

to a cryogenic temperature in the reliquefaction apparatus including a refrigeration cycle, and the reliquefied BOG is returned to the cargo tank.

In the case of a conventional LNG carrier equipped with a DFDE propulsion system, BOG is consumed in such a manner that it is supplied as fuel to the DFDE after treating BOG by only a BOG compressor and heating, without installing the reliquefaction facility. Therefore, when an amount of fuel necessary for an engine is smaller than a generation amount of BOG, there is a problem that BOG is burnt in a gas combustion unit (GCU) or is vented to atmosphere.

Even though a conventional LNG carrier equipped with a reliquefaction facility and a low-speed diesel engine can treat BOG through the reliquefaction facility, the control of the entire system is complicated due to the operation complexity of the reliquefaction facility using nitrogen gas, and a considerable amount of power is consumed.

Consequently, there is a need for continuous research and development of systems and methods for efficiently treating liquefied gas, including BOG generated naturally from the cargo tank.

DISCLOSURE

TECHNICAL PROBLEM

~~The Embodiments of the present invention has been made in an effort seek~~ to solve the above problems and is directed to a liquefied gas treatment system for a vessel, which can efficiently use BOG by using most of BOG discharged from a cargo tank as a fuel of a high pressure natural gas injection engine (that is, a propulsion system) and returning a part of the remaining BOG to the cargo tank by liquefying it with cold energy of BOG newly discharged from the cargo tank.

TECHNICAL SOLUTION

According to an aspect of the present invention, there is provided a liquefied gas

while passing through all or part of the plurality of compression cylinders included in the compressor.

The liquefied gas treatment system may further include a forcible vaporizer configured to forcibly vaporize the liquefied natural gas stored in the cargo tank and supply the vaporized liquefied natural gas to the compressor.

The liquefied gas treatment system may further include: a compressor line through which the boil-off gas inside the cargo tank is compressed by the compressor and is supplied as fuel to the engine; and a high pressure pump line through which the liquefied natural gas inside the cargo tank is compressed by a high pressure pump and is supplied as fuel to the engine.

The engine may include an ME-GI engine and a DF engine.

The decompressing means may be an expansion valve or an expander.

~~According to another aspect of the present invention~~the disclosure, a liquefied gas treatment system for a vessel, which has a cargo tank storing liquefied natural gas and a high pressure natural gas injection engine using boil-off gas discharged from the cargo tank as fuel, includes: a compressor configured to compress the boil-off gas generated from the cargo tank; the high pressure natural gas injection engine configured to use the boil-off gas compressed in the compressor as fuel; a heat exchanger configured to liquefy a part of the compressed boil-off gas that is not supplied to the high pressure natural gas injection engine; and an expansion valve or an expander installed to lower a pressure of the boil-off gas liquefied in the heat exchanger, wherein the heat exchanger exchanges heat between a part of the compressed boil-off gas that is not supplied to the high pressure natural gas injection engine and the boil-off gas that is discharged from the cargo tank and transferred to the compressor.

~~According to another aspect of the present invention~~the disclosure, a liquefied gas treatment method for a vessel, which has a cargo tank storing liquefied natural gas and a high pressure natural gas injection engine using boil-off gas discharged from the cargo tank as fuel, includes: compressing the boil-off gas generated from the cargo tank by a

compressor; classifying the boil-off gas compressed in the compressing step and supplying a part of the boil-off gas as fuel to the high pressure natural gas injection engine; liquefying the remaining boil-off gas that is not supplied to the high pressure natural gas injection engine by exchanging heat with boil-off gas before compression after being discharged from the cargo tank; and lowering a pressure of the boil-off gas liquefied in the heat exchanger, wherein in the liquefying step, a part of the boil-off gas that is not supplied to the high pressure natural gas injection engine is heat-exchanged with boil-off gas that is discharged from the cargo tank and transferred to the compressor.

ADVANTAGEOUS EFFECTS

According to embodiments of the present invention, there can be provided a liquefied gas treatment system for a vessel, which can supply a high pressure gas injection engine (that is, a propulsion system) as fuel with a part of BOG compressed after pressurizing BOG discharged from a cargo tank and can newly discharge the remaining compressed BOG from a cargo tank to return it to the cargo tank by liquefying with cold energy of BOG before compression.

Therefore, according to the liquefied gas treatment system in embodiments of the present invention, BOG generated from the cargo tank can be reliquefied without installing a reliquefaction apparatus consuming a large amount of energy and requiring excessive initial installation cost, thereby saving energy consumed in the reliquefaction apparatus.

In addition, according to the liquefied gas treatment system in embodiments of the present invention, all BOG generated during the transportation of cargo (that is, LNG) in the LNG carrier can be used as the fuel of the engine, or may be reliquefied, be returned to the cargo tank and be stored therein. Therefore, an amount of BOG consumed in the GCU or the like can be reduced or removed. Furthermore, BOG can be treated by reliquefaction, without using separate refrigerants such as nitrogen.

In addition, in the liquefied gas treatment system according to embodiments of the present invention, since it is unnecessary to install the reliquefaction apparatuses using separate

refrigerants (that is, nitrogen-refrigerant refrigeration cycle, mixed-refrigerant refrigeration cycle, or the like), facilities for supplying and storing the refrigerants need not be separately installed. Consequently, it is possible to save initial installation cost and operation cost for configuring the entire system.

5 | In addition, according to the liquefied gas treatment system in embodiments of the present invention, when BOG cooled and liquefied in the heat exchanger after compression is decompressed by the expander, wasted energy can be reused because energy can be generated during expansion.

10 DESCRIPTION OF DRAWINGS

FIG. 1 is a schematic configuration diagram illustrating a liquefied gas treatment system for a vessel according to a first embodiment of the present invention.

FIG. 2 is a schematic configuration diagram illustrating a liquefied gas treatment system for a vessel according to a second embodiment of the present invention.

15 | FIGS. 3 and 4 are schematic configuration diagrams illustrating liquefied gas treatment systems for a vessel according to modifications of the second embodiment of the present invention.

FIG. 5 is a schematic configuration diagram illustrating a liquefied gas treatment system for a vessel according to a third embodiment of the present invention.

20 | FIG. 6 is a schematic configuration diagram illustrating a liquefied gas treatment system for a vessel according to a fourth embodiment of the present invention.

FIGS. 7 and 8 are schematic configuration diagrams illustrating liquefied gas treatment systems for a vessel according to modifications of the fourth embodiment of the present invention.

25 | FIG. 9 is a schematic configuration diagram illustrating a liquefied gas treatment system for a vessel according to a fifth embodiment of the present invention.

FIGS. 10 to 12 are schematic configuration diagrams illustrating liquefied gas treatment systems for a vessel according to modifications of the fifth embodiment of the