

FUEL OIL SUPPLY SYSTEM AND METHOD FOR SHIP

【TECHNICAL FIELD】

[1] The present invention relates to a fuel oil supply system for ships, which supplies fuel oil to an engine fueled by both natural gas and fuel oil, and a fuel oil supply method using the same.

【BACKGROUND ART】

[2] Recently, consumption of liquefied gas such as liquefied natural gas (LNG) is rapidly increasing worldwide. Liquefied gas obtained by cooling a gas to a very low temperature has a much smaller volume than the gas and is thus beneficial in improving storage and transport efficiency. In addition, liquefied gas such as LNG emits little or no air pollutants during a liquefaction process and thus can be considered as an eco-friendly fuel with less emission of air pollutants during combustion.

[3] LNG is a colorless and transparent liquid obtained by cooling natural gas containing methane as a main component to about -162°C , and has a volume of about 1/600 that of natural gas. Thus, liquefaction of natural gas allows efficient transportation of natural gas.

[4] However, since natural gas is liquefied at a very low temperature of 162°C under atmospheric pressure, LNG is sensitive to temperature change and evaporates easily. Although an LNG storage tank is insulated, LNG continues to evaporate naturally in the storage tank due to external heat continuously transferred to the storage tank during transportation, causing generation of boil-off gas (BOG). The same is applied to other cryogenic liquefied gases such as ethane.

[5] Boil-off gas is a kind of loss and is critical to transportation efficiency. In addition, if boil-off gas is accumulated in the storage tank, the internal pressure of the tank can excessively increase, at worst causing damage to the tank. Accordingly, various methods have been studied to handle boil-off gas generated in a storage tank.

Recently, in order to handle boil-off gas, there have been proposed a method of reliquefying boil-off gas and returning the reliquefied boil-off gas to the storage tank, a method of using boil-off gas as an energy source for on-board fuel demand sites such as a marine engine, and the like.

[6] Examples of an engine capable of being fueled by natural gas include an ME-GI engine and a dual fuel (DF) engine.

[7] The ME-GI engine uses a diesel cycle consisting of two strokes, in which natural gas at a high pressure of about 300 bar is injected directly into a combustion chamber near the top dead point of a piston.

[8] The DF engine uses an Otto cycle consisting of four strokes, in which natural gas at a relatively low pressure of about 6.5 bar is injected through a combustion air inlet to form a mixed gas of the natural gas and combustion air, which, in turn, is compressed by a piston moving upward.

[9] Since natural gas is cheaper than fuel oil and there is a need to handle boil-off gas generated in an LNG storage tank, the ME-GI engine or the DF engine may be operated to be preferentially fueled by natural gas and to be fueled by fuel oil when shortage of natural gas occurs.

[10] However, if the engine is operated in this manner, a fuel oil feed pump is required to be operated at all times in order to supply fuel oil immediately after a shortage of natural gas occurs even though fuel oil consumption by the engine is zero or insignificant, causing huge energy loss.

【DISCLOSURE】

【Technical Problem】

[11] It is an aspect of the present invention to provide a fuel oil supply system for ships, which can supply fuel oil to an engine immediately after shortage of natural gas occurs while operating a fuel oil feed pump only when necessary rather than at all times, and a fuel oil supply method using the same.

【Technical Solution】

[12] In accordance with one aspect of the present invention, there is provided a fuel oil supply method for ships to supply fuel oil to an engine fueled by both natural gas and fuel oil, the fuel oil supply method including: storing fuel oil under pressure in a pressurized tank by supplying compressed air to the pressurized tank; supplying the fuel oil stored in the pressurized tank to a circulation pump when the engine is operated in a fuel oil mode; regulating, by a temperature regulation unit, the fuel oil pressurized by the circulation pump to a temperature required for the engine; and supplying the fuel oil having passed through the temperature regulation unit to the engine.

[13] When the fuel oil stored in the pressurized tank does not meet fuel oil demand of the engine, fuel oil stored in a storage tank may be pressurized by a feed pump to be supplied to the engine.

[14] The fuel oil stored in the storage tank may be pressurized by the feed pump to be supplied to the pressurized tank when the amount of the fuel oil in the pressurized tank is less than or equal to a first threshold.

[15] The fuel oil remaining after use in the engine may be sent to the circulation pump after being temporarily stored in a pipe to be deaerated.

[16] The fuel oil stored in the pipe may be sent to the storage tank when the amount of the fuel oil in the pipe is greater than or equal to a third threshold.

[17] The fuel oil remaining after use in the engine may be sent to the storage tank after bypassing the pipe.

[18] The fuel oil discharged from the pressurized tank may be prevented from flowing back toward the feed pump.

[19] In accordance with another aspect of the present invention, there is provided a fuel oil supply system for ships to supply fuel oil to an engine fueled by both natural gas and fuel oil, the fuel oil supply system including: a storage tank storing fuel oil to be supplied to the engine; a feed pump pressurizing the fuel oil discharged from the storage tank; a pressurized tank disposed downstream of the feed pump and supplied with compressed air to store fuel oil under pressure; a circulation pump disposed

downstream of the pressurized tank to pressurize fuel oil; and a temperature regulation unit disposed downstream of the circulation pump to regulate the fuel oil pressurized by the circulation pump to a temperature required for the engine, wherein, the engine is preferentially fueled by the fuel oil stored in the pressurized tank upon operation in a fuel oil mode.

[20] The fuel oil supply system may further include a return line branched off of a line between the feed pump and the pressurized tank and joined to a line between the feed pump and the storage tank, wherein the fuel oil compressed by the feed pump in excess of what is required for the engine may be circulated via the return line.

[21] The return line may include a heat dissipation pipe.

[22] The circulation pump may compress: the fuel oil discharged from the pressurized tank; or a fluid composed of the fuel oil discharged from the pressurized tank and the fuel oil compressed by the feed pump.

[23] The fuel oil supply system may further include a level sensor measuring the amount of the fuel oil in the pressurized tank, wherein the level sensor may send a signal to the feed pump to operate the feed pump when the measured amount of the fuel oil is less than or equal to a first threshold and may send a signal to the feed pump to stop the feed pump when the measured amount of the fuel oil is greater than or equal to a second threshold, and the feed pump may pressurize the fuel oil discharged from the storage tank and supply the pressurized fuel oil to the pressurized tank when the amount of the fuel oil measured by the level sensor is less than or equal to the first threshold.

[24] The fuel oil supply system may further include: a pipe temporarily storing the fuel oil remaining after use in the engine; and a deaeration unit deaerating the fuel oil temporarily stored in the pipe, wherein the fuel oil deaerated by the deaeration unit may be sent to the circulation pump.

[25] The fuel oil supply system may further include a first valve adapted to be opened to deliver the fuel oil stored in the pipe to the storage tank when the amount of the fuel oil in the pipe is greater than or equal to a third threshold.

[26] The fuel oil supply system may further include a bypass line branched off of a line between the pipe and the engine and joined to a line between the pipe and the

storage tank, wherein the fuel oil bypasses the pipe to be sent to the storage tank along the bypass line.

[27] The fuel oil supply system may further include a flowmeter disposed downstream of the feed pump and the pressurized tank to measure a flow rate of the fuel oil to be supplied to the engine.

[28] The fuel oil supply system may further include a filtration unit disposed upstream of the engine to filter out impurities from the fuel oil to be sent to the engine.

[29] The fuel oil supply system may further include a fifth valve disposed between the feed pump and the pressurized tank to prevent the fuel oil discharged from the pressurized tank from flowing back toward the feed pump.

[30] In accordance with a further aspect of the present invention, there is provided a fuel oil supply method for ships, wherein, when an engine is operated in a fuel oil mode, the engine is preferentially fueled by fuel oil stored under pressure in a pressurized tank and is additionally fueled by fuel oil discharged from a storage tank and having been pressurized by a feed pump upon shortage of the fuel oil stored under pressure.

【Advantageous Effects】

[31] According to the present invention, with arrangement of a pressurized tank storing fuel oil under pressure by compressed air, an engine can be preferentially fueled by the fuel oil stored in the pressurized tank upon operation in a fuel oil mode, thereby preventing unnecessary energy consumption by a feed pump.

[32] In addition, according to the present invention, the feed pump is driven while the engine consumes the fuel oil stored in the pressurized tank to achieve an intended function of the feed pump without delay.

【DESCRIPTION OF DRAWINGS】

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

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

【BEST MODE】

[35] 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.

[36]

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

[38] Referring to FIG. 1, the fuel oil supply system for ships according to this embodiment includes a storage tank 300, a feed pump 400, a pressurized tank 500, a return line L1, a circulation pump 700, and a temperature regulation unit 800.

[39] In this embodiment, the storage tank 300 stores fuel oil to be supplied to an engine 100. The fuel oil remaining after use in the engine 100 may be sent to the storage tank 300, wherein a third valve 30 controlling the flow rate of the fuel oil and switchable between open and closed positions may be disposed on a line through which the fuel oil remaining after use in the engine 100 is sent to the storage tank 300.

[40] The engine 100 supplied with the fuel oil by the fuel oil supply system for ships according to this embodiment is an engine capable of being fueled by both a gas and fuel oil, and may be, for example, an ME-GI engine. In this embodiment, the engine 100 may be operated in a gas mode in which the engine is mainly fueled by natural gas or in a fuel oil mode in which the engine is fueled by the fuel.

[41] In this embodiment, the feed pump 400 pressurizes the fuel oil discharged from the storage tank 300. In this embodiment, the feed pump 400 may include a plurality of feed pumps arranged in parallel to ensure continued operation even when one or more of the feed pumps fail.

[42] In this embodiment, the pressurized tank 500 is disposed downstream of the feed pump 400 and is supplied with compressed air from the outside to store the fuel

oil under pressure. A second valve 20 controlling the flow rate of the compressed air and switchable between open and closed positions may be disposed on a line through which the compressed air is supplied to the pressurized tank 500.

[43] The fuel oil supply system for ships according to this embodiment may further include a fifth valve 50 disposed between the pressurized tank 500 and the feed pump 400 to prevent the fuel oil discharged from the pressurized tank 500 from flowing back toward the feed pump 400.

[44] Since the fuel oil supply system for ships according to this embodiment includes the pressurized tank 500, the engine 100 can be preferentially fueled by the fuel oil stored in the pressurized tank 500 when operated in the fuel oil mode.

[45] In general, consumption of fuel oil is insignificant since the engine 100 is primarily fueled by natural gas and is fueled by the fuel oil only when a shortage of the natural gas occurs. Therefore, the pressurized tank 500 alone can stably supply a sufficient amount of the fuel oil to the engine 100, and the feed pump 400 is operated when the fuel oil stored in the pressurized tank 500 is insufficient.

[46] In the fuel oil supply system for ships according to this embodiment, since the feed pump 400 is operated only in an exceptional situation where the fuel oil stored in the pressurized tank 500 is insufficient, energy consumption by the feed pump 400 can be reduced.

[47] In addition, in the fuel oil supply system for ships according to this embodiment, the feed pump 400 only needs to be driven while the engine 100 consumes the fuel oil stored in the pressurized tank 500 to achieve the intended function of the feed pump 400 without delay.

[48] Further, since consumption of the fuel oil by the engine 100 is insignificant and loss of the fuel oil is thus also insignificant, it is possible to ensure sufficient pressure to circulate the fuel oil by the circulation pump 700 without operating the feed pump 400.

[49] That is, in the fuel oil supply system for ships according to this embodiment, the engine 100 can be stably supplied with the fuel oil without operating the feed pump 400 at all times.

[50] In this embodiment, the return line L1 is branched off of a line between the

feed pump 400 and the pressurized tank 500 and is joined to a line between the feed pump 400 and the storage tank 300.

[51] The fuel oil compressed by the feed pump 400 may be supplied to the engine 100 after being further compressed by the circulation pump 700 or may be sent upstream of the feed pump 400 via the return line L1. Here, the fuel oil compressed by the feed pump 400 in excess of what is required for the engine 100 is sent upstream of the feed pump 400 via the return line L1 and is then compressed again by the feed pump 400 to be circulated continuously.

[52] A certain amount of the fuel oil is required to operate the feed pump 400. Thus, when the engine 100 does not require the fuel oil at all or requires only a small amount of the fuel oil, all or a portion of the fuel oil compressed by the feed pump 400 is circulated via the return line L1.

[53] The return line L1 may be partially formed of a heat dissipation pipe such that the fuel oil increased in both temperature and pressure in the process of being compressed by the feed pump 400 can be cooled while passing through the heat dissipation pipe. In addition, a fourth valve 40 controlling the flow rate of the fuel oil and switchable between open and closed positions may be disposed on the return line L1.

[54] For a typical fuel oil supply system free from the pressurized tank 500, since the feed pump 400 needs to be operated at all times to supply the fuel oil immediately after the engine 100 is switched to the fuel oil mode, the return line L1 is essentially required to circulate surplus fuel oil.

[55] In this embodiment, the circulation pump 700 is disposed downstream of the feed pump 400 and the pressurized tank 500 to pressurize the fuel oil. The circulation pump 700 may include a plurality of circulation pumps 400 arranged in parallel to ensure continued operation even when one or more of the circulation pumps fail.

[56] Depending on how the system is operated, the circulation pump 700 may compress the fuel oil discharged from the pressurized tank 500 or a fluid composed of the fuel oil discharged from the pressurized tank 500 and the fuel oil compressed by the feed pump 400.

[57] That is, when the engine 100 requires a relatively small amount of the fuel

oil, only the fuel oil stored in the pressurized tank 500 is supplied to the engine 100 without operating the feed pump 400, and thus the circulation pump 700 compresses the fuel oil discharged from the pressurized tank 500 and supplies the compressed fuel oil to the engine 100.

[58] On the contrary, when the engine 100 requires a relatively large amount of the fuel oil, the feed pump 400 is operated to meet fuel oil demand of the engine not covered by the fuel oil stored in the pressurized tank 500, and thus the circulation pump 700 compresses the fluid composed of the fuel oil discharged from the pressurized tank 500 and the fuel oil compressed by the feed pump 400.

[59] In this embodiment, the temperature regulation unit 800 is disposed downstream of the circulation pump 700 to regulate the fuel oil compressed by the circulation pump 700 to a temperature required for the engine 100. Depending on the configuration of the system, the temperature regulation unit 800 may be a heater or a cooler.

[60] The fuel oil supply system for ships according to this embodiment may further include a level sensor 510 disposed inside the pressurized tank 500.

[61] The level sensor 510 detects the level of the fuel oil in the pressurized tank 500 to measure the amount of the fuel oil in the pressurized tank 500. When the amount of the fuel oil measured by the level sensor 510 is less than or equal to a first threshold, the level sensor 510 sends a signal to the feed pump 400 to operate the feed pump 400.

[62] The feed pump 400 compresses the fuel oil in response to the signal from the level sensor 510 and delivers the compressed fuel oil to the pressurized tank 500. When the amount of the fuel oil in the pressurized tank 500 is increased to a level greater than or equal to a second threshold, the level sensor 510 sends a signal to the feed pump 400 to stop the feed pump 400.

[63] The fuel oil supply system for ships according to this embodiment may further include a pipe 200 and a deaeration unit 210.

[64] The pipe 200 temporarily stores the fuel oil remaining after use in the engine 100. The deaeration unit 210 removes air from the fuel oil stored in the pipe 200, wherein the removed air is discharged to the outside.

[65] Along with the fuel oil discharged from the pressurized tank 500 or the fluid composed of the fuel oil discharged from the pressurized tank 500 and the fuel oil compressed by the feed pump 400, the fuel oil deaerated by the deaeration unit 210 is sent to the circulation pump 700 to be reused as fuel for the engine.

[66] In the fuel oil supply system for ships according to this embodiment, since the fuel oil remaining after use in the engine 100 is deaerated before being circulated, it is possible to minimize bubbling during heating the fuel oil and to minimize damage to the pump due to air in the fuel oil.

[67] When the fuel oil supply system for ships according to this embodiment includes the pipe 200, the fuel oil supply system may further include a first valve 10 disposed on a line through which the fuel oil is sent to the storage tank 300 from the pipe 200.

[68] The first valve 10 remains closed under normal circumstances and is opened when the amount of the fuel oil in the pipe 200 is excessively large (that is, greater than or equal to a third threshold) to deliver the fuel oil from the pipe 200 to the storage tank 300.

[69] When the fuel oil supply system for ships according to this embodiment includes the pipe 200, the fuel oil supply system may further include a bypass line L2 branched off of a line between the pipe 200 and the engine 100 and joined to a line between the pipe 200 and the storage tank 300.

[70] When the fuel oil supply system for ships according to this embodiment includes the bypass line L2, the fuel oil remaining after use in the engine 100 may be sent to the pipe 200 or may be sent to the storage tank 300 along the bypass line L2 after bypassing the pipe 200. The bypass line L2 is not used under normal circumstances and is used when the fuel oil is replaced or when the pipe 200 is damaged and fails.

[71] The fuel oil supply system for ships according to this embodiment may further include a flowmeter 600 disposed between the pressurized tank 500 and the engine 100 to measure the flow rate of the fuel oil.

[72] Since the flowmeter 600 according to this embodiment is disposed downstream of the feed pump 400 and the pressurized tank 500, the flowmeter can

measure the flow rate of the fuel oil to be sent to the engine 100 both when only the fuel oil discharged from the pressurized tank 500 is supplied to the engine 100 and when the fluid composed of the fuel oil discharged from the pressurized tank 500 and the fuel oil compressed by the feed pump 400 is supplied to the engine 100.

[73] The fuel oil supply system for ships according to this embodiment may further include a filtration unit 900 disposed upstream of the engine 100 to filter out impurities from the fuel oil to be sent to the engine 100.

[74] Now, an exemplary flow of the fuel oil will be described using an example in which the fuel oil supply system for ships according to this embodiment further includes the pipe 200, the flowmeter 600, and the filtration device 900.

[75] When the engine 100 is in the fuel oil mode, the pressurized fuel oil having been stored in the pressurized tank 500 leaves the pressurized tank 500, passes through the flowmeter 600, and reaches the circulation pump 700. The fuel oil pressurized by the circulation pump 700 is supplied to the engine 100 after passing through the temperature regulation unit 800 and the filtration unit 900. The fuel oil remaining after use in the engine 100 is sent to the pipe 200 to be deaerated and is then sent back to the circulation pump 700.

[76] When the fuel oil in the pressurized tank 500 alone cannot meet fuel oil demand of the engine 100, the feed pump 400 is operated to compress the fuel oil discharged from the storage tank 300. Along with the discharged from the pressurized tank 500, the fuel oil compressed by the feed pump 400 is supplied to the engine after passing through the flow meter 600, the circulation pump 700, the temperature regulation unit 800, and the filtration unit 900.

[77] When the engine 100 is switched to the gas mode, the feed pump 400 is operated to compress the fuel oil discharged from the storage tank 300 and send the compressed fuel oil to the pressurized tank 500 so as to replenish the pressurized tank 500. Even in ordinary times, if the amount of the fuel oil in the pressurized tank 500 is reduced due to leakage from the pressurized tank 500 or the like, the feed pump 400 may be operated to compress the fuel oil discharged from the storage tank 300 and send the compressed fuel oil to the pressurized tank 500.

[78]

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

[80] The fuel oil supply system for ships according to the second embodiment of FIG. 2 differs from the fuel oil supply system for ships according to the first embodiment of FIG. 1 in that the return line L1 is omitted therefrom, and description below will be focused on the difference. In addition, detailed description of the same members as in the first embodiment will be omitted.

[81] Referring to FIG. 2, the fuel oil supply system for ships according to this present embodiment includes a storage tank 300, a feed pump 400, a pressurized tank 500, a return line L1, a circulation pump 700, and a temperature regulation unit 800, as in the first embodiment.

[82] As in the first embodiment, the storage tank 300 stores fuel oil to be supplied to the engine 100. As in the first embodiment, the fuel oil remaining after use in the engine 100 may be sent to the storage tank 300, wherein a third valve 30 controlling the flow rate of the fuel oil and switchable between open and closed positions may be disposed on a line through which the fuel oil remaining after use in the engine 100 is sent to the storage tank 300.

[83] As in the first embodiment, the engine 100 supplied with the fuel oil by the fuel oil supply system for ships according to this embodiment is an engine capable of being fueled by both a gas and fuel oil, and may be an ME-GI engine. As in the first embodiment, the engine 100 may be operated in a gas mode in which the engine is mainly fueled by natural gas or in a fuel oil mode in which the engine is fueled by the fuel oil.

[84] As in the first embodiment, the feed pump 400 pressurizes the fuel oil discharged from the storage tank 300. As in the first embodiment, the feed pump 400 may include a plurality of feed pumps arranged in parallel to ensure continued operation even when one or more of the feed pumps fail.

[85] As in the first embodiment, the pressurized tank 500 is disposed downstream of the feed pump 400 and is supplied with compressed air from the outside to store the fuel oil under pressure. As in the first embodiment, a second valve 20 controlling the flow rate of the compressed air and switchable between open and closed positions

may be disposed on a line through which the compressed air is supplied to the pressurized tank 500.

[86] As in the first embodiment, the fuel oil supply system for ships according to this embodiment may further include a fifth valve 50 disposed between the pressurized tank 500 and the feed pump 400 to prevent the fuel oil discharged from the pressurized tank 500 from flowing back toward the feed pump 400.

[87] As in the first embodiment, in the fuel oil supply system for ships according to this embodiment, when the engine 100 is operated in the fuel oil mode, the engine 100 is preferentially fueled by the fuel oil stored in the pressurized tank 500 and the feed pump 400 is operated only when the fuel oil stored in the pressurized tank 500 is insufficient.

[88] As in the first embodiment, in the fuel oil supply system for ships according to this embodiment, the engine 100 can be stably supplied with the fuel oil without operating the feed pump 400 at all times.

[89] As in the first embodiment, the circulation pump 700 is disposed downstream of the feed pump 400 and the pressurized tank 500 to pressurize the fuel oil. As in the first embodiment, the circulation pump 700 may include a plurality of circulation pumps arranged in parallel to ensure continued operation even when one or more of the circulation pumps fail.

[90] As in the first embodiment, when the engine 100 requires a relatively small amount of the fuel oil, only the fuel oil stored in the pressurized tank 500 is compressed by the circulation pump 700 to be supplied to the engine 100, whereas, when the engine 100 requires a relatively large amount of the fuel oil, a fluid composed of the fuel oil discharged from the pressurized tank 500 and the fuel oil compressed by the feed pump 400 is compressed by the circulation pump 700 to be supplied to the engine 100.

[91] As in the first embodiment, the temperature regulation unit 800 is disposed downstream of the circulation pump 700 to regulate the fuel oil compressed by the circulation pump 700 to a temperature required for the engine 100. As in the first embodiment, the temperature regulation unit 800 may be a heater or a cooler.

[92] As in the first embodiment, the fuel oil supply system for ships according to

this embodiment may further include a level sensor 510 disposed inside the pressurized tank 500.

[93] As in the first embodiment, the level sensor 510 detects the level of the fuel oil in the pressurized tank 500. When the amount of the fuel oil measured by the level sensor 510 is less than or equal to a first threshold, the level sensor 510 sends a signal to the feed pump 400 to operate the feed pump 400 and, when the amount of the fuel oil in the pressurized tank 500 is increased to a level greater than or equal to a second threshold, the level sensor 510 sends a signal to the feed pump 400 to stop the feed pump 400.

[94] As in the first embodiment, the fuel oil supply system for ships according to this embodiment may further include a pipe 200 and a deaeration unit 210.

[95] As in the first embodiment, the pipe 200 temporarily stores the fuel oil remaining after use in the engine 100 and the deaeration unit 210 removes air from the fuel oil stored in the pipe 200, wherein the removed air is discharged to the outside.

[96] As in the first embodiment, the fuel oil deaerated by the deaeration unit 210 is sent to the circulation pump 700 to be reused as fuel for the engine.

[97] As in the first embodiment, when the fuel oil supply system for ships according to this embodiment includes the pipe 200, the fuel oil supply system may further include a first valve 10 disposed on a line through which the fuel oil is sent to the storage tank 300 from the pipe 200.

[98] As in the first embodiment, the first valve 10 remains closed under normal circumstances and is opened to deliver the fuel oil from the pipe 200 to the storage tank 300 when the amount of the fuel oil in the pipe 200 is excessively large (that is, greater than or equal to a third threshold).

[99] As in the first embodiment, when the fuel oil supply system for ships according to this embodiment includes the pipe 200, the fuel oil supply system may further include a bypass line L2 branched off of a line between the pipe 200 and the engine 100 and joined to a line between the pipe 200 and the storage tank 300.

[100] As in the first embodiment, when the fuel oil supply system for ships according to this embodiment includes the bypass line L2, the fuel oil remaining after use in the engine 100 may be sent to the pipe 200 or may be sent to the storage tank

300 along the bypass line L2 after bypassing the pipe 200. The bypass line L2 is not used under normal circumstances and is used when the fuel oil is replaced or when the pipe 200 is damaged and fails.

[101] As in the first embodiment, the fuel oil supply system for ships according to this embodiment may further include a flowmeter 600 disposed between the pressurized tank 500 and the engine 100 to measure the flow rate of the fuel oil.

[102] As in the first embodiment, the fuel oil supply system for ships according to this embodiment may further include a filtration unit 900 disposed upstream of the engine 100 to filter out impurities from the fuel oil to be supplied to the engine 100.

[103] However, unlike the first embodiment, the return line L1 branched off of a line between the feed pump 400 and the pressurized tank 500 and joined to a line between the feed pump 400 and the storage tank 300 is omitted from the fuel oil supply system for ships according to this embodiment.

[104] According to the present invention, since the engine 100 is preferentially fueled by the fuel oil stored in the pressurized tank 500 when operated in the fuel oil mode and thus the feed pump 400 does not need to be operated at all times, it is possible to eliminate a need to continuously supply a required amount of the fuel oil to the feed pump 400 regardless of fuel oil demand of the engine and to eliminate a need to circulate the fuel oil compressed by the feed pump 400 in excess of what is required for the engine 100 via the return line L1.

[105] Therefore, according to the present invention, as in the second embodiment in which the return line L1 is omitted, there is no need to provide the return line L1 as in the related art, thereby allowing a simpler system configuration.

[106]

[107] 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 oil supply method for ships to supply fuel oil to an engine fueled by both natural gas and fuel oil, comprising:

storing fuel oil under pressure in a pressurized tank by supplying compressed air to the pressurized tank;

supplying the fuel oil stored in the pressurized tank to a circulation pump when the engine is operated in a fuel oil mode;

regulating, by a temperature regulation unit, the fuel oil pressurized by the circulation pump to a temperature required for the engine; and

supplying the fuel oil having passed through the temperature regulation unit to the engine.

【Claim 2】

The fuel oil supply method according to claim 1, wherein fuel oil stored in a storage tank is pressurized by a feed pump and supplied to the engine when the fuel oil stored in the pressurized tank does not meet fuel oil demand of the engine.

【Claim 3】

The fuel oil supply method according to claim 2, wherein the fuel oil stored in the storage tank is pressurized by the feed pump and supplied to the pressurized tank when the amount of the fuel oil in the pressurized tank is less than or equal to a first threshold.

【Claim 4】

The fuel oil supply method according to claim 2 or 3, wherein the fuel oil remaining after use in the engine is sent to the circulation pump after being

temporarily stored in a pipe to be deaerated.

【Claim 5】

The fuel oil supply method according to claim 4, wherein the fuel oil stored in the pipe is sent to the storage tank when the amount of the fuel oil in the pipe is greater than or equal to a third threshold.

【Claim 6】

The fuel oil supply method according to claim 4, wherein the fuel oil remaining after use in the engine is sent to the storage tank after bypassing the pipe.

【Claim 7】

The fuel oil supply method according to claim 2, wherein the fuel oil discharged from the pressurized tank is prevented from flowing back toward the feed pump.

【Claim 8】

A fuel oil supply system for ships to supply fuel oil to an engine fueled by both natural gas and fuel oil, comprising:

a storage tank storing fuel oil to be supplied to the engine;

a feed pump pressurizing the fuel oil discharged from the storage tank;

a pressurized tank disposed downstream of the feed pump and supplied with compressed air to store fuel oil under pressure;

a circulation pump disposed downstream of the pressurized tank to pressurize fuel oil; and

a temperature regulation unit disposed downstream of the circulation pump to regulate the fuel oil pressurized by the circulation pump to a temperature required for the engine,

wherein the engine is preferentially fueled by the fuel oil stored in the

pressurized tank upon operation in a fuel oil mode.

【Claim 9】

The fuel oil supply system according to claim 8, further comprising:
a return line branched off of a line between the feed pump and the pressurized tank and joined to a line between the feed pump and the storage tank,
wherein the fuel oil compressed by the feed pump in excess of what is required for the engine is circulated via the return line.

【Claim 10】

The fuel oil supply system according to claim 9, wherein the return line comprises a heat dissipation pipe.

【Claim 11】

The fuel oil supply system according to claim 8, wherein the circulation pump compresses the fuel oil discharged from the pressurized tank or a fluid composed of the fuel oil discharged from the pressurized tank and the fuel oil compressed by the feed pump.

【Claim 12】

The fuel oil supply system according to claim 8, further comprising:
a level sensor measuring the amount of the fuel oil in the pressurized tank,
wherein the level sensor sends a signal to the feed pump to operate the feed pump when the measured amount of the fuel oil is less than or equal to a first threshold and sends a signal to the feed pump to stop the feed pump when the measured amount of the fuel oil is greater than or equal to a second threshold, and the feed pump pressurizes the fuel oil discharged from the storage tank and supplies the pressurized fuel oil to the pressurized tank when the amount of the fuel oil measured by the level sensor is less than or equal to the first threshold.

【Claim 13】

The fuel oil supply system according to claim 8, further comprising:
a pipe temporarily storing the fuel oil remaining after use in the engine; and
a deaeration unit deaerating the fuel oil temporarily stored in the pipe,
wherein the fuel oil deaerated by the deaeration unit is sent to the circulation pump.

【Claim 14】

The fuel oil supply system according to claim 13, further comprising:
a first valve adapted to be opened to deliver the fuel oil stored in the pipe to the storage tank when the amount of the fuel oil in the pipe is greater than or equal to a third threshold.

【Claim 15】

The fuel oil supply system according to claim 13, further comprising:
a bypass line branched off of a line between the pipe and the engine and joined to a line between the pipe and the storage tank,
wherein the fuel oil bypasses the pipe to be sent to the storage tank along the bypass line.

【Claim 16】

The fuel oil supply system according to claim 8, further comprising:
a flowmeter disposed downstream of the feed pump and the pressurized tank to measure a flow rate of the fuel oil to be supplied to the engine.

【Claim 17】

The fuel oil supply system according to claim 8, further comprising:

a filtration unit disposed upstream of the engine to filter out impurities from the fuel oil to be sent to the engine.

【Claim 18】

The fuel oil supply system according to any one of claims 8 to 17, further comprising:

a fifth valve disposed between the feed pump and the pressurized tank to prevent the fuel oil discharged from the pressurized tank from flowing back toward the feed pump.

【Claim 19】

A fuel oil supply method for ships, wherein, when an engine is operated in a fuel oil mode, the engine is preferentially fueled by fuel oil stored under pressure in a pressurized tank and is additionally fueled by fuel oil discharged from a storage tank and having been pressurized by a feed pump upon shortage of the fuel oil stored under pressure.