 21 is installed on the deck 30 while the second treatment unit 22 is installed on the floor of the steering gear room 9. Thus, flexible adaptation to various conditions is permitted in the installation of various types of ballast-water

treatment apparatuses 20 differing in structure, shape, etc.

Although the first treatment unit 21 is installed on the deck 30 in the exemplary configuration shown in Fig. 1, the invention is not limited thereto.

[0030]

In the case where the ballast-water treatment apparatus 20 is of a type requiring a buffer tank, if it is installed in the steering gear room 9, the aft peak tank, for example, installed in the nearby void 10 can be used as a buffer tank.

Such a configuration allows the space in the void 10 to be effectively utilized to readily ensure the installation space for the buffer tank. That is, even the void 10, which is located at the bow and therefore has a complicated shape, can be effectively utilized without the constraints of spatial shape because the buffer tank is merely a tank for storing the ballast water.

For an open-to-air ballast-water treatment apparatus 20, installation at or below a vessel draft line 40 should be avoided, for structural reasons, to prepare for the worst. On the other hand, installing the ballast-water treatment apparatus 20 at the same level or above the top of the ballast tanks 6 while using an existing ballast pump 13 is inefficient because it requires additional modifications such as increasing the pumping pressure of the ballast pump 13. For an open-to-air ballast-water treatment apparatus 20,

therefore, it is extremely reasonable to install it in the steering gear room 9, which is located above the vessel draft line 40 and below the top of the ballast tanks 6.

[0031]

The above vessel structure of the present invention thus allows the ballast-water treatment apparatus 20, which will become mandatory, to be installed without the need for a substantial change in hull design and shape and, additionally, allows many different types of ballast-water treatment apparatuses to be readily installed in many different types of vessels irrespective of whether they are installed in newly built vessels or in existing vessels with some adaptation. That is, the present invention is based on the finding that the space in the steering gear room 9, which is required for a vessel structure but has little configurational constraint and little effect on the rest of the vessel structure, can be effectively utilized, serving as the ideal installation site for the ballast-water treatment apparatus 20 in the vessel structure.

[0032]

Because the steering gear room 9 is adjacent to the engine room 8, in which the ballast pump 13 is installed, a shorter piping length and a smaller piping installation space are required for the treatment-apparatus inlet piping system (including treatment-apparatus vessel connect piping) 15 and

the treatment-apparatus outlet piping system 16, and a pressure loss accompanying the ballast water treatment can also be minimized.

Another advantage is that various control devices and electrical devices have fewer constraints because the steering gear room 9 is not an explosion-proof area.

A further advantage is that the ballast water can readily be released outside in an emergency because the steering gear room 9 is located above the vessel draft.

The present invention is not limited to the above embodiment and can be appropriately changed without departing from the spirit of the present invention.

CLAIMS

1. A vessel including a ballast-water treatment apparatus for treating ballast water to eliminate or kill microorganisms therein when the ballast water is taken up or released,

wherein the ballast-water treatment apparatus is disposed in a steering gear room at the rear of the vessel.

2. The vessel according to Claim 1, wherein the ballast-water treatment apparatus is disposed in the steering gear room or on a deck provided in an inner space thereof.

3. The vessel according to Claim 1 or 2, wherein a stern void space such as an aft peak tank is used as a buffer tank of the ballast-water treatment apparatus.

4. The vessel according to Claim 1, wherein the steering gear room is not an explosion-proof area.

5. The vessel according to Claim 1, wherein the steering gear room is adjacent to the engine room, in which a ballast pump is installed.

6. The vessel according to Claim 1, wherein the steering gear room is located above the vessel draft.

7. A vessel including a ballast-water treatment apparatus for treating ballast water to eliminate or kill microorganisms therein when the ballast water is taken up or released,

wherein the ballast-water treatment apparatus is disposed in a steering gear room at the rear of not an explosion-proof area.