SCRUBBER HAVING GUIDE SHAPE

Technical Field

[1] The present disclosure relates to a scrubber having a guide shape for minimizing accumulation or stagnation of exhaust gas inside a scrubber main body.

Background Art

[2] Recently, global warming and environmental disasters associated therewith have occurred due to the effects of greenhouse gas emissions resulting from indiscriminate use of fossil fuels.

[3] Accordingly, a series of technologies related to capturing and storing carbon dioxide without releasing carbon dioxide, which is a representative greenhouse gas, has recently received significant attention and is referred to as Carbon Dioxide Capture and Storage (CCS) technology. Among CCS technologies, chemical absorption is the most widely commercialized technology in terms of its capability for large-scale processing.

[4] In addition, carbon dioxide emission regulations are imposed through the International Maritime Organization (IMO)'s Energy Efficiency Design Index (EEDI). Since emissions are required to be reduced by 40% from the 2008 emission level by 2030, technologies for emitting no CO_2 or capturing emitted CO_2 are attracting attention, and a reduction of 50% or more from the 2008 emission level is also targeted by 2050.

[5] Technologies for reducing the emission of carbon dioxide or capturing generated carbon dioxide as described above have not yet been commercialized for ships. Although methods using hydrogen or ammonia as fuel are currently under development, they have not yet reached a commercially viable stage.

[6] As measures for reducing sulfur oxides in exhaust gas from ships, one option is to use marine gas oil (MGO) containing 0.5% or less of SOx, which is a premium fuel. However, this option has a disadvantage in that operating expenses (OPEX) increase due to the use of the premium fuel. Another option is to apply an LNG-fueled ship. However, although this option is a system using LNG as a fuel, the initial capital expenditure (CAPEX) is excessively high, and the pay-back period is 15 to 20 years even when the OPEX associated with the use of the premium fuel is taken into account, making the option impractical. Accordingly, an exhaust gas cleaning system (EGCS), which requires an initial installation cost but has a realistic pay-back period of three years or less even when the OPEX associated with the use of the premium fuel is taken into account, is emerging as an alternative.

[7] Accordingly, there is a need for a technology capable of more efficiently improving the flow structure of exhaust gas in an exhaust gas cleaning system so that the exhaust gas can be smoothly discharged.

[8] (Patent Document 1) Korean Patent No. 10-1895192 (Venturi-Integrated Scrubber Apparatus, September 4, 2018)

Disclosure of the Invention

Technical Goals

[9] An object to be achieved by the idea of the present disclosure is to provide a scrubber having a guide shape, in which exhaust gas can flow smoothly without stagnation or accumulation and can be prevented from being biased toward one side, and cavitation can be minimized.

Technical Solutions

[10] In order to achieve the above object, an embodiment of the present disclosure provides a scrubber having a guide shape, including: a scrubber main body having an inlet formed at a front thereof, through which exhaust gas from a ship engine is introduced, and an outlet formed at an upper end thereof, through which the exhaust gas having passed through an internal space is discharged, the scrubber main body being configured to remove greenhouse gases from the exhaust gas by spraying seawater; an exhaust gas guide portion coupled to a rear end of the inlet to form an inlet space for the exhaust gas, the exhaust gas guide portion including a rear plate formed to face the inlet and configured to guide the exhaust gas introduced through the inlet downward, and side plates respectively coupled to opposite side surfaces of the rear plate; and a guide shape spaced apart from a lower end of the exhaust gas guide portion by a predetermined distance and formed at a predetermined height from an upper end of a bottom plate of the scrubber main body, the guide shape being configured to uniformly diffuse, into the internal space, the exhaust gas guided downward by the exhaust gas guide portion so that the exhaust gas is discharged through the outlet.

[11] Here, the guide shape may include a first branching plate symmetrically inclined and formed to respectively branch and guide the exhaust gas outwardly from the side plates at the lower end of the exhaust gas guide portion, and a second branching plate inclined and formed to guide the exhaust gas outwardly from the rear plate from the lower end of the exhaust gas guide portion.

[12] In addition, the guide shape may include a first branching plate having an arcuate cross-sectional structure and configured to respectively branch and guide the exhaust gas outwardly from the side plates at the lower end of the exhaust gas guide portion, and a second

branching plate having a streamlined shape and configured to guide the exhaust gas outwardly from the rear plate from the lower end of the exhaust gas guide portion.

[13] In addition, a nozzle portion configured to spray seawater downward may be provided inside the exhaust gas guide portion.

[14] In addition, one or more stages of column packing may be provided between an outer side of the exhaust gas guide portion and an inner surface of the scrubber main body.

Advantageous Effects

[15] According to the present disclosure, exhaust gas can flow smoothly without stagnation or accumulation, can be prevented from being biased toward one side, and can cause only minimal cavitation, thereby enabling smooth discharge into the atmosphere.

Brief Description of Drawings

[16] FIG. 1 illustrates a scrubber having a guide shape according to an embodiment of the present disclosure.

[17] FIG. 2 separately illustrates an exhaust gas guide portion and the guide shape of the scrubber having the guide shape of FIG. 1.

[18] FIG. 3 illustrates a front structure of the scrubber having the guide shape of FIG. 1.

[19] FIGS. 4 and 5 respectively illustrate flow analysis results of the scrubber having the guide shape of FIG. 1.

[20] <Description of Reference Numerals>

[21] 110: Scrubber main body 111: Inlet

[22] 112: Outlet 113: Bottom plate

[23] 114: Spray nozzle 120: Exhaust gas guide portion

[24] 121: Rear plate 122: Side plate

[25] 130: Guide shape 131: First branching plate

[26] 132: Second branching plate 133: First branching plate

[27] 134: Second branching plate

Best Mode for Carrying Out the Invention

[28] Hereinafter, embodiments of the present disclosure having the above-described features will be described in more detail with reference to the accompanying drawings.

[29] A scrubber having a guide shape according to an embodiment of the present disclosure includes a scrubber main body 110 having an inlet 111 formed at a front thereof, through which exhaust gas from a ship engine is introduced, and an outlet 112 formed at an upper end thereof, through which exhaust gas having passed through an internal space A is discharged, the scrubber main body 110 being configured to remove greenhouse gases from the exhaust gas by spraying seawater, an exhaust gas guide portion 120 coupled to a rear end of the inlet 111 to form an inlet space B for the exhaust gas, the exhaust gas guide portion 120 including a rear plate 121 formed to face the inlet 111 and configured to guide the exhaust gas introduced through the inlet 111 downward, and side plates 122 respectively coupled to opposite side surfaces of the rear plate 121, and a guide shape 130 spaced apart from a lower end of the exhaust gas guide portion 120 by a predetermined distance and formed at a predetermined height from an upper end of a bottom plate 113 of the scrubber main body 110, the guide shape 130 being configured to uniformly diffuse, into the internal space A, the exhaust gas guided downward by the exhaust gas guide portion 120 so that the exhaust gas is discharged through the outlet 112, thereby minimizing accumulation or stagnation of exhaust gas inside the scrubber main body 110.

[30] Hereinafter, the scrubber having the guide shape configured as described above will be described in detail with reference to the drawings.

[31] First, referring to FIG. 1, the scrubber main body 110 may have one or more inlets 111 formed at the front thereof, through which exhaust gas from a ship engine (not shown) is introduced, and the outlet 112 formed at the upper end thereof, through which exhaust gas having passed through the internal space A is discharged, in a large ship, such as an LNG carrier or an oil tanker. Accordingly, the exhaust gas flows from the inlet 111 toward the outlet 112, and greenhouse gases are removed from the exhaust gas by spraying seawater onto the exhaust gas.

[32] Next, referring to FIGS. 1 and 2, the exhaust gas guide portion 120 is coupled to the rear end of the inlet 111 to form the inlet space B for the exhaust gas and includes the rear plate 121, which is formed to face the inlet 111 and guides the exhaust gas introduced through the inlet 111 downward, and the side plates 122 respectively coupled to opposite side surfaces of the rear plate 121.

[33] Here, an upper end of the rear plate 121 may be formed as a curved plate having a predetermined radius of curvature, and a lower end thereof may be formed as a flat plate, so as to guide the exhaust gas introduced in a horizontal direction downward.

[34] Next, referring to FIGS. 1 and 2, the guide shape 130 is spaced apart from the lower end of the exhaust gas guide portion 120 by a predetermined distance and is formed at a predetermined height from the upper end of the bottom plate 113 of the scrubber main body 110 so as to uniformly diffuse, into the internal space A, the exhaust gas guided downward by the exhaust gas guide portion 120 and discharge the exhaust gas through the outlet 112. Accordingly, the guide shape 130 may minimize the exhaust gas being biased toward one side or the occurrence of cavitation in the internal space A of the scrubber main body 110, such that

washing water, such as seawater, sprayed from a spray nozzle 114 (see FIG. 3) formed at an upper portion of the internal space A of the scrubber main body 110 can be uniformly distributed in the exhaust gas and effectively wash the exhaust gas.

[35] Specifically, as illustrated in FIGS. 2(A) and 2(B), the guide shape 130 may include a pair of first branching plates 131 symmetrically inclined and formed to respectively branch and guide the exhaust gas outwardly from the side plates 122 at the lower end of the exhaust gas guide portion 120 toward the internal space A, and a second branching plate 132 inclined and formed to guide the exhaust gas outwardly from the rear plate 121 from the lower end of the exhaust gas guide portion 120 toward the internal space A (see FIG. 1(B)).

[36] Alternatively, as illustrated in FIG. 2(C), the guide shape 130 may include a first branching plate 133 having an arcuate cross-sectional structure and configured to respectively branch and guide the exhaust gas outwardly from the side plates 122 at the lower end of the exhaust gas guide portion 120 toward the internal space A, and a second branching plate 134 having a streamlined shape and configured to guide the exhaust gas outwardly from the rear plate 121 from the lower end of the exhaust gas guide portion 120 toward the internal space A.

[37] In addition, a nozzle portion (not shown) configured to spray seawater downward may be provided inside the exhaust gas guide portion 120, thereby cleaning the exhaust gas by removing particulate components, such as SOx and soot, while guiding the exhaust gas downward.

[38] In addition, one or more stages of column packing may be provided between an outer side of the exhaust gas guide portion 120 and an inner surface of the scrubber main body 110. For example, column packing designed to have a large contact area per unit volume may be configured in multiple stages, column packing appropriate for the process may be selected in

consideration of the contact area per unit area, gas pressure drop, and flooding velocity, and a solution redistributor (not shown) may be provided between the multiple stages of column packing to prevent channeling.

[39] FIGS. 4 and 5 respectively illustrate flow analysis results of the scrubber having the guide shape of FIG. 1. Referring thereto, FIG. 4(A) illustrates streamlines of the scrubber having the guide shape 130, and FIG. 4(B) illustrates streamlines of a scrubber without the guide shape 130. Compared with FIG. 4(B), FIG. 4(A) shows that exhaust gas can flow smoothly without stagnation or accumulation, can be prevented from being biased toward one side, and can cause only minimal cavitation, thereby enabling smooth discharge through the outlet 112.

[40] In addition, FIG. 5(A) illustrates a velocity field of the scrubber having the guide shape 130, and FIG. 5(B) illustrates a velocity field of a scrubber without the guide shape 130. Compared with FIG. 5(B), FIG. 5(A) shows that exhaust gas can relatively flow smoothly without stagnation or accumulation, thereby enabling smooth discharge through the outlet 112.

[41] Therefore, according to the configuration of the scrubber having the guide shape as described above, exhaust gas may flow smoothly without stagnation or accumulation, may be prevented from being biased toward one side, and may cause only minimal cavitation, thereby enabling smooth discharge into the atmosphere.

[42] The embodiments described in this specification and the configurations illustrated in the drawings are merely preferred embodiments of the present disclosure and do not represent all of the technical ideas of the present disclosure. Accordingly, it should be understood that various equivalents and modifications capable of replacing the embodiments and configurations may exist as of the filing date of the present application.

CLAIMS

1. A scrubber having a guide shape, comprising:

a scrubber main body having an inlet formed at a front thereof, through which exhaust gas from a ship engine is introduced, and an outlet formed at an upper end thereof, through which the exhaust gas having passed through an internal space is discharged, the scrubber main body being configured to remove greenhouse gases from the exhaust gas by spraying seawater;

an exhaust gas guide portion coupled to a rear end of the inlet to form an inlet space for the exhaust gas, the exhaust gas guide portion including a rear plate formed to face the inlet and configured to guide the exhaust gas introduced through the inlet downward, and side plates respectively coupled to opposite side surfaces of the rear plate; and

a guide shape spaced apart from a lower end of the exhaust gas guide portion by a predetermined distance and formed at a predetermined height from an upper end of a bottom plate of the scrubber main body, the guide shape being configured to uniformly diffuse, into the internal space, the exhaust gas guided downward by the exhaust gas guide portion so that the exhaust gas is discharged through the outlet,

wherein an upper end of the rear plate is formed as a curved plate having a predetermined radius of curvature, and a lower end thereof is formed as a flat plate,

wherein the guide shape comprises a first branching plate symmetrically inclined and formed to respectively branch and guide the exhaust gas outwardly from the side plates at the lower end of the exhaust gas guide portion, and a second branching plate inclined and formed to guide the exhaust gas outwardly from the rear plate from the lower end of the exhaust gas guide portion,

wherein a nozzle portion configured to spray seawater downward is provided inside the exhaust gas guide portion, and

wherein one or more stages of column packing are provided between an outer side of the exhaust gas guide portion and an inner surface of the scrubber main body.

2. The scrubber of claim 1, wherein the guide shape comprises a first branching plate having an arcuate cross-sectional structure and configured to respectively branch and guide the exhaust gas outwardly from the side plates at the lower end of the exhaust gas guide portion, and a second branching plate having a streamlined shape and configured to guide the exhaust gas outwardly from the rear plate from the lower end of the exhaust gas guide portion.