【DESCRIPTION】

【Invention Title】

FUEL SUPPLY SYSTEM AND METHOD FOR SHIP

【Technical Field】

[1] The present invention relates to a fuel supply system for ship, which uses an incompressible fluid as fuel for an engine, and a fuel supply method using the same.

【Background Art】

[2] In general, petroleum gas is transported to a distant destination by an LNG carrier after being transformed into liquefied petroleum gas (LPG) through liquefaction at extremely low temperatures at a production site.

[3] Conventionally, fuel oil, such as heavy fuel oil (HFO) or marine diesel oil (MDO), has been used as fuel for an engine of LPG carriers. As cargo of an LPG carrier, LPG is typically stored in a storage tank. Here, boil-off gas (BOG) generated in the storage tank is reliquefied in a reliquefaction plant and then delivered to and stored in the storage tank.

[4] As such, in typical LPG carriers, fuel and cargo are handled or treated by separate systems, without means such as an engine fueled by LPG stored as cargo in a storage tank.

[5] Recently, there is increasing interest in a method of supplying LPG stored as cargo in a storage tank as fuel for an engine.

【Disclosure】

【Technical Problem】

[6] When surplus fuel discharged from an engine is returned to a storage tank, a large amount of flash gas is generated as liquefied gas in liquid state is decompressed.

[7] In order to prevent increase of the internal pressure of the storage tank by flash gas when surplus fuel discharged from an engine is returned to the storage tank, the present invention provides a fuel supply system and method for ship that decompress the surplus fuel discharged from an engine, separates the surplus fuel in a gas-liquid mixed state (two-phase state) by a gas-liquid separator, and then sends a separated fluid to the storage tank.

【Technical Solution】

[8] In accordance with one aspect of the present invention, a fuel supply system for ships includes: a first decompressor (50) decompressing surplus fuel discharged from an engine (E); a gas-liquid separator (60) separating the surplus fuel in a gas-liquid mixed state decompressed by the first decompressor (50) into a gaseous phase fluid and a liquid phase fluid, wherein the gaseous phase fluid separated by the gas-liquid separator (60) is returned to a storage tank (T), and, after supplying an excess of liquefied gas as fuel to the engine (E), fuel remaining after use in the engine (E) is discharged from the engine (E) and is supplied to the first decompressor (50).

[9] The liquid phase fluid separated by the gas-liquid separator (60) may be joined with liquefied gas discharged from the storage tank (T).

[10] The first decompressor (50) may decompress the surplus fuel to a pressure of the liquefied gas discharged from the storage tank (T).

[11] The fuel supply system may further include a second decompressor (70) decompressing the gaseous phase fluid separated by the gas-liquid separator (60) and sending to the storage tank (T).

[12] The liquid phase fluid separated by the gas-liquid separator (60) may be sent to the storage tank (T).

[13] The first decompressor (50) may decompress the surplus fuel to an internal pressure of the storage tank (T).

[14] The fuel supply system may further include a first pump (10) disposed inside the storage tank (T) to pump the liquefied gas out of the storage tank (T).

[15] The fuel supply system may further include a second pump (20) pumping the liquefied gas discharged from the storage tank (T) to be supplied to the engine (E) to a pressure required for the engine (E).

[16] The liquid phase fluid separated by the gas-liquid separator (60) may be sent upstream of the second pump (20) to be joined with the liquefied gas discharged from the storage tank (T) to be used as fuel for the engine (E).

[17] The fuel supply system may further include a valve (V) disposed in a line through which the liquid phase fluid separated by the gas-liquid separator 60 is discharged.

[18] The fuel supply system may further include a heater (40) heating the liquefied gas discharged from the storage tank (T) to be supplied to the engine (E) to a temperature required for the engine (E).

[19] In accordance with another aspect of the present invention, a fuel supply method for ships, comprising: 1) supplying an excess of liquefied gas as fuel to an engine (E) and discharging fuel remaining after use in the engine (E) from the engine (E); 2) decompressing a surplus fuel discharged from the engine (E) in step 1); 3) separating the gas-liquid mixed fluid decompressed in step 2) into a gaseous phase fluid and a liquid phase fluid; and 4) returning the gaseous phase fluid separated in step 3) to a storage tank (T), wherein liquefied gas discharged from the storage tank (T) is supplied as fuel to the engine (E).

【Advantageous Effects】

[20] According to one embodiment, since only a gas in gaseous state (a gaseous phase fluid) separated by the gas-liquid separator, rather than a gas-liquid mixed fluid, is supplied to the storage tank, it is possible to prevent generation of flash gas due to reduction in pressure of a liquefied gas in liquid state in the storage tank,

thereby allowing easy control over the internal pressure of the storage tank.

[21] According to another embodiment, since a gas in gaseous state and a liquefied gas in liquid state separated by the gas-liquid separator are separately supplied to the storage tank, instead of supplying a gas-liquid mixed fluid to the storage tank, and the liquefied gas in liquid state is decompressed to the internal pressure of the storage tank before being sent to the storage tank, it is possible to prevent generation of flash gas due to reduction in pressure of the liquefied gas in liquid state in the storage tank, thereby allowing easy control of the internal pressure of the storage tank.

[22] According to a further embodiment, since a liquefied gas in liquid state separated by the gas-liquid separator is joined with liquefied gas discharged from the storage tank and then sent to the second pump, it is possible to reduce the amount of the liquefied gas compressed by the first pump, thereby allowing reduction in power consumption of the first pump.

【Description of Drawings】

[23] FIG. 1 is a schematic diagram of a fuel supply system for ships according to a first embodiment of the present invention.

FIG. 2 is a schematic diagram of a fuel supply system for ships according to a second embodiment of the present invention.

【Best Mode】

[24] Hereinafter, embodiments of the present invention will be described in detail with reference to the accompanying drawings. It should be understood that the present invention may be embodied in different ways and is not limited to the following embodiments.

[25]

[26] FIG. 1 is a schematic diagram of a fuel supply system for ships according to a first embodiment of the present invention.

[27] Referring to FIG. 1, the fuel supply system for ships according to this embodiment includes: a first decompressor 50 decompressing surplus fuel discharged from an engine E; and a gas-liquid separator 60 separating the gas-liquid mixed fluid decompressed by the first decompressor 50 into a gas phase fluid and a liquid phase fluid.

[28] A storage tank T according to this embodiment stores liquefied gas. The liquefied gas discharged from the storage tank T is supplied as fuel to the engine E. A first pump 10 that pumps the liquefied gas out of the storage tank T may be provided inside the storage tank T.

[29] According to this embodiment, after an excess of the liquefied gas is supplied as fuel to the engine E, fuel remaining after use in the engine E is discharged from the engine E and then sent to the first decompressor 50.

[30] When a compressible gaseous fluid is supplied as fuel to the engine E, a fuel supply line F1 may be filled with the fluid to a pressure slightly higher than required for the engine E such that fuel compressed to some degree can be present in the fuel supply line F1, whereby, even when the engine E suddenly needs a large amount of fuel, the fuel can be immediately supplied to the engine, thereby supplying fuel stably in load change of the engine.

[31] However, when an incompressible liquid fluid is supplied as fuel to the engine E, the method of filling the fuel supply line F1 with the fluid to a pressure slightly higher than required for the engine E cannot be used since the incompressible liquid fluid undergoes insignificant volume change upon application of pressure to the fluid.

[32] If a required amount of fuel for the engine E is not supplied when the engine E suddenly needs a large amount of fuel, the engine E can suffer from cavitation.

[33] Thus, the inventors of the present invention concluded that it is better to supply more fuel than required for the engine than to cause a situation in which the engine E is short of fuel.

[34] According to this embodiment, a sufficient amount of the liquefied gas to handle sudden changes in load of the engine E, rather than only as much liquefied

gas as is required for the engine, is supplied to the engine E, and fuel remaining after use in the engine E is discharged from the engine E.

[35] Thus, according to the present invention, even when an incompressible liquid fluid is supplied as fuel to the engine, fuel can be supplied to the engine stably.

[36] According to this embodiment, the amount of the liquefied gas supplied to the engine E may be about 100% to 120% of the amount of fuel required for the engine E. Preferably, the amount of the liquefied gas supplied to the engine E is about 110% of the amount of fuel required for the engine E.

[37] Although the first decompressor 50 according to the present invention may be any suitable device commonly used in the art to decompress a fluid, the first decompressor 50 is preferably an expansion valve such as a Joule-Thomson valve.

[38] The gas-liquid separator 60 according to the present embodiment separates gas in gaseous state (a gaseous phase fluid) and liquefied gas in liquid state (a liquid phase fluid) from the surplus fuel discharged from the engine E and having been decompressed into a gas-liquid mixed state by the first decompressor 50.

[39] The gaseous phase fluid separated by the gas-liquid separator 60 may be returned to the storage tank T, and the liquid phase fluid separated by the gas-liquid separator 60 may be joined with the liquefied gas discharged from the storage tank T to be used again as fuel for the engine E.

[40] A valve V may be disposed in a line through which the liquid phase fluid separated by the gas-liquid separator 60 is discharged. Here, the level of the liquid phase fluid in the gas-liquid separator 60 may be controlled within a predetermined range by opening/closing of the valve V.

[41] The fuel supply system for ships according to this embodiment may further include at least one of a second pump 20 and a heater 40, wherein the second pump serves to pump the liquefied gas discharged from the storage tank T to be supplied to the engine E to a pressure required for the engine E, and the heater serves to heat the liquefied gas discharged from the storage tank T to be supplied to the engine E to a temperature required for the engine E.

[42] The heater 40 according to this embodiment may heat the liquefied gas to about 40°C to 50°C, preferably to about 45°C.

[43] In an embodiment in which the liquid phase fluid separated by the gas-liquid separator 60 is joined with the liquefied gas discharged from the storage tank T, it is desirable that the first decompressor 50 decompress the surplus fuel to be sent to the gas-liquid separator 60 to the pressure of the liquefied gas discharged from the storage tank T (that is, to the pressure at the joining point, more specifically, to the pressure of the liquefied gas pumped by the first pump 10 when the fuel supply system includes only the first pump 10 or to the pressure upstream of the second pump 20 when the fuel supply system further includes the second pump 20). In addition, it is desirable that the gaseous phase fluid separated by the gas-liquid separator 60 be decompressed once more to the internal pressure of the storage tank T by a second decompressor 70 before being sent to the storage tank T.

[44] Although the second decompressor 70 according to the present invention may be any suitable device commonly used in the art to decompress a fluid, the second decompressor 70 is preferably an expansion valve such as a Joule-Thomson valve. Here, the second decompressor may decompress the fluid to a pressure of about 15 bar to about 20 bar, preferably about 19 bar.

[45] According to this embodiment, since only the gaseous phase fluid separated by the gas-liquid separator 60, rather than a gas-liquid mixed fluid, is supplied to the storage tank T, it is possible to prevent generation of flash gas due to decompression of the liquefied gas in liquid state in the storage tank, thereby allowing easy control over the internal pressure of the storage tank T.

[46] In addition, when the fuel supply system according to this embodiment includes both the first pump 10 and the second pump 20, since the liquid phase fluid separated by the gas-liquid separator 60 is sent to the second pump 20 after being joined with the liquefied gas discharged from the storage tank T, the amount of the liquefied gas to be compressed by the first pump 10 can be reduced, thereby reducing power consumption of the first pump 10, as compared with when the entire required amount of the liquefied gas is pumped only by the first pump 10.

[47]

[48] FIG. 2 is a schematic diagram of a fuel supply system for ships according to a second embodiment of the present invention.

[49] The fuel supply system for ships according to the second embodiment shown in FIG. 2 is different from the fuel supply system for ships according to the first embodiment shown in FIG. 1 in that the liquid phase fluid separated by the gas-liquid separator 60 is sent to the storage tank T, and the difference will be mainly described below. Detailed description of the same features as those of the fuel supply system for ships according the first embodiment will be omitted.

[50] According to this embodiment, since the liquid phase fluid separated by the gas-liquid separator 60 is sent to the storage tank T rather than being joined with the liquefied gas discharged from the storage tank T as in the first embodiment, it is desirable that the first decompressor 50 decompress the liquefied gas (surplus fuel) to be sent to the gas-liquid separator 60 to the internal pressure of the storage tank T. Thus, according to this embodiment, it is not necessary to further provide the second decompressor 70 as in the first embodiment.

[51] In this embodiment, the first decompressor 50 may decompress the fluid to a pressure of about 15 bar to about 20 bar, preferably about 19 bar.

[52] According to this embodiment, instead of supplying a gas-liquid mixed fluid to the storage tank T, the gas in gaseous state (a gas phase fluid) and the liquefied gas in liquid state (a liquid phase fluid) are separated by the gas-liquid separator 60 and each supplied to the storage tank T separately, and the liquid phase fluid is decompressed to the internal pressure of the storage tank T before being sent to the storage tank T. As a result, it is possible to prevent generation of flash gas due to reduction in pressure of the liquefied gas in liquid state in the storage tank, thereby allowing easy control of the internal pressure of the storage tank T.

[53]

[54] Although some embodiments have been described herein, it should be understood that these embodiments are provided for illustration only and are not to be construed in any way as limiting the present invention, and that various modifications, changes, alterations, and equivalent embodiments can be made by those skilled in the art without departing from the spirit and scope of the invention.

【CLAIMS】

【Claim 1】

A fuel supply system for ships, comprising:

a first decompressor (50) decompressing a surplus fuel discharged from an engine (E); and

a gas-liquid separator (60) separating the surplus fuel in a gas-liquid mixed state decompressed by the first decompressor (50) into a gaseous phase fluid and a liquid phase fluid,

wherein the gaseous phase fluid separated by the gas-liquid separator (60) is returned to a storage tank (T), and, after supplying an excess of liquefied gas as fuel to the engine (E), fuel remaining after use in the engine (E) is discharged from the engine (E) and is supplied to the first decompressor (50), and

the liquid phase fluid separated by the gas-liquid separator (60) is joined with liquefied gas discharged from the storage tank (T).

【Claim 2】

A fuel supply system for ships, comprising

a first decompressor (50) decompressing a surplus fuel discharged from an engine (E); and

a gas-liquid separator (60) separating the surplus fuel in a gas-liquid mixed state decompressed by the first decompressor (50) into a gaseous phase fluid and a liquid phase fluid,

wherein the gaseous phase fluid separated by the gas-liquid separator (60) is returned to a storage tank (T), and, after supplying an excess of liquefied gas as fuel to the engine (E), fuel remaining after use in the engine (E) is discharged from the engine (E) and is supplied to the first decompressor (50),

the liquid phase fluid separated by the gas-liquid separator (60) is sent to the storage tank (T), and

the first decompressor (50) decompresses the surplus fuel to an internal pressure of the storage tank (T).

【Claim 3】

The fuel supply system according to claim 1, wherein the first decompressor (50) decompresses the surplus fuel to a pressure of the liquefied gas discharged from the storage tank (T).

【Claim 4】

The fuel supply system according to claim 3, further comprising:

A second decompressor (70) decompressing the gaseous phase fluid separated by the gas-liquid separator (60),

wherein the gaseous phase fluid separated by the gas-liquid separator (60) is decompressed by the second decompressor (70) and sent to the storage tank (T).

【Claim 5】

The fuel supply system according to claim 1 or 2, further comprising:

a first pump (10) disposed inside the storage tank (T) to pump the liquefied gas out of the storage tank (T).

【Claim 6】

The fuel supply system according to any one of claim 1 to 5, further comprising:

a second pump (20) pumping the liquefied gas discharged from the storage tank (T) to be supplied to the engine (E) to a pressure required for the engine (E).

【Claim 7】

The fuel supply system according to claim 6, wherein the liquid phase fluid separated by the gas-liquid separator (60) is sent upstream of the second pump (20) to be joined with the liquefied gas discharged from the storage tank (T) to be used as fuel for the engine (E).

【Claim 8】

The fuel supply system according to any one of claim 1 to 5, further comprising:

a valve (V) disposed in a line through which the liquid phase fluid separated by the gas-liquid separator 60 is discharged.

【Claim 9】

The fuel supply system according to any one of claim 1 to 5, further comprising:

a heater (40) heating the liquefied gas discharged from the storage tank (T) to be supplied to the engine (E) to a temperature required for the engine (E).

【Claim 10】

A fuel supply method for ships, comprising:

1) supplying an excess of liquefied gas as fuel to an engine (E) and discharging fuel remaining after use in the engine (E) from the engine (E);

2) decompressing a surplus fuel discharged from the engine (E) in step 1);

3) separating the gas-liquid mixed fluid decompressed in step 2) into a gaseous phase fluid and a liquid phase fluid; and

4) returning the gaseous phase fluid separated in step 3) to a storage tank (T) and joining the liquid phase fluid separated in step 3) with liquefied gas discharged from the storage tank (T),

wherein liquefied gas discharged from the storage tank (T) is supplied as fuel to the engine (E).

【Claim 11】

A fuel supply method for ships, comprising:

1) supplying an excess of liquefied gas as fuel to an engine (E) and discharging fuel remaining after use in the engine (E) from the engine (E);

2) decompressing a surplus fuel discharged from the engine (E) in step 1) to an internal pressure of a storage tank (T);

3) separating the gas-liquid mixed fluid decompressed in step 2) into a gaseous phase fluid and a liquid phase fluid; and

4) returning the gaseous phase fluid separated in step 3) to the storage tank (T) and sending the liquid phase fluid separated in step 3) to the storage tank (T),

wherein liquefied gas discharged from the storage tank (T) is supplied as fuel to the engine (E).