DESCRIPTION

Title of Invention

SYSTEM FOR TREATING SHIP BALLAST WATER

Technical Field

[0001]

The present invention relates to a system for treating ballast water that is stored in a ship in order to stabilize the ship when the ship is underway. In particular, the present invention relates to high-level treatment of ballast water that is taken on board a ship and then discharged to another sea area.

Background Art

[0002]

In recent years, treatment of ballast water stored in a ship has become an issue. Ballast water is sea water that is stored in a ship in order to enable the ship to sail safely when the ship is not carrying cargo. Ballast water is taken into a ship from the ocean near a departure port and is discharged to the ocean near a destination port. That is, in a case where sea water taken into a ship as ballast water at a departure port is discharged at a destination port, such as a case where an oil tanker leaves a port in Japan and arrives at a port in a Middle East oil-producing country, such as Kuwait, and loads oil at the port, sea water in a sea area in Japan is taken on board the ship as ballast water and discharged to a sea area in the Middle East. In such a case, because ballast water is discharged to a sea area that is different from a sea area from which the ballast water was originally taken, organisms in the sea water are transferred to a sea area that is not their native habitat and may have a significant effect on marine ecosystems.

[0003]

Therefore, various methods for purifying ballast water to remove, kill, or inactivate microorganisms have been examined. For example, PTL 1 describes a method for killing aquatic organisms by heating sea water. PTL 2 discloses a method using steam, a method using ultraviolet irradiation, electrical methods using voltage application and an impact wave, a method using a chemical agent such as sodium hypochlorite, and the like. Filtration methods have been also examined as pretreatment before performing killing treatments described above or in order to remove comparatively large microorganisms.

channel 108 is connected to the bottom portion 133. Sea water, which is untreated water, flows into the case 103 through an untreated water pipe 106. A cleaning water nozzle 102 ejects untreated water, which is cleaning water, toward a filtration surface of the filter 101. The cleaning water nozzle 102 extends from the untreated water pipe 106 so that a nozzle opening 121 thereof is located inside the outer cylindrical portion 131 of the case 103. Therefore, untreated water is ejected toward the outer peripheral surface of the filter.
[0019]

In the present embodiment, untreated water ejected from the cleaning water nozzle hits the pleated outer peripheral surface of the pleated filter. The pressure of the untreated water produces an effect of cleaning the filter. The shaft 141 of an electric motor 140 is connected to a central shaft of the cylindrical filter 101, so that the filter 101 is rotated by the electric motor 140. As the filter 101 rotates, different portions of the filter are successively cleaned, and thereby the entirety of the cylindrical outer surface can be cleaned. The rotation speed of the electric motor may be constant or may be determined by an operator to be at any appropriate speed. It is preferable that the rotation speed be controlled in accordance with the state of filtration by detecting the turbidity of filtered water, the pressures inside and outside of the filter, and the like.
[0020]

Untreated water that is not filtered and suspended particles that have settled in the case are successively discharged through the discharge channel in the bottom portion of the case. Thus, the present apparatus is characterized in that it performs filtration while continuously and constantly discharging suspended particles and untreated water that is not filtered. This is effective in increasing the treatment rate to a range of 10 to 20 ton/hour, which is required for treating ballast water, and further to a level of 100 ton/hour or more. Note that, although valves and the like in the discharge channel are not shown in the drawings, devices that are necessary for maintenance or for adjusting flow rate are provided. Filtered water that is filtered by the filter 101 is guided to a filtered water channel 107 through a water intake hole 105 that is formed in a central pipe 104, and flows to outside of the case.
[0021]

Figure 4 is a perspective view showing a typical structure of a pleated filter that is preferably used in the present invention. This filter is made by folding a flat strip-shaped

CLAIMS

[Claim 1]

A ballast water treatment system for a ship, the system comprising a rotary filtration apparatus including a filter that is cylindrically formed so as to surround an axis, that is rotatable around the axis, and that has a pleated shape that is folded in a cylinder radial direction; a cleaning nozzle that ejects untreated water toward an outer peripheral portion of the filter; a case that includes an outer cylindrical portion that is disposed so as to surround the filter, a nozzle opening of the cleaning nozzle being disposed inside the case; a filtered water channel through which filtered water that has passed through the filter flows from a cylindrical space inside the filter to outside of the case; a discharge channel through which discharged water that has not passed through the filter is discharged to outside of the case; and an electric motor for rotating the filter,

wherein a distance between the cleaning nozzle and a recess of the filter is 120 mm or less, and

wherein the ballast water treatment system is configured to perform a steady-state operation that satisfies the following conditions a to d:

a) a rotation speed of the filter during a filtering operation is in the range of 20 to 100 rpm,

b) a flow speed of cleaning water ejected from the cleaning nozzle is 250 m/min or more,

c) a flow rate of filtered water per unit area of the filter is 5.1 m/h or less, and

d) a flow rate of discharged water discharged from the discharge channel is 5% of the flow rate of filtered water or more.

[Claim 2]

The ballast water treatment system for a ship according to Claim 1, wherein the filter has an effective filtration area of 5 m^3 or more and is capable of removing 99% or more of microorganisms in sea water having a size of 30 μm or more.

[Claim 3]

The ballast water treatment system for a ship according to Claim 1 or 2, wherein in a case where the untreated water is sea water having a turbidity in the range of 1 to 1000 NTU, the ballast water treatment system is capable of continuing the steady-state operation for 12 hours or more.

DESCRIPTION

Title of Invention

BALLAST WATER TREATMENT SYSTEM FOR SHIP

Technical Field

[0001]

The present invention relates to a system for treating ballast water that is stored in a ship in order to stabilize the ship when the ship is underway. In particular, the present invention relates to high-level treatment of ballast water that is taken on board a ship and then discharged to another sea area.

Background Art

[0002]

In recent years, treatment of ballast water stored in a ship has become an issue. Ballast water is sea water that is stored in a ship in order to enable the ship to sail safely when the ship is not carrying cargo. Ballast water is taken into a ship from the ocean near a departure port and is discharged to the ocean near a destination port. That is, in a case where sea water taken into a ship as ballast water at a departure port is discharged at a destination port, such as a case where an oil tanker leaves a port in Japan and arrives at a port in a Middle East oil-producing country, such as Kuwait, and loads oil at the port, sea water in a sea area in Japan is taken on board the ship as ballast water and discharged to a sea area in the Middle East. In such a case, because ballast water is discharged to a sea area that is different from a sea area from which the ballast water was originally taken, organisms in the sea water are transferred to a sea area that is not their native habitat and may have a significant effect on marine ecosystems.

[0003]

Therefore, various methods for purifying ballast water to remove, kill, or inactivate microorganisms have been examined. For example, PTL 1 describes a method for killing aquatic organisms by heating sea water. PTL 2 discloses a method using steam, a method using ultraviolet irradiation, electrical methods using voltage application and an impact wave, a method using a chemical agent such as sodium hypochlorite, and the like. Filtration methods have been also examined as pretreatment before performing killing treatments described above or in order to remove comparatively large microorganisms.

channel 108 is connected to the bottom portion 133. Sea water, which is untreated water, flows into the case 103 through an untreated water channel 106. A cleaning water nozzle 102 ejects untreated water, which is cleaning water, toward a filtration surface of the filter 101. The cleaning water nozzle 102 extends from the untreated water channel 106 so that a nozzle opening 121 thereof is located inside the outer cylindrical portion 131 of the case 103. Therefore, untreated water is ejected toward the outer peripheral surface of the filter.
[0019]

In the present embodiment, untreated water ejected from the cleaning water nozzle hits the pleated outer peripheral surface of the pleated filter. The pressure of the untreated water produces an effect of cleaning the filter. The shaft 141 of an electric motor 140 is connected to a central shaft of the cylindrical filter 101, so that the filter 101 is rotated by the electric motor 140. As the filter 101 rotates, different portions of the filter are successively cleaned, and thereby the entirety of the cylindrical outer surface can be cleaned. The rotation speed of the electric motor may be constant or may be determined by an operator to be at any appropriate speed. It is preferable that the rotation speed be controlled in accordance with the state of filtration by detecting the turbidity of filtered water, the pressures inside and outside of the filter, and the like.
[0020]

Untreated water that is not filtered and suspended particles that have settled in the case are successively discharged through the discharge channel in the bottom portion of the case. Thus, the present apparatus is characterized in that it performs filtration while continuously and constantly discharging suspended particles and untreated water that is not filtered. This is effective in increasing the treatment rate to a range of 10 to 20 ton/hour, which is required for treating ballast water, and further to a level of 100 ton/hour or more. Note that, although valves and the like in the discharge channel are not shown in the drawings, devices that are necessary for maintenance or for adjusting flow rate are provided. Filtered water that is filtered by the filter 101 is guided to a filtered water channel 107 through a water intake hole 105 that is formed in a central pipe 104, and flows to outside of the case.
[0021]

Figure 4 is a perspective view showing a typical structure of a pleated filter that is preferably used in the present invention. This filter is made by folding a flat strip-shaped

CLAIMS

[Claim 1]

A ballast water treatment system for a ship, the system comprising a rotary filtration apparatus including a filter that is cylindrically formed so as to surround an axis, that is rotatable around the axis, and that has a pleated shape that is folded in a cylinder radial direction; a cleaning nozzle that ejects untreated water toward an outer peripheral portion of the filter; a case that includes an outer cylindrical portion that is disposed so as to surround the filter, a nozzle opening of the cleaning nozzle being disposed inside the case; a filtered water channel through which filtered water that has passed through the filter flows from a cylindrical space inside the filter to outside of the case; a discharge channel through which discharged water that has not passed through the filter is discharged to outside of the case; and an electric motor for rotating the filter,

wherein a distance between the cleaning nozzle and a recess of the filter is 120 mm or less, and

wherein the ballast water treatment system is configured to perform a steady-state operation that satisfies the following conditions a to d:

a) a rotation speed of the filter during a filtering operation is in the range of 20 to 100 rpm,

b) a flow speed of cleaning water ejected from the cleaning nozzle is 250 m/min or more,

c) a flow rate of filtered water per unit area of the filter is 5.1 m/h or less, and

d) a flow rate of discharged water discharged from the discharge channel is 5% of the flow rate of filtered water or more.

[Claim 2]

The ballast water treatment system for a ship according to Claim 1, wherein the filter has an effective filtration area of 5 m^2 or more and is capable of removing 99% or more of microorganisms in sea water having a size of 30 μm or more.

[Claim 3]

The ballast water treatment system for a ship according to Claim 1 or 2, wherein in a case where the untreated water is sea water having a turbidity in the range of 1 to 1000 NTU, the ballast water treatment system is capable of continuing the steady-state operation for 12 hours or more.