

【Invention Title】

FUEL GAS SUPPLY SYSTEM

5 【TECHNICAL FIELD】

[1] The present invention relates to a fuel gas supply system, and more particularly, to a fuel gas supply system that supplies a fuel gas by using a liquefied gas or a boil-off gas of the liquefied gas.

10 【BACKGROUND ART】

[2] As International Maritime Organization (IMO) regulations on the emission of greenhouse gases and various air pollutants are strengthened, in shipbuilding and shipping industries, instead of using conventional fuels such as heavy oil and diesel oil, natural gas, which is a clean energy source, is
15 often used as fuel gas for ships.

[3] Conventionally, for ease of storage and transportation, natural gas is cooled to about -162 degrees Celsius to be phase-changed to liquefied natural gas (LNG) which is a colorless transparent cryogenic liquid whose volume is reduced to 1/600, thereby performing management and operation
20 of the natural gas.

[4] Such liquefied natural gas contained in a storage tank insulated and installed on a hull is stored and transported. However, since it is substantially impossible to contain the liquefied natural gas while being completely

insulated, the external heat is continuously transferred to the inside of the storage tank, and a boil-off gas generated due to natural vaporization of the liquefied natural gas is accumulated in the storage tank. Since the boil-off gas may increase the internal pressure of the storage tank and cause deformation and damage of the storage tank, there is a need to treat and remove the boil-off gas.

[5] Thus, according to the related art, boil-off gas is flowed into a vent mast provided at the upper side of a storage tank, or a scheme of burning boil-off gas by using a gas combustion unit (GCU) has been used. However, this is not a preferable scheme in terms of energy efficiency. Therefore, it is necessary to supply the boil-off gas to the engine of ship separately or together with the liquefied natural gas as fuel or to re-liquefy the boil-off gas by using a re-liquefying apparatus including refrigeration cycle and the like for use.

[6] Power generation facilities using liquefied gas, such as liquefied natural gas, are installed mainly on the land. To this end, the land has to be purchased and transmission lines have to be installed, so that excessive installation costs were incurred. Thus, in recent years, there have been increased cases in which a floating power generation system is installed on a coastal area where raw material supply is easy and the cost of securing land is low.

[7] Generally, a floating power generation system includes a re-condenser for re-condensing the boil-off gas generated due to the

vaporization liquefied gas from a storage tank storing the liquefied gas to be used as fuel for a gas turbine or the like. However, when the liquefied gas is shipped from the liquefied gas carrier carrying the liquefied gas to the storage tank, a large amount of boil-off gas is generated due to heat received during transportation or the like as compared with a normal state. As described above, when a large amount of boil-off gas is generated as compared with a normal state, the amount of boil-off gas generated may exceed the capacity of a conventional re-condenser.

[8] In general, the floating power generation system includes a vaporizer for vaporizing a liquefied gas before supplying liquefied gas to a gas turbine that generates electricity using liquefied gas. In addition, the floating power generation system may also include an air cooler that cools the air supplied to the gas turbine to increase the efficiency of the gas turbine. The thermal fluid or cooling fluid used in the vaporizer and the air cooler and the system for circulating thermal fluid or cooling fluid are generally separated from a cooling system that cools other components of a float member or floating power generation system, such as a ship equipped with a floating power generation system, which is required to be cooled.

20 【DETAILED DESCRIPTION OF THE INVENTION】

【TECHINICAL PROBLEM】

[9] It is an object of the present invention to provide a fuel gas supply system which is capable of effectively re-condensing the boil-off gas of which

the amount is greatly changed according to the operation mode, with a small supply amount of the liquefied gas.

[10] An another object of the present invention is to provide a fuel gas supply system capable of reducing the amount of boil-off gas generated.

5 [11] A still another object of the present invention is to provide a fuel gas supply system capable of utilizing a large amount of boil-off gas.

[12] A still another object of the present invention is to provide a fuel gas supply system capable of adjusting the temperature of a heat source flowing into a vaporizer.

10 [13] A still another object of the present invention is to provide a fuel gas supply system capable of increasing cooling and heating efficiency.

【TECHNICAL SOLUTION】

[14] In accordance with an aspect of the present invention, a fuel gas
15 supply system includes a storage unit that contains a liquefied gas and a boil-off gas generated from the liquefied gas; a compression unit that compresses the boil-off gas generated in the storage unit and transfer the compressed boil-off gas; a re-condensation unit that re-condenses the boil-off gas compressed in the compression unit by using a super-cooled liquefied gas of
20 the storage unit; a high-pressure pump unit that is installed on a consumer supply line connected from the re-condensation unit to a consumer to pressurize the liquefied gas of the re-condensation unit at a pressure requested by the consumer or more; and a heat-exchange unit including a

vaporizer that heats the liquefied gas pressurized in the high-pressure pump unit to re-vaporize the liquefied gas, wherein the re-condensation unit includes a first condensation part that mixes the liquefied gas transferred from the storage unit and the boil-off gas compressed in the compression unit
5 to re-condense the boil-off gas; and a second condensation part that exchanges heat between the liquefied gas which is pressurized in and transferred from the high-pressure pump unit and the boil-off gas compressed in the compression unit to re-condense the boil-off gas.

[15] The compression unit may include a first compression part that
10 compresses the boil-off gas transferred from the storage unit and transfers the compressed boil-off gas to the first condensation part; and a second compression part that compresses the boil-off gas and transfer the compressed boil-off gas to the second condensation part when the boil-off gas is generated more than a re-condensation capacity of the first
15 condensation part or more.

[16] The fuel gas supply system may further include a minimum flow line branched from a rear end of the high-pressure pump unit and circulated to the first condensation part, wherein the second condensation part is installed on a condensation line branched from the minimum flow line and connected
20 to the rear end of the high-pressure pump unit such that heat exchange between the liquefied gas passing through the condensation line and the boil-off gas flowing from the compression unit to the first condensation part is performed.

[17] The boil-off gas re-condensed in the second condensation part may be collected in the first condensation part.

[18] The first condensation part may mix the liquefied gas pressurized by a supply pump of the storage unit with the boil-off gas compressed by the first
5 compression part of the compression unit, and re-condense all or a part of the boil-off gas.

[19] The compression unit may further include a high-pressure compression part that compresses a part of the boil-off gas generated in the storage unit to transfer the compressed part of the boil-off gas to the
10 consumer supply line on a rear end of the vaporizer.

[20] The heat exchange unit 500 may further include a heater provided on a rear end of the vaporizer to heat a fluid passing through the vaporizer to a temperature required by a consumer.

[21] In accordance with another aspect of the present invention, a fuel gas
15 supply system includes a liquefied gas supply line that transfers a liquefied gas contained in a storage unit to a first condensation part; a boil-off gas first supply line that transfers boil-off gas contained in the storage unit to the first condensation part through a first compression part; a boil-off gas second supply line that transfers the boil-off gas contained in the storage unit to a
20 second condensation part through a second compression part; a consumer supply line that transfers the liquefied gas stored in the first condensation part to a consumer through a high-pressure pump unit and a vaporizer; and a condensation line branched from and rejoined with a rear end of the high-

pressure pump unit of the consumer supply line to bypass the liquefied gas pressurized in the high-pressure pump unit, wherein the second condensation part allows heat to be exchanged between the boil-off gas of the boil-off gas second supply line and the liquefied gas of the condensation
5 line to re-condense the boil-off gas of the boil-off gas second supply line.

[22] The liquefied gas supply line may include a liquefied gas first supply line and a liquefied gas second supply line, wherein the first condensation part sprays the liquefied gas supplied from the liquefied gas second supply line to the boil-off gas stored in the first condensation part to re-condense the
10 boil-off gas.

[23] The fuel gas supply system may further include a minimum flow line connected from the rear end of the high-pressure pump unit of the consumer supply line to the first condensation part, wherein the condensation line is branched from the minimum flow line and rejoined with the rear end of the
15 high-pressure pump unit of the consumer supply line.

[24] The fuel gas supply system may shut off a fluid flow from the boil-off gas second supply line, the condensation line and the consumer supply line to the consumer when being driven at a minimum flow rate, and allows the liquefied gas stored in the first condensation part to circulate through the
20 high-pressure pump unit and the minimum flow line, thereby enabling continuous operation of the high-pressure pump unit.

[25] The fuel gas supply system may shut off the fluid flow to the boil-off gas second supply line and the condensation line during normal operation

and disable the operation of the second condensation part, open the fluid flow to the boil-off gas second supply line and the condensation line during loading operation, and operate the second condensation part, thereby being operated differently according to an operation mode.

5 [26] The fuel gas supply system may further include a boil-off gas high-pressure supply line that pressurizes an excessive boil-off gas using the high-pressure compression part to directly supply the excessive boil-off gas to a rear end of the vaporizer when an amount of the boil-off gas generated in the storage unit is excessive or more than an amount that is capable of
10 being re-condensed in the first and second condensation parts during the loading operation.

[27] The fuel gas supply system may further include a heater for adjusting the temperature of the fuel gas supplied to the customer, and a heat exchange line branched from the customer supply line.

15 [28] The fuel gas supply system may further include a vaporization reduction module that reduces a vaporization amount of the liquefied gas in the storage unit, wherein the vaporization reduction module includes a cooling unit that cools a storage tank of the storage unit.

[29] The cooling unit may include a spray member that sprays the liquefied
20 gas stored in the storage tank into the storage tank; a spray pump that supplies the liquefied gas stored in the storage tank to the spray member; and a spray line that connects the spray member and the spray pump.

[30] The fuel gas supply system may further include a shipment unit that transfers the liquefied gas from a liquefied gas carrier to the storage tank, wherein the vaporization reduction module further includes a controller that controls the cooling unit to cool the storage tank before the shipment unit
5 transfers the liquefied gas.

[31] The controller may control the cooling unit to cool the storage tank while the shipment unit transfers the liquefied gas.

[32] The vaporization reduction module may further include a pressure regulation unit that regulates a pressure in the storage tank.

10 [33] The controller may control the pressure regulation unit to pressurize an inside of the storage tank for a first time before or after the shipment unit starts a liquefied gas transfer and to maintain a pressure inside the storage tank for a second time after the first time.

[34] The controller may control the pressure regulation unit to depressurize
15 the inside of the storage tank for a third time after the second time.

[35] The fuel gas supply system may further include a boil-off gas supply line through which a boil-off gas is transferred from the storage tank to the re-condensation unit, and the pressure regulation unit may include a pressure regulating valve that regulates an opening rate of the boil-off gas supply line.

20 [36] The consumer may include a gas power generation module provided with a gas turbine that generates electricity by using a liquefied gas, and the fuel gas supply system may further include an excess gas supply unit that

compresses a part of the boil-off gas in the boil-off gas supply line and supplies the compressed part of the boil-off gas to the gas turbine.

[37] The fuel gas supply system may further include a boil-off gas transfer unit that transfers a part of the boil-off gas generated in the storage tank to
5 the liquefied gas carrier.

[38] The boil-off gas transfer unit may include a transfer line provided to transfer a part of the boil-off gas generated in the storage tank to the liquefied gas carrier; and a transfer gas pressurizer that pressurizes the boil-off gas in the transfer line toward the liquefied gas carrier.

10 [39] The boil-off gas transfer unit may include a bypass line provided to transfer the boil-off gas from the storage tank to the liquefied gas carrier by bypassing the transfer gas pressurizer.

[40] The boil-off gas transfer unit may include a pressure regulating member that regulates a pressure of the liquefied gas storage tank in which
15 the liquefied gas of the liquefied gas carrier is stored.

[41] The fuel gas supply system may further include a circulation module that circulates a cooling fluid, wherein the circulation module includes a main circulation module that circulates the cooling fluid to cool an cooling object; and an auxiliary circulation module that branches the cooling fluid circulated
20 by the main circulation module to circulate the cooling fluid to flow into the vaporizer, thereby heat-exchanging with the liquefied gas in the vaporizer.

[42] The consumer may include a gas generating module provided with a gas turbine that generates electricity by using the liquefied gas, wherein the

gas generating module includes an air cooler that cools an outside air flowing into the gas turbine, and the auxiliary circulation module circulates the cooling fluid such that the cooling fluid after heat exchange with the liquefied gas in the vaporizer flows into the air cooler to exchange heat with the
5 outside air.

[43] The main circulation module may include a cooling unit that cools the cooling fluid; a main circulation pipe through which the cooling fluid flows to circulate between the cooling unit and the cooling object; and a main pump that pressurizes the cooling fluid such that the cooling fluid flows through the
10 main circulation pipe.

[44] The auxiliary circulation module may include a temperature regulating unit for regulating a temperature of the cooling fluid flowing into the vaporizer, wherein the temperature regulating unit includes a mixing member in which a first fluid as the cooling fluid flowing from the cooling unit to the cooling object
15 is mixed with a second fluid as the cooling fluid flowing from the cooling object to the cooling unit; and a controller that controls the mixing member to adjust a mixing ratio between the first fluid and the second fluid according to a temperature of the outside air and the temperature of the cooling fluid flowing into the vaporizer.

20 [45] A third fluid, which is a cooling fluid having completed heat exchange with the liquefied gas in the vaporizer, may be mixed with the first fluid and the second fluid in the mixing member, and the controller may control the mixing member to adjust a mixing ratio between the first fluid, the second

fluid and the third fluid according to the temperature of the outside air and the temperature of the cooling fluid flowing into the vaporizer.

[46] The auxiliary circulation module may include a bypass flow path provided to allow the cooling fluid to bypass the air cooler.

5 [47] The auxiliary circulation module may circulate the cooling fluid such that the cooling fluid passing through the air cooler or the bypass flow path is mixed with the first fluid and supplied to the cooling object.

[48] The controller may regulate a flow rate of the cooling fluid flowing into the vaporizer according to the temperature of the outside air and the
10 temperature of the cooling fluid flowing into the vaporizer.

[49] The fuel gas supply system may further include a circulation module that circulates a cooling fluid and an intermediate heat medium, wherein the circulation module includes a main circulation module that circulates the cooling fluid to cool a cooling object; an auxiliary circulation module that
15 circulates the intermediate heat medium to vaporize the liquefied gas in the vaporizer; and a heater that heats the intermediate heat medium by exchanging heat between the cooling fluid circulated by the main circulation module and the intermediate heat medium circulated by the auxiliary circulation module.

20 [50] The consumer may include a gas generating module provided with a gas turbine that generates electricity by using the liquefied gas, wherein the gas generating module includes an air cooler that cools an outside air introduced into the gas turbine, and the auxiliary circulation module circulates

the intermediate heat medium such that the intermediate heat medium flows into the air cooler to exchange heat with the outside air after exchanging heat with the liquefied gas in the vaporizer.

[51] The auxiliary circulation module may include a temperature regulating unit that regulates a temperature of the intermediate heat medium flowing into the vaporizer, wherein the temperature regulating unit includes a bypass pipe that is provided to allow the intermediate heat medium to bypass the heater; a regulating valve that controls a flow of the intermediate heat medium bypassed to the bypass pipe; and a controller that controls the flow of the intermediate heat medium by controlling the regulating valve according to a temperature of an outside air and a temperature of the intermediate heat medium heated by the heater and flowing into the vaporizer.

【 ADVANTAGEOUS EFFECTS OF THE INVENTION 】

[52] According to the fuel gas supply system of the present invention, since the liquefied gas can be re-vaporized and supplied to the consumer (HP fuel gas consumer), it is possible to reduce the cost of the exhaust gas treatment equipment due to a small exhaust amount of sulfur oxide (SOx), nitrogen oxide (NOx), or the like.

[53] In addition, it is possible to effectively re-condense the boil-off gas of which the amount is greatly changed according to the operation mode, with a small supply amount of the liquefied gas.

[54] In addition, the boil-off gas generated during operation may be collected and used as fuel. For example, the boil-off gas generated in various operations, particularly, the boil-off gas excessively generated in the loading operation is re-condensed and collected by using the second compression
5 part (Aux. LP BOG compressor) and the second condensation part (Aux. BOG re-condenser).

[55] In addition, since the liquefied gas passing through the second condensation part is pressurized and sufficiently sub-cooled by the high-pressure pump unit (HP LNG booster pump) during loading operation, even
10 though the liquefied gas exchanges heat with the boil-off gas (BOG) transferred from the second compression part to the first condensation part, any boil-off gas is not generated so that it is possible to efficiently supply the fuel gas.

[56] In addition, since a part of the liquefied gas passing through the high-
15 pressure pump unit condenses the boil-off gas in the second condensation part so that the boil-off gas is re-condensed and used without any additional energy sources, there is not required any re-liquefying apparatus. Thus, energy required for re-liquefaction can be minimized

[57] In addition, the second condensation part (Aux. BOG re-condenser) is
20 installed to re-condense the excess boil-off gas generated during loading operation and is installed on the condensation line branched from the minimum flow line, so that it is possible to minimize the quantity of pipes.

[58] In addition, in case where the excess boil-off gas generated during the loading operation is liquefied, the amount required for liquefaction is adjusted and used through the condensation line without using the entire amount of the liquefied gas pressurized by the high-pressure pump unit (HP LNG booster pump), thereby reducing the quantity of pipes and minimizing the size of the second condensation part (Aux. BOG recondenser).

[59] In addition, since the excess boil-off gas passes through the second condensation part only during the loading operation, there is no problem of energy loss due to pressure drop during normal operation.

10 [60] In addition, since the compression unit includes three parts of the first and second compression parts (the first and second low-pressure compression parts), and the high-pressure compression part, the three parts may be selectively used according to the operating state. For example, during the loading operation unlike the normal operation, when the excess
15 boil-off gas is generated, for the remaining boil-off gas exceeding the capacity that can be processed by the first compression part, the second compression part is used, so that the first and second low-pressure compression parts take charge of the transfer of the boil-off gas. Further, when the boil-off gas exceeding the capacity of the first and second low-
20 pressure compression parts is generated, the high-pressure compression part may be applied and used for the remaining boil-off gas.

[61] In addition, the boil-off gas re-condensed through the second condensation part (Aux. BOG recondenser) is transferred to the first

condensation part (Main BOG recondenser) instead of the storage tank, thereby reducing energy waste. That is, when the re-condensed boil-off gas is returned to the low-pressure storage tank, it is necessary to pressurize the boil-off gas again in the low-pressure (5 kPag) environment by using the supply pump and transfer the boil-off gas to the first condensation part, so that it is possible to reduce energy waste as much as that.

[62] In addition, the amount of boil-off gas can be reduced, and a large amount of boil-off gas can be utilized.

[63] In addition, the temperature of the heat source flowing into the vaporizer for vaporizing the liquefied gas can be adjusted, so that the cooling and heating efficiency can be increased.

【 DESCRIPTION OF THE DRAWINGS 】

[64] FIG. 1 illustrates a fuel gas supply system according to a first embodiment of the present invention.

[65] FIG. 2 illustrates a fuel gas supply system according to a second embodiment of the present invention.

[66] FIG. 3 illustrates a normal operation state of a fuel gas supply system according to a second embodiment of the present invention.

[67] FIG. 4 illustrates a minimum flow operation state of the fuel gas supply system according to the second embodiment of the present invention.

[68] FIG. 5 illustrates a loading operation state of the fuel gas supply system according to the second embodiment of the present invention.

[69] FIG. 6 illustrates a fuel gas supply system according to a third embodiment of the present invention.

[70] FIG. 7 illustrates a fuel gas supply system according to a fourth embodiment of the present invention.

5 [71] FIG. 8 illustrates a fuel gas supply system according to a fifth embodiment of the present invention.

[72] FIG. 9 illustrates a fuel gas supply system according to a sixth embodiment of the present invention.

10 [73] FIG. 10 is a block diagram illustrating the temperature regulation unit of FIG. 9.

[74] FIG. 11 illustrates a fuel gas supply system according to a seventh embodiment of the present invention.

[75] FIG. 12 illustrates a fuel gas supply system according to an eighth embodiment of the present invention.

15 [76] FIG. 13 is a block diagram illustrating the temperature regulation unit of FIG. 12.

[77] FIG. 14 illustrates a fuel gas supply system according to a ninth embodiment of the present invention.

20 **【 BEST MODE 】**

[78] Hereinafter, the embodiments of the present disclosure will be described in detail with reference to accompanying drawings. In the drawings, the portions irrelevant to the description will not be shown in order

to make the present disclosure clear, and the sizes of the components may be somewhat exaggerated in order to help understanding the present disclosure. In addition, the same reference numerals used in each drawing represent the same elements.

5 [79] Hereinafter, the liquefied natural gas and the boil-off gas generated from the liquefied natural gas are described as an example to facilitate understanding of the present invention, but the present invention is not limited thereto. Thus, even when various liquefied gases, such as liquefied ethane gas and liquefied hydrocarbon gas, and boil-off gas generated
10 therefrom are applied, the present invention should be equally understood by the same technical idea.

[80] FIG. 1 illustrates a fuel gas supply system according to a first embodiment of the present invention. Referring to FIG. 1, a fuel gas supply system according to the first embodiment may include a storage unit 100 for
15 containing a liquefied gas and a boil-off gas generated from the liquefied gas, a compression unit 200 for compressing the boil-off gas generated in the storage unit and transferring the compressed boil-off gas, a re-condensation unit 300 for re-condensing the boil-off gas compressed in the compression unit 200 by using a super-cooled liquefied gas of the storage unit 100, a high-
20 pressure pump unit 400 installed on a consumer supply line L30 connected from the re-condensation unit 300 to a consumer 10 to pressurize the liquefied gas of the re-condensation unit 300 at a pressure requested by the consumer 10 or more, and a heat exchange unit 500 including a vaporizer

510 for heating the liquefied gas pressurized in the high-pressure pump unit 400 to re-vaporize the liquefied gas, where the re-condensation unit 300 includes a first condensation part 310 for mixing the liquefied gas transferred from the storage unit 100 and the boil-off gas compressed in the compression unit 200 to re-condense the boil-off gas, and a second condensation part 320 for exchanging heat between the liquefied gas which is pressurized in and transferred from the high-pressure pump unit 400 and the boil-off gas compressed in the compression unit 200 to re-condense the boil-off gas.

10 [81] In other words, the fuel gas supply system according to the first embodiment may include a liquefied gas supply line L10 for transferring a liquefied gas contained in the storage unit 100 to the first condensation part 310, a boil-off gas first supply line L21 for transferring a boil-off gas contained in the storage unit 100 to the first condensation part 310 through a first
15 compression part 210, a boil-off gas second supply line 220 for transferring the boil-off gas contained in the storage unit 100 to the first condensation part 310 through a second compression part 220, a consumer supply line L30 for transferring the liquefied gas stored in the first condensation part 310 to the consumer 10 through the high-pressure pump unit 400 and the vaporizer 510,
20 a condensation line L41 branched from and rejoined with a rear end of the high-pressure pump unit 400 of the consumer supply line L30 to bypass the liquefied gas pressurized in the high-pressure pump unit 400, and the second condensation part 320 that allows heat to be exchanged between the boil-off

gas of the boil-off gas second supply line L22 and the liquefied gas of the condensation line L41 to re-condense the boil-off gas of the boil-off gas second supply line L22. Hereinafter, each part of the fuel gas supply system will be described in detail.

5 [82] First, the consumer 10 may be an engine which receives a fuel gas in a gaseous state through a boil-off gas supply line L20 or the liquefied gas supply line L10, which will be described below, to generate the propulsive force of a ship, where the fuel gas is composed of a boil-off gas or the like which is generated when the liquefied gas contained in the storage unit 100
10 is vaporized or naturally vaporized. For example, the engine may be a gas turbine, which is a rotary type heat engine driven by high temperature and high pressure combustion gas, a high-pressure gas injection engine such as an ME-GI engine, or an X-DF engine capable of receiving a fuel gas such as a medium pressure fuel gas of about 15 to 17 bar and generating an output.
15 However, the present invention is not limited thereto, and may include various types of engines if the engine can receive a fuel gas in a gaseous state and generate an output.

[83] A gas combustion unit (GCU) 20 may consume the fuel gas in such a manner as to receive the fluid pressurized by the first compression part 210
20 from the boil-off gas first supply line L21 and incinerate the fluid.

[84] The storage unit 100 will be described. The storage unit 100 may include a plurality of storage tanks 101 arranged in parallel. In this case, each of the storage tanks 101 receives and stores the liquefied fuel supplied from

a production site of natural gas, and stably keeps the liquefied fuel until it arrives at the destination and unloads the liquefied fuel. In addition, the storage tank 101 may be provided with a membrane-type cargo storehouse that is heat-insulated to minimize vaporization of liquefied fuel due to external
5 heat penetration. The liquefied fuel stored in the storage tank 101 may be used as a fuel gas for a propulsion engine, a power generation engine, and a GCU of a ship as described later.

[85] A supply pump 110 may be provided at an inlet side end of the liquefied gas supply line L10 in the storage tank 101 and may be provided
10 adjacent to a bottom surface inside the storage tank 101 to improve the operation efficiency. The supply pump 110 may transfer the liquefied gas stored in the storage tank 101 to the liquefied gas supply line L10.

[86] A circulation line 120 returns a part of the liquefied gas supplied to the liquefied gas supply line L10 through the supply pump 110 to the storage
15 tank 101 again such that an amount of liquefied gas supplied to the first condensation part 310 may be adjusted according to an amount of liquefied gas in the first condensation part 310 or the amount of fuel required by the consumer 10.

[87] Next, the compression unit 200 will be described. The compression
20 unit 200 may include the first compression part 210 for compressing the boil-off gas transferred from the storage unit 100 to transfer it to the first condensation part 310, and the second compression part 220 for transferring the boil-off gas to the second condensation part 320 when the amount of the

generated boil-off gas is equal to or greater than the re-condensation capacity of the first condensation part 310.

[88] The first compression part 210 may be provided on the boil-off gas first supply line L21 and the second compression part 220 may be provided
5 on the boil-off gas second supply line L22. In this case, the first compression part 210 may be always operated according to the operation mode of the fuel gas supply system, and the second compression part 220 may be operated only during a loading operation. Since a large amount of boil-off gas is generated in the storage unit 100 during the loading operation, the first and
10 second compression units 210 and 220 are operated together.

[89] The re-condensation unit 300 will be described. The re-condensation unit 300 substantially includes the first and second condensation parts 310 and 320.

[90] The first condensation part 310 may serve as a reservoir for
15 temporarily storing the liquefied gas supplied from the liquefied gas supply line L10. In addition, the first condensation part 310 may mix the liquefied gas pressurized by the supply pump 110 of the storage unit 100 with the boil-off gas compressed by the first compression part 210 of the compression unit 200, and may re-condense all or a part of the boil-off gas. In this case, re-
20 condensation of the inflow boil-off gas may be implemented by spraying the liquefied gas supplied through a liquefied gas second supply line L12.

[91] The second condensation part 320 may be provided on the condensation line L41 which will be described later and may re-condense the

boil-off gas which passes through the boil-off gas second supply line L22 toward the first condensation part 310 by using the liquefied gas which is pressurized by the high-pressure pump unit 400 in the consumer supply line L30 by heat exchange with the boil-off gas first and second supply lines L21
5 and L22.

[92] The high-pressure pump unit 400 may transfer the liquefied gas contained in the first condensation part 310 to the consumer supply line L30, and simultaneously, may pressurize the liquefied gas at a pressure level corresponding to a pressure condition of the fuel gas required by the
10 consumer 10. For example, when the consumer 10 is a gas turbine, the high-pressure pump unit 400 may pressurize the liquefied gas to about 30 to 40 bar and transfer it to the vaporizer 510.

[93] The heat exchange unit 500 includes the vaporizer 510 to vaporize the liquefied gas supplied from the first compression part 210 to the consumer 10
15 through the consumer supply line L30. In addition, the heat exchange unit 500 may further include not only the vaporizer 510 but also a heater 520 provided on a rear end of the vaporizer 510 to heat the fluid passing through the vaporizer 510 to a temperature required by the consumer 10. In other words, a heat exchange line L31 is additionally provided on the consumer
20 supply line L30 and the heater 520 is provided on the heat exchange line L31 to regulate the temperature of the fuel gas supplied to the consumer 10 through the consumer supply line L30. The heat exchange line L31 may

constantly supply the fuel supplied to the consumer 10 through the consumer supply line L30 at a temperature required by the consumer 10.

[94] The liquefied gas supply line L10 connects the storage unit 100 and the re-condensation unit 300 described above. In detail, the liquefied gas supply line L10 supplies the fuel gas transferred from the supply pump 110 provided at one side end to the first condensation part 310. The liquefied gas supply line L10 may include a liquefied gas first supply line L11 and the liquefied gas second supply line L12.

[95] The liquefied gas first supply line L11 may be branched from the liquefied gas supply line L10 and connected to a lower portion of the first condensation part 310. The liquefied gas second supply line L12 may be branched from the liquefied gas supply line L10 and connected to an upper portion of the first condensation part 310. The liquefied gas second supply line L12 may spray the liquefied gas to an upper portion of the first condensation part 310, thereby re-condensing the boil-off gas supplied to an inside of the first condensation part 310.

[96] The boil-off gas supply line L20 may supply the boil-off gas stored in the storage unit 100 to the compression unit 200. The boil-off gas first and second supply lines L21 and L22 may be branched from a rear end of the boil-off gas supply line L20.

[97] The boil-off gas first supply line L21 may extend from the boil-off gas supply line L20 toward the GCU 20. In this case, the boil-off gas first supply

line L21 may be provided with the first compression part 210 for pressurizing and supplying the boil-off gas to the GCU 20.

[98] In addition, the boil-off gas first supply line L21 may extend toward the GCU 20 and may transfer a part of the boil-off gas to first and second branch
5 lines L21a and L21b. In this case, the first branch line L21a may connect the boil-off gas first and second supply lines L21 and L22 and the second branch line L21b may connect the boil-off gas first supply line L21 and the first condensation part 310 to transfer the boil-off gas to the boil-off gas second supply line L22 or the first condensation part 310.

10 [99] The boil-off gas second supply line L22 may extend from the boil-off gas supply line L20 toward the first condensation part 310 via the second compression part 220 and the second condensation part 320. The boil-off gas second supply line L22 may be used only when an excessive amount of boil-off gas which is difficult to be processed in the boil-off gas first supply
15 line L21 is generated in the storage tank 101, and the relative amount of fluid passing therethrough may be small compared to the boil-off gas first supply line L21. In addition, the boil-off gas passing through the boil-off gas second supply line L22 may be re-condensed in the second condensation part 320 to be collected in the first condensation part 310.

20 [100] The consumer supply line L30 pressurizes the liquefied gas passing through the first condensation part 310 via the high-pressure pump unit 400 and vaporizes the pressurized liquefied gas in the vaporizer 510 to be supplied to the consumer 10.

[101] A minimum flow line L40 connected to the first condensation part 310 may be provided on a rear end of the high-pressure pump unit 400 of the consumer supply line L30, and the condensation line L41 may be branched from the minimum flow line L40 and rejoined to the rear end of the high-pressure pump unit 400 of the consumer supply line L30.

[102] The minimum flow line L40 may be a line that returns the liquefied gas from the rear end of the high-pressure pump unit 400 of the consumer supply line L30 to the first condensation part 310 again. There is the minimum flow rate that the high-pressure pump unit 400 may continuously transfer the liquefied gas without causing a trouble or the like. The minimum flow line L40 for flowing the minimum flow rate may be secured, so that the high-pressure pump unit 400 may be driven without difficulty before a normal state or in a standby state.

[103] The condensation line L41 is provided with the second condensation part 320 for re-condensing the excess boil-off gas generated in a loading operation mode which will be described later, where the second condensation part 320 may be installed while being branched from the minimum flow line L40.

[104] FIG. 2 illustrates a fuel gas supply system according to a second embodiment of the present invention. Since the description of the second embodiment described below is the same as the description of the fuel gas supply system according to the first embodiment except for the additional

description of other reference numerals, the description of the same parts is omitted to avoid duplication of contents.

[105] Referring to FIG. 2, when the boil-off gas is excessively generated in the storage tank 101, the boil-off gas supply line L20 may be provided with a
5 boil-off gas high-pressure supply line L23 through which the excess boil-off gas pressurized by a high-pressure compression part 230 is supplied to a rear end of the vaporizer 510 of the consumer supply line L30. This function serves as means for supplying the boil-off gas directly to the consumer 10
when the boil-off gas is excessively generated in a loading operation mode to
10 be described later.

[106] FIG. 3 illustrates a normal operation state of a fuel gas supply system according to the second embodiment of the present invention. FIG. 4 illustrates a minimum flow operation state of the fuel gas supply system according to the second embodiment of the present invention. FIG. 5
15 illustrates a loading operation state of the fuel gas supply system according to the second embodiment of the present invention.

[107] Referring to the drawings, the fuel gas supply system according to the second embodiment of the present invention may be substantially operated in three operation modes of a normal operation mode, a minimum flow
20 circulation mode, and a loading operation mode.

[108] In the minimum flow circulation mode, the fluid flow from the boil-off gas second supply line L22, the condensation line L41, and the consumer supply line L30 to the consumer 10 is blocked. The liquefied gas stored in the

first condensation part 310 may be circulated through the high-pressure pump unit 400 to enable the high-pressure pump unit 400 to be continuously operated.

[109] In the normal operation mode, the fluid flow to the boil-off gas second supply line L22 and the condensation line L41 may be cut off and the operation of the second condensation part 320 may be stopped. In the loading operation, the fluid flow to boil-off gas second supply line L22 and the condensation line L41 may be opened and the second condensation part 320 may be operated, so that they may be operated differently according to the operation mode. Hereinafter, the operation schemes in the respective modes will be described in detail.

[110] A. Normal operation mode

[111] In the storage tank 101, the liquefied gas is pressurized to a predetermined pressure by the supply pump 110 and transferred to the first condensation part 310. In this case, since the liquefied gas is pressurized, the liquefied gas may be super-cooled at the corresponding pressure and maintained in a liquid state even when the temperature rises to some extent.

[112] The boil-off gas (BOG) is generated in the storage tank 101 for storing the liquefied gas. The generating amount of boil-off gas is varied with the thickness of the insulation provided in the storage tank 101 and the size of the storage tank 101, an ambient condition, a storage capacity of boil-off gas, and the like. In this case, since the thickness of the insulation, the size of the storage tank 101, and the ambient condition are fixed values at the time of

design, the maximum boil-off gas generation amount (Max. NBOG) may be estimated under conservative conditions according to the storage capacity of liquefied gas in the storage state.

[113] The boil-off gas is pressurized by the first compression part 210 in the
5 boil-off gas first supply line L21 and is transferred to the first condensation part 310. In addition, the boil-off gas is re-condensed by the super-cooled liquefied gas transferred from the storage tank 101 through the supply pump 110 in the first condensation part 310.

[114] The liquefied gas and the re-condensed boil-off gas in the first
10 condensation part 310 are sufficiently pressurized by the high-pressure pump unit 400 in order to meet the required pressure of the consumer 10. The liquefied gas pressurized at a high pressure is vaporized again in the vaporizer 510 and becomes a gaseous state. In this case, the heat source may be seawater, heated cooling water, or the like. In addition, if necessary,
15 the temperature of the fuel gas re-vaporized is heated to a temperature required by the consumer 10 in the heater (fuel gas heater) 520. The heat source may be steam or the like.

[115] B. Minimum flow circulation mode

[116] In the initial operation and the standby state, the high-pressure pump
20 unit 400 may be operated without being turned off. This is possible by circulating a part of the liquefied gas stored in the first condensation part 310 through the high-pressure pump unit 400 and the minimum flow line L40 to the first condensation part 310. In this case, the first condensation part 310

does not perform the re-condensation but may be operated to temporarily store the liquefied gas and to separate the boil-off gas like a suction drum.

[117] In this mode, since the liquefied gas is not large enough to re-condense the boil-off gas and repeats the recirculation through the minimum
5 flow line L40, the re-condensation cannot be performed so that all the boil-off gas is transferred to the GCU 20 and incinerated. If impossible, the boil-off gas may be vent.

[118] C. Loading operation mode

[119] Basically, the same operation as the normal operation mode is
10 performed. In the loading operation mode, an excessive amount of boil-off gas is generated as compared with the normal operation mode. The amount of boil-off gas generated differs depending on the loading scheme and the system configuration. The following three cases apply differently.

[120] 1) Amount of generated boil-off gas < capacity of second
15 condensation part 320

[121] Only the boil-off gas that can control the pressure and the level of the first condensation part 310 is transferred to the first condensation part 310 by using a first low-pressure compression part (main LP boil-off gas compressor), and the remaining boil-off gas is transferred to the second
20 condensation part 320 by using the first low-pressure compression part (main LP boil-off gas compressor) and the second low-pressure compression part (Aux. LP boil-off gas compressor), and the entire amount is re-condensed. In

this case, the refrigerant, which is the liquefied gas pressurized by the high-pressure pump unit 400, is branched from the minimum flow line L40 and supplied to the second condensation part 320.

[122] 2) Capacity of second condensation part 320 < amount of generated
5 boil-off gas < capacity of second condensation part 320 + first condensation part 310

[123] The boil-off gas that can be re-condensed by the second condensation part 320 is first transferred to the second condensation part 320 and the remaining boil-off gas is transferred to the first condensation part 310 to be
10 re-condensed.

[124] 3) Capacity of second condensation part 320 + first condensation part 310 < amount of generated boil-off gas

[125] Basically, it is operated in the same manner as in case 2). The amount or more that can be re-condensed by two condensation parts 310 and 320
15 may be directly pressurized at a high pressure by using the high-pressure compression part 230 and may be transferred to the consumer 10 connected to the rear end of the vaporizer 510.

[126] The operation scheme of the fuel gas supply system according to the present invention has been described above. As described above, according
20 to the present invention, since the liquefied gas can be re-vaporized and supplied to the consumer (HP fuel gas consumer) 10, it is possible to reduce

the cost of the exhaust gas treatment equipment due to a small exhaust amount of sulfur oxide (SO_x), nitrogen oxide (NO_x), or the like.

[127] In addition, it is possible to effectively re-condense the boil-off gas of which the amount is greatly changed according to the operation mode, with a
5 small supply amount of the liquefied gas.

[128] In addition, the boil-off gas generated during operation may be collected and used as fuel. For example, the boil-off gas generated in various operations, particularly, the boil-off gas excessively generated in the loading operation is re-condensed and collected by using the second compression
10 part 220 and the second condensation part 320.

[129] In other words, the boil-off gas generated in various operations, particularly, the boil-off gas excessively generated in the loading operation is re-condensed and collected by using the second compression part 220 and the second condensation part 320. If the boil-off gas is directly pressurized
15 with a high pressure without re-condensing and supplied as fuel, the energy consumption required for compression increases, which is advantageous in terms of energy efficiency. It is thermodynamically obvious that energy consumption in pressurizing and then vaporizing liquid is less than that in pressurizing gas.

20 [130] In addition, since the liquefied gas passing through the second condensation part is pressurized and sufficiently sub-cooled by the high-pressure pump unit (HP LNG booster pump) 400 during loading operation, even though the liquefied gas exchanges heat with the boil-off gas (BOG)

transferred from the second compression part 220 to the first condensation part 310, any boil-off gas is not generated so that it is possible to efficiently supply the fuel gas.

[131] In addition, since a part of the liquefied gas passing through the high-
5 pressure pump unit 400 condenses the boil-off gas in the second condensation part 320 so that the boil-off gas is re-condensed and used without any additional energy sources, there is not required any re-liquefying apparatus. Thus, energy required for re-liquefaction can be minimized.

[132] In addition, the second condensation part 320 is installed to re-
10 condense the excess boil-off gas generated during loading operation and is installed on the condensation line L41 branched from the minimum flow line L40, so that it is possible to minimize the quantity of pipes.

[133] In addition, in case where the excess boil-off gas generated during the loading operation is liquefied, the amount required for liquefaction is adjusted
15 through the condensation line L41 without using the entire amount of the liquefied gas pressurized by the high-pressure pump unit 400, thereby reducing the quantity of pipes and minimizing the size of the second condensation part 320.

[134] In addition, since the excess boil-off gas passes through the second
20 condensation part 320 only during the loading operation, there is no problem of energy loss due to pressure drop during normal operation.

[135] In addition, since the compression unit 200 includes three parts of the first and second compression parts 210 and 220, and the high-pressure compression part 230, the three parts may be selectively used according to the operating state. For example, during the loading operation unlike the normal operation, when the excess boil-off gas is generated, for the remaining boil-off gas exceeding the capacity that can be processed by the first compression part 210 (the first low-pressure compression part), the second compression part (the second low-pressure compression part) 220 is used, so that the first and second compression parts 210 and 220 take charge of the transfer of the boil-off gas. Further, when the boil-off gas exceeding the capacity of the first and second compression parts 210 and 220 is generated, the high-pressure compression part 230 may be applied and used for the remaining boil-off gas.

[136] In addition, the boil-off gas re-condensed through the second condensation part 320 is transferred to the first condensation part 310 instead of the storage tank, thereby reducing energy waste. That is, when the re-condensed boil-off gas is returned to the low-pressure storage tank 101, it is necessary to pressurize the boil-off gas again in the low-pressure (5 kPag) environment by using the supply pump 110 and transfer the boil-off gas to the first condensation part, so that it is possible to reduce energy waste as much as that.

[137] FIG. 6 illustrates a fuel gas supply system according to a third embodiment of the present invention. Hereinafter, a fuel gas supply system

according to an embodiment of the present invention will be described with reference to a case where it is applied to a floating power generation system. The fuel gas supply system according to the embodiment of FIG. 6 differs from the above-described embodiments in that the fuel gas supply system
5 further includes a shipment unit 50, a vaporization reduction module 5000, and a boil-off gas transfer unit 6000.

[138] Referring to FIG. 6, the floating power generation system is installed in a float to produce electricity by using liquefied gas. The float may be floated on water such as a sea, a river, or the like and may be provided as a ship or
10 an offshore structure on which the floating power generation system is installed. According to an embodiment, the floating power generation system includes a storage tank 30, a gas power generation module 2000, a gas supply module 3000, the shipment unit 50, the vaporization reduction module 5000, and the boil-off gas transfer unit 6000. Although not illustrated in the
15 drawings and specification for convenience of explanation, it is assumed that the floating power generation system includes essential components such as a pump, a compressor, a valve, and the like which are naturally required for the operation of the floating power generation system.

[139] Liquefied gas is stored in the storage tank 30. The storage tank 30
20 corresponds to a storage unit that contains liquefied gas and its boil-off gas. The liquefied gas is a combustible material in which gaseous gas at room temperature is condensed into a liquid state. For example, the liquefied gas is provided as liquefied natural gas (LNG).

[140] The gas power generation module 2000 corresponds to a consumer of the fuel gas. The gas power generation module 2000 generates electricity by using the liquefied gas supplied from the storage tank 30. According to an embodiment, the gas power generation module 2000 has a gas turbine 2100.

5 [141] The gas turbine 2100 generates electricity by burning the liquefied gas supplied in the gaseous state from the storage tank 30 and rotating the turbine. In order for the gas turbine 2100 to operate using the liquefied gas, it is generally required to rotate the turbine over a predetermined number of rpm. Thus, generally, the gas power generation module 2000 is provided with
10 a starter (not shown) for rotating the turbine of the gas turbine 2100 at the predetermined number of rpm or more before the gas turbine 2100 burns the liquefied gas and operates autonomously. Alternatively, the gas power generation module 2000 may include an engine instead of the gas turbine 2100. The engine generates electricity by using, as fuel, the liquefied gas
15 vaporized in the same manner as the gas turbine 2100, but is different from the gas turbine 2100 in operating conditions. When an engine is provided instead of the gas turbine 2100, the gas supply module 3000 supplies the liquefied gas stored in the storage tank 30 to the engine.

[142] The gas power generation module 2000 may further include an air
20 cooler (not shown). The air cooler cools the air flowing into the gas turbine 2100 for combustion of the liquefied gas. As the temperature of the air flowing into the gas turbine 2100 is lowered, the mass of the air supplied to the gas turbine for the same time increases, so that the output of the gas

turbine can be increased. If the gas turbine 2100 is a type that is not sensitive to the temperature of the supplied outside air, the air cooler may not be provided selectively.

[143] The gas supply module 3000 supplies the liquefied gas stored in the storage tank 30 to the gas turbine 2100. According to an embodiment, the gas supply module 3000 includes a re-condensation unit 3100, a consumer supply line 3200, a vaporizer 3300, a supply pump 3400, a liquefied gas supply line 3500, and a boil-off gas supply line 3600.

[144] The re-condensation unit 3100 re-condenses the boil-off gas generated from the liquefied gas in the storage tank 30. The boil-off gas that is generated due to the vaporization of the liquefied gas in the storage tank 30 is supplied from above into the re-condensation unit 3100, and the liquefied gas in a liquid state is supplied from the storage tank 30. The boil-off gas supplied to the re-condensation unit 3100 is cooled through heat exchange with the liquefied gas in a liquid state at a high pressure and condensed into a liquid state. According to an embodiment, a part of the liquefied gas in the liquid state that is supplied to the re-condensation unit 3100 is sprayed within the re-condensation unit 3100 in a spray manner. Therefore, the contact area with the boil-off gas is increased, so that the heat is more easily exchanged between the liquefied gas in the liquid state and the boil-off gas.

[145] The consumer supply line 3200 connects the re-condensation unit 3100 and the gas turbine 2100. Thus, the liquefied gas condensed in the re-

condensation unit 3100 is vaporized in the vaporizer 3300 through the consumer supply line 3200, and then supplied to the gas turbine 2100. A high-pressure pump unit 3210 may be installed on the consumer supply line 3200. The high-pressure pump unit 3210 applies pressure to the liquefied
5 gas to transfer the liquefied gas in the re-condensation unit 3100 to the gas turbine 2100.

[146] The vaporizer 3300 vaporizes the liquefied gas before being supplied to the gas turbine 2100 so that the liquefied gas may be used as fuel in the gas turbine 2100. The vaporizer 3300 is installed on the consumer supply
10 line 3200.

[147] The supply pump 3400 transfers the liquefied gas in the storage tank 30 to the re-condensation unit 3100. That is, the supply pump 3400 applies pressure to the liquefied gas such that the liquefied gas in the liquid state in the storage tank 30 is transferred to the re-condensation unit 3100 along the
15 liquefied gas supply line 3500.

[148] The liquefied gas supply line 3500 connects the supply pump 3400 and the re-condensation unit 3100. Thus, the liquefied gas, which is pressurized by the supply pump 3400, is transferred to the re-condensation unit 3100 along the liquefied gas supply line 3500.

20 [149] The boil-off gas supply line 3600 connects the storage tank 30 and the re-condensation unit 3100. The boil-off gas generated in the storage tank 30 is transferred to the re-condensation unit 3100 along the boil-off gas supply line 3600 by the pressure in the storage tank 30. The boil-off gas supply line

3600 may be provided with a compression unit 3700. The compression unit 3700 compresses the boil-off gas transferred from the storage tank 30 to the re-condensation unit 3100 before the boil-off gas generated in the storage tank 30 is supplied to the re-condensation unit 3100. As the boil-off gas is
5 compressed by the compression unit 3700, the boil-off gas may be more easily condensed in the re-condensation unit 3100 and it may be easy to maintain the pressure in the re-condensation unit 3100.

[150] The gas supply module 3000 may further include a gas temperature regulator (not shown). The gas temperature regulator heats the liquefied gas
10 vaporized in the vaporizer 3300 to a temperature at which the efficiency of the gas turbine 2100 is optimized and supplies the boil-off gas to the gas turbine 2100 in order to increase the efficiency of the gas turbine 2100.

[151] The shipment unit 50 transfers the liquefied gas from a liquefied gas carrier 40 to the storage tank 30. The liquefied gas carrier 40 is a ship that
15 carries liquefied gas to a floating power generation system. The shipment unit 50 includes a transfer line through which the liquefied gas is transferred from the liquefied gas carrier 40 to the storage tank 30. The shipment unit 50 may further include a valve (not shown) for opening and closing the transfer line, and a sensor (not shown) for transmitting a signal indicating whether it is
20 being shipped to a controller 5300.

[152] The vaporization reduction module 5000 reduces the evaporation amount of the liquefied gas in the storage tank 30. For example, the vaporization reduction module 5000 may reduce the evaporation amount of

the liquefied gas in the storage tank 30 by cooling the storage tank 30 and pressurizing the internal pressure of the storage tank 30. According to an embodiment, the vaporization reduction module 5000 includes a cooling unit 5100, a pressure regulation unit 5200 and the controller 5300.

5 [153] The cooling unit 5100 cools the storage tank 30. In general, since a minimum amount of liquefied gas may be required to transport to the supply pump 3400, the liquefied gas may remain in the storage tank 30 in an amount greater than the minimum amount that is capable of being transported to the supply pump 3400. The cooling unit 5100 may cool the
10 storage tank 30 by spraying the liquefied gas in the liquid state stored in the storage tank 30 to an inside of the storage tank 30. According to an embodiment, the cooling unit 5100 includes a spray member 5110, a spray pump 5120, a spray line 5130, and a temperature meter 5140.

[154] The spray member 5110 sprays the liquefied gas in the liquid state
15 stored in the storage tank 30 to the inside of the storage tank 30.

[155] The spray pump 5120 applies a pressure to the liquefied gas in the storage tank 30 such that the liquefied gas stored in the storage tank 30 is supplied to the spray member 5110.

[156] The spray line 5130 connects the spray member 5110 and the spray
20 pump 5120. Accordingly, the liquefied gas pressurized by the spray pump 5120 is transferred to the spray member 5110 through the spray line 5130.

[157] The temperature meter 5140 measures the temperature inside the storage tank 30. The temperature meter 5140 transmits the measured value obtained by measuring the temperature of the storage tank 30 to the controller 5300 in real time.

5 [158] The pressure regulation unit 5200 regulates the pressure in the storage tank 30. The pressure regulation unit 5200 may regulate the pressure in the storage tank 30 by regulating the flow rate of the boil-off gas transferred from the storage tank 30 to the re-condensation unit 3100. According to an embodiment, the pressure regulation unit 5200 includes a
10 pressure regulation valve 5210 and a pressure meter 5220.

[159] The pressure regulation valve 5210 regulates the opening rate of the boil-off gas supply line 3600. For example, when the opening rate of the pressure regulation valve 5210 is lowered, the amount of boil-off gas discharged to the outside of the storage tank 30 is reduced, so that the
15 internal pressure of the storage tank 30 may be increased. In addition, when the opening rate of the pressure regulation valve 5210 is increased, the amount of the generated boil-off gas discharged to the outside of the storage tank 30 increases, so that the internal pressure of the storage tank 30 may be decreased.

20 [160] The pressure meter 5220 measures the pressure inside the storage tank 30. The pressure meter 5220 transfers the measured value of the pressure of the storage tank 30 to the controller 5300 in real time.

[161] The controller 5300 controls the cooling unit 5100 and the pressure regulation unit 5200.

[162] The controller 5300 controls the cooling unit 5100 to cool the inside of the storage tank 30. The controller 5300 controls the cooling unit 5100 to cool
5 the storage tank 30 before the shipment unit 50 starts to transfer the liquefied gas from the liquefied gas carrier 40 to the storage tank 30. According to an embodiment, the controller 5300 operates the spray pump 5120 and opens the spray line 5130 to spray the liquefied gas through the spray member 5110 in the storage tank 30. The controller 5300 controls the cooling unit
10 5100 to spray liquefied gas for a time sufficient to cool the storage tank 30 to a predetermined temperature. For example, when the liquefied gas is provided as liquefied natural gas (LNG), the controller controls the cooling unit 5100 to spray the liquefied gas until the storage tank 30 is cooled to -160°C. In addition, the controller 5300 controls the cooling unit 5100 to cool
15 the storage tank 30 while the shipment unit 50 transports the liquefied gas from the liquefied gas carrier 40 to the storage tank 30. The storage tank 30 may be continuously cooled not only before the shipment unit 50 starts the transfer to the storage tank 30 but also during transfer, thereby preventing the temperature of a region of the storage tank 30 which is not in contact with
20 the liquefied gas from rising while the shipment unit 50 transfers the liquefied gas. A specific example in which the controller 5300 controls the cooling unit 5100 when the storage tank 30 is cooled while the liquefied gas is transferred

to the storage tank 30 is the same as a case where the storage tank 30 is cooled before the liquefied gas is transferred.

[163] The controller 5300 controls the pressure regulation unit 5200 to regulate the pressure in the storage tank 30. For example, the controller may

5 pressurize the inside of the storage tank 30 for a first time before or after the shipment unit 50 starts to transfer the liquefied gas, and controls the pressure regulation unit 5200 to maintain the internal pressure of the storage tank 30 for a second time after the first time. In addition, the controller 5300 may control the pressure regulation unit 5200 to depressurize the inside of the

10 storage tank for a third time after the second time. The first time may be the time until the pressure of the storage tank 30 reaches a set pressure before or after the shipment unit 50 starts the liquefied gas transfer. For example, the set pressure may be 15 kPaG or more. The second time may be the time to the time point at which the shipment unit 50 has finished the liquefied gas

15 transfer after the first time. The controller 5300 may control the pressure regulation unit 5200 such that the pressure regulation unit 5200 depressurizes the pressure in the storage tank 30 for the third time by supplying the liquefied gas in a configuration of the re-condensation unit 3100, the gas turbine 2100, and the like required for power generation.

20 According to an embodiment, the controller 5300 controls the opening rate of the pressure regulation valve 5210 to adjust the amount of the boil-off gas generated in the storage tank 30 and transferred through the boil-off gas supply line 3600 to the re-condensation unit 3100, thereby regulating the

pressure in the storage tank 30. For example, when the controller 5300 lowers the opening rate of the pressure regulation valve 5210, the amount of the boil-off gas in the storage tank 30 transferred to the re-condensation unit 3100 is reduced, so that the pressure of the storage tank 30 may be increased. Alternatively, when the controller 5300 increases the opening rate of the pressure regulation valve 5210, the amount of the boil-off gas transferred from the storage tank 30 to the re-condensation unit 3100 may be increased, so that the pressure of the storage tank 30 may be lowered.

[164] As described above, the storage tank 30 is cooled and pressurized by the vaporization reduction module 5000, so that the amount of boil-off gas generated in the storage tank 30 may be reduced.

[165] The boil-off gas transfer unit 6000 transfers a part of the boil-off gas generated in the storage tank 30 to the liquefied gas carrier 40. A part of the boil-off gas generated in the storage tank 30 is transferred to the liquefied gas carrier 40 by the boil-off gas transfer unit 6000 so that the amount of boil-off gas to be treated in the floating power generation system may be reduced. In addition, it is possible to maintain the pressure of the liquefied gas storage tank of the liquefied gas carrier 40, which may be lowered by loading the liquefied gas into the storage tank 30. Alternatively, the boil-off gas transfer unit 6000 may not be provided.

[166] The boil-off gas transfer unit 6000 includes a transfer line 6100. The transfer line 6100 is provided to transfer a part of the boil-off gas generated in the storage tank 30 to the liquefied gas carrier 40. For example, the transfer

line 6100 may be provided to connect the liquefied gas carrier 40 with the area between the pressure regulation valve 5210 and the compression unit 3700 of the boil-off gas supply line 3600.

[167] FIG. 7 illustrates a fuel gas supply system according to a fourth embodiment of the present invention. Referring to FIG. 7, unlike FIG. 6, the boil-off gas transfer unit 6000 may further include a transfer gas pressurizer 6200, a bypass line 6300, and a pressure regulation member 6400.

[168] The transfer gas pressurizer 6200 pressurizes the boil-off gas in the transfer line 6100 toward the liquefied gas carrier 40. When the pressure in the storage tank 30 is not sufficient to easily transfer the boil-off gas to the liquefied gas carrier 40 through the transfer line 6100, a pressure may be applied to the boil-off gas by the transfer gas pressurizer 6200, so that the boil-off gas is more easily transferred to the liquefied gas carrier through the transfer line 6100.

[169] The bypass line 6300 is provided to transfer the boil-off gas from the storage tank 30 to the liquefied gas carrier 40 by bypassing the transfer gas pressurizer 6200. For example, both ends of the bypass line 6300 is connected to the area between a point branched from the boil-off gas supply line 3600 of the transfer line 6100 and the transfer gas pressurizer 6200, and an area between the transfer gas pressurizer 6200 of the transfer line 6100 and the liquefied gas carrier 40. When the pressure in the storage tank 30 is sufficient to easily transfer the boil-off gas to the liquefied gas carrier 40 through the transfer line 6100, the boil-off gas passing through the transfer

line 6100 is transferred to the liquefied gas carrier 40 through the bypass line 6300, and the transfer gas pressurizer 6200 is prevented from being unnecessarily operated, so that it is possible to reduce unnecessary energy consumption.

5 [170] The pressure regulation member 6400 regulates the pressure of the liquefied gas storage tank of the liquefied gas carrier 40. According to an embodiment, the pressure regulation member 6400 may be provided as a valve 6400 for controlling the opening rate of the gas line, both ends of which are connected to the boil-off gas supply line 3600 and the transfer line 6100
10 to transfer a part of the boil-off gas pressurized by the transfer gas pressurizer 6200 to the re-condensation unit 3100 through the boil-off gas supply line 3600. The boil-off gas transfer unit 6000 may further include a pressure meter 6500 that measures the pressure of the carrier tank of the liquefied gas carrier. According to an embodiment, the controller 5300 may
15 regulate the pressure of the carrier tank by controlling the valve 6400 in accordance with the pressure of the carrier tank measured by the pressure meter 6500. By regulating the pressure by the valve 6400, it is possible to prevent the pressure inside the carrier tank from rising excessively. The other configuration, structure, and function of the fuel gas supply system illustrated
20 in FIG. 7 are similar to the fuel gas supply system of FIG. 6.

[171] FIG. 8 illustrates a fuel gas supply system according to a fifth embodiment of the present invention. Referring to FIG. 8, the gas supply module 3000a may further include an excess gas supply unit 3800. The

excess gas supply unit 3800 compresses a part of the boil-off gas in the boil-off gas supply line 3600 and supplies it to the gas turbine 2100. According to an embodiment, the excess gas supply unit 3800 includes an excess gas supply pipe 3810 and an excess gas compressor 3820.

5 [172] According to an embodiment, both ends of the excess gas supply pipe 3810 are connected to the boil-off gas supply line 3600 and an area between the gas turbine 2100 and the vaporizer 3300 of the consumer supply line 3200. When there is provided the compression unit 3700, one end connected to the boil-off gas supply line 3600 of the excess gas supply pipe 3810 is
10 connected to an area between the compression unit 3700 of the boil-off gas supply line 3600 and the pressure regulation valve 5210.

[173] The excess gas compressor 3820 compresses a part of the boil-off gas in the boil-off gas supply line 3600 to a pressure that can be used in the gas turbine 2100. The excess gas compressor 3820 is installed on the
15 excess gas supply pipe 3810. According to an embodiment, when the amount of boil-off gas generated in the storage tank 30 exceeds the amount that can be condensed in the re-condensation unit 3100, the controller 5300 controls such that the excess amount of the boil-off gas in the boil-off gas supply line 3600 is compressed to be mixed with the liquefied gas vaporized
20 in the vaporizer 3300, the excess gas supply pipe 3810 is opened to supply the mixed gas to the gas turbine 2100, and the excess gas compressor 3820 is operated. Thus, since the excess gas supply pipe 3810 and the excess gas compressor 3820 are provided, even when a boil-off gas exceeding an

amount that can be condensed in the re-condensation unit 3100 is generated, the boil-off gas may be treated to be used as fuel of the gas turbine 2100. The other configuration, structure, and function of the fuel gas supply system shown in FIG. 8 are similar to the fuel gas supply system of FIG. 6. In addition, the boil-off gas transfer unit 6000 of the fuel gas supply system illustrated in FIG. 8 may further include the transfer gas pressurizer 6200, the bypass line 6300, the pressure regulation member 6400, and the pressure meter 5220 like the fuel gas supply system of FIG. 7.

[174] As described above, the fuel gas supply system according to the embodiment of the present invention may reduce the amount of boil-off gas generated by cooling and pressurizing the storage tank. The fuel gas supply system according to an embodiment of the present invention may utilize a large amount of boil-off gas by transporting a part of the boil-off gas to the liquefied gas carrier or compressing the boil-off gas and supplying the boil-off gas directly to the gas turbine.

[175] FIG. 9 illustrates a fuel gas supply system according to a sixth embodiment of the present invention. The fuel gas supply system according to the embodiment of FIG. 9 differs from the above-described embodiments in that it further includes a circulation module 4000 for circulating a cooling fluid. Referring to FIG. 9, the floating power generation system includes a storage tank 1000, the gas power generation module 2000, the gas supply module 3000, and the circulation module 4000.

[176] Liquefied gas is stored in the storage tank 1000. The storage tank 1000 corresponds to a storage unit that contains liquefied gas and its boil-off gas.

[177] The gas power generation module 2000 generates electricity by using
5 the liquefied gas supplied from the storage tank 1000. According to an embodiment, the gas power generation module 2000 includes the gas turbine 2100 and an air cooler 2200.

[178] The gas turbine 2100 generates electricity by burning the liquefied gas supplied in the gaseous state from the storage tank 30 and rotating the
10 turbine.

[179] The air cooler 2200 cools the air flowing into the gas turbine 2100 for burning the liquefied gas. As the temperature of the air flowing into the gas turbine is lowered, the mass of the air supplied to the gas turbine for the same time increases, so that the output of the gas turbine may be increased.

[180] The gas power generation module 2000 may further include a bypass
15 pipe 2300. The bypass pipe 2300 is provided to allow an outside air to bypass the air cooler 2200. For example, when the temperature of the outside air supplied to the gas turbine 2100 is sufficiently low so that any additional cooling is not required, the outside air does not flow into the air
20 cooler 2200, and supplied to the gas turbine 2100 through the bypass pipe 2300. When the gas turbine 2100 is a type that is not sensitive to the temperature of the supplied outside air, the air cooler 2200 may not be provided selectively.

[181] The gas supply module 3000 supplies the liquefied gas stored in the storage tank 1000 to the gas turbine 2100. The gas supply module 3000 has the vaporizer 3300.

[182] The vaporizer 3300 vaporizes the liquefied gas before being supplied
5 to the gas turbine 2100 so that the liquefied gas may be used as fuel in the gas turbine 2100. Alternatively, a compression unit (reference numeral 200 of FIGS. 1 to 5 or reference numeral 3700 of FIGS. 6 to 8) and a re-condensing unit (reference numeral 300 of FIGS. 1 to 5, or reference numeral 3100 of FIGS. 6 to 8) may be provided between the vaporizer 3300 and the storage
10 tank 1000.

[183] The gas supply module 3000 may further include a gas temperature regulator 3900. The gas temperature regulator 3900 heats the liquefied gas vaporized in the vaporizer 3300 to a temperature at which the efficiency of the gas turbine 2100 is optimized and supplies the boil-off gas to the gas
15 turbine 2100 in order to enhance the efficiency of the gas turbine 2100.

[184] The circulation module 4000 circulates the cooling fluid. The circulation module 4000 includes a main circulation module 4100 and an auxiliary circulation module 4200.

[185] The main circulation module 4100 circulates the cooling fluid to cool a
20 cooling object 7000 requiring cooling in the configuration of the float and/or floating power generation system. In this case, the cooling object 7000 is a general configuration requiring cooling of the float or floating generation system, and does not include the air cooler 2200 in which the cooling fluid is

circulated by the auxiliary cooling module, which will be described below. For example, the cooling object 7000 may be cooling equipment of a ship and a cooling device of various electric equipment, and the like provided as a float. According to an embodiment, the main circulation module 4100 includes a
5 cooling unit 4110, a main circulation pipe 4120 and a main pump 4130.

[186] The cooling unit 4110 cools the cooling object 7000 to cool the heated cooling fluid. The cooling unit 4110 may use seawater or a river on which the float is floated, as a cooling source for cooling the cooling fluid.

[187] The main circulation pipe 4120 is provided as a flow path through
10 which the cooling fluid is circulated between the cooling unit 4110 and the cooling object 7000.

[188] The main pump 4130 applies a pressure to the cooling fluid to allow the cooling fluid to flow along the main circulation pipe 4120.

[189] The auxiliary circulation module 4200 branches the cooling fluid
15 circulated by the main circulation module 4100 to circulate the cooling fluid such that the cooling fluid flows into the vaporizer 3300 and the air cooler 2200. The cooling fluid introduced into the vaporizer 3300 by the auxiliary circulation module 4200 is heat-exchanged with the liquefied gas. The liquefied gas that has been heat exchanged with the cooling fluid in the
20 vaporizer 3300 is vaporized to be used as fuel in the gas turbine 2100. The auxiliary circulation module 4200 circulates the cooling fluid such that the cooling fluid, which has been heat-exchanged with the liquefied gas in the vaporizer 3300, flows into the air cooler 2200 to exchange heat with the

outside air. The outside air that has been heat exchanged with the cooling fluid in the air cooler 2200 is cooled before being supplied to the gas turbine 2100. The cooling fluid is used as a heat source in the vaporizer 3300 so that the cooling fluid is cooled to a temperature sufficient to cool the outside air in
5 the air cooler 2200. According to an embodiment, the auxiliary circulation module 4200 includes a temperature regulation unit 4210.

[190] The temperature regulation unit 4210 regulates the temperature of the cooling fluid flowing into the vaporizer 3300. As the temperature of the cooling fluid flowing into the vaporizer 3300 is lowered, the required amount
10 of cooling fluid supplied per hour to the vaporizer 3300 is increased to provide sufficient heat to vaporize the liquefied gas. However, when the air cooler 2200 is provided, since the cooling fluid sequentially passes through the vaporizer 3300 and the air cooler 2200, as the temperature of the cooling fluid supplied to the vaporizer 3300 is increased, the temperature of the
15 cooling fluid to be supplied to the air cooler 2200 is also increased. Therefore, when the temperature of the cooling fluid flowing into the air cooler 2200 becomes a predetermined temperature or more, the outside air supplied to the gas turbine 2100 cannot be sufficiently cooled. Thus, the temperature of the cooling fluid flowing into the vaporizer 3300 is adjusted to a proper
20 temperature range by providing the temperature regulation unit 4210 that regulates the temperature of the cooling fluid flowing into the vaporizer 3300, so that the amount of cooling fluid supplied per hour to the vaporizer 3300 and the temperature of the air cooled in the air cooler 2200 may be regulated

in an appropriate range. According to an embodiment, the temperature regulation unit 4210 includes a mixing member 4211 and a controller 4212.

[191] FIG. 10 is a block diagram illustrating the temperature regulation unit of FIG. 9. Referring to FIGS. 9 and 10, in the mixing member 4211, the first to third fluids are mixed with each other. The cooling fluid mixed in the mixing member 4211 flows sequentially through the vaporizer 3300 and the air cooler 2200. The first fluid is a cooling fluid flowing from the cooling unit 4110 to the cooling object 7000. That is, the first fluid is branched from the area where the cooling fluid flows from the cooling unit 4110 of the main circulation pipe 4120 to the cooling object 7000, and flows into the mixing member 4211. The second fluid is a cooling fluid flowing from the cooling object 7000 to the cooling unit 4110. That is, the second fluid is branched from the area where the cooling fluid flows from the cooling object 7000 of the main circulation pipe 4120 to the cooling unit 4110, and flows into the mixing member 4211. The third fluid is a cooling fluid in which heat exchange with the liquefied gas in the vaporizer 3300 is completed. According to an embodiment, the third fluid is a cooling fluid prior to flowing into the cooling object 7000 through a bypass flow path 4220 or the air cooler 2200, which will be described below, after being heat-exchanged in the vaporizer 3300. Therefore, the temperature of the third fluid heat exchanged with the liquefied gas in the liquid state is generally lower than the temperature of the second fluid heat-exchanged with the refrigerant such as seawater used in the cooling unit 4110, and the temperature of the first fluid heat-exchanged with

the cooling object is higher than the temperature of the second fluid cooled in the cooling unit.

[192] The controller 4212 controls the mixing member 4211 to adjust the mixing ratio between the first to third fluids according to the temperatures of the cooling fluid and the external air introduced into the vaporizer 3300.

[193] According to an embodiment, the temperature regulation unit 4210 may further include an outside air temperature meter 4213, a cooling fluid temperature meter 4214 and a flow meter 4215. The outside air temperature meter 4213 measures the temperature of the outside air outside the float and the floating power generation system. The cooling fluid temperature meter 4214 measures the temperature of the cooling fluid flowing into the vaporizer 3300 after being mixed in the mixing member 4211. The flow meter 4215 measures the flow rate of the cooling fluid flowing into the vaporizer 3300 after mixing in the mixing member 4211. The controller 4212 controls the mixing member 4211 according to the values measured by the outside air temperature meter 4213, the cooling fluid temperature meter 4214, and the flow meter 4215.

[194] The controller 4212 may regulate the flow rate of the cooling fluid flowing into the vaporizer 3300 according to the temperature of the outside air and the temperature of the cooling fluid flowing into the vaporizer. For example, a flow regulation valve 4216 for regulating a flow rate is provided on a flow path through which the cooling fluid mixed by the mixing member 4211 flows into the vaporizer 3300, and the controller 4212 controls the flow

regulation valve 4216 to increase the opening rate of the flow regulation valve 4216 when it is necessary to increase the amount of the cooling fluid to be introduced into the vaporizer 3300 in accordance with the temperature of the outside air and the temperature of the cooling fluid flowing into the vaporizer 3300. In addition, when it is necessary to decrease the amount of the cooling fluid to be introduced into the vaporizer 3300 in accordance with the temperature of the outside air and the temperature of the cooling fluid flowing into the vaporizer 3300, the controller 4212 controls the flow regulation valve 4216 to reduce the opening rate of the flow regulation valve 4216.

[195] The auxiliary circulation module 4200 may further include the bypass flow path 4220. The bypass flow path 4220 is provided to allow the cooling fluid to bypass the air cooler. For example, when the temperature of the outside air sucked into the air cooler 2200 is provided sufficiently low so that no additional cooling is required, the cooling fluid passing through the vaporizer 3300 does not flow into the air cooler 2200, and is supplied to the cooling object 7000 through the bypass flow path 4220.

[196] The auxiliary circulation module 4200 circulates the cooling fluid such that the cooling fluid passing through the air cooler 2200 or the bypass flow path 4220 is mixed with the first fluid and supplied to the cooling object 7000.

[197] FIG. 11 illustrates a fuel gas supply system according to a seventh embodiment of the present invention. Referring to FIG. 11, when the air cooler 2200 is not provided, since it is not required to lower the temperature

of the cooling fluid supplied to the air cooler 2200, the temperature regulation unit 4210 may not be provided. In this case, the cooling fluid is provided to sequentially circulate the cooling object 7000, the cooling unit 4110, and the vaporizer 3300. That is, only the first fluid flows into the vaporizer 3300. The
5 other configuration, structure, function and the like of the fuel gas supply system illustrated in FIG. 11 are similar to those of the floating power generation system of FIG. 9.

[198] FIG. 12 illustrates a fuel gas supply system according to an eighth embodiment of the present invention. FIG. 13 is a block diagram illustrating
10 the temperature regulation unit of FIG. 12. Referring to FIGS. 12 and 13, in order to further increase the temperature of the cooling fluid supplied to the vaporizer 3300, unlike the case of FIG. 11, the temperature regulation unit 4210 may be provided to mix the first fluid with a part of the second fluid of which the temperature is higher than that of the first fluid. In this case, the
15 configuration for introducing the third fluid, which is provided to further lower the temperature of the cooling fluid, into the mixing member 4211 may not be provided. The other configuration, structure and function of the fuel gas supply system illustrated in FIGS. 12 and 13 are similar to the floating power generation system of FIG. 9.

20 [199] FIG. 14 illustrates a fuel gas supply system according to a ninth embodiment of the present invention. The fuel gas supply system illustrated in FIG. 14 allows the intermediate thermal medium to circulate in the auxiliary circulation module 4200 of the circulation module 4000. The fuel gas supply

system allows the cooling fluid flowing in the main circulation module 4100 and the intermediate thermal medium flowing in the auxiliary circulation module 4200 to be heat-exchanged with each other, such that the liquefied gas is vaporized in vaporizer 3300 by using thermal energy of the intermediate thermal medium of the auxiliary circulation module 4200 which is heated in a heater 4300 through heat exchange with the cooling fluid of the main circulation module 4100. Thus, the fuel gas supply system differs from the embodiments described above in that the circulation module is configured. For example, as the intermediate thermal medium circulating in the auxiliary circulation module 4200, a fluid such as seawater, river, glycol, or the like may be used.

[200] The circulation module 4000 includes the main circulation module 4100, the auxiliary circulation module 4200, and the heater 4300. A part of the cooling fluid whose temperature has risen in the process of cooling the cooling object 7000 in the main circulation module 4100 is supplied to the cooling unit 4110 to be cooled and the remaining cooling fluid is transferred to the heater 4300 through a transfer line L80. The cooling fluid transferred to the heater 4300 through the transfer line L80 is cooled in the process of heat exchange with the intermediate thermal medium circulated in the auxiliary circulation module 4200 and then supplied again through the main pump 4130 to the cooling object 7000.

[201] The intermediate thermal medium circulating in the auxiliary circulation module 4200 is heat-exchanged with the cooling fluid of the main circulation

module 4100 in the heater 4300 so that the intermediate thermal medium is heated in terms of trade-off. The intermediate thermal medium heated by the heater 4300 is supplied to the vaporizer 3300 through an intermediate thermal medium pipe L70 by a circulation pump 4230. The liquefied gas is
5 vaporized by the thermal energy of the intermediate thermal medium in the vaporizer 3300, and the intermediate thermal medium is supplied to the air cooler 2200 after being cooled by the liquefied gas in terms of trade-off. The intermediate thermal medium cooled in the vaporizer 3300 is supplied to the heater 4300 through a intermediate thermal medium line L50 after cooling the
10 outside air to be supplied to the gas turbine 2100 in the air cooler 2200. Then, the intermediate thermal medium is heated in the process of heat exchange with the cooling fluid of the main circulation module 4100 and is supplied to the vaporizer 3300.

[202] The temperature regulation unit 4210 of the auxiliary circulation
15 module 4200 regulates the temperature of the intermediate thermal medium flowing into the vaporizer 3300. The temperature regulation unit 4210 includes a bypass pipe L60, a regulation valve 4217, and the controller 4212.

[203] The bypass pipe L60 is connected to the intermediate thermal medium line L50 to allow the intermediate thermal medium to bypass the heater 4300.
20 The regulation valve 4217 regulates the flow rate of the intermediate thermal medium bypassing through the bypass pipe L60. In an embodiment, the regulation valve 4217 may be provided as a three-way valve installed at the contact of the intermediate thermal medium line L50 and the bypass pipe L60.

As another embodiment, the regulation valve 4217 may be provided as a valve installed on the intermediate thermal medium line L50 and/or the bypass pipe L60.

[204] The controller 4212 controls the regulation valve 4217 according to the temperature of outside air measured by the outside air temperature meter 4213 and the temperature of the intermediate thermal medium at an inlet side of the vaporizer measured by an intermediate thermal medium temperature meter 4214 to regulate the flow rate of the intermediate thermal medium passing through the heater 4300.

10 [205] According to the embodiment of FIG. 14, not only the effect obtained by the embodiment of FIGS. 9 to 13 but also the effect of enhancing safety in leakage of liquefied natural gas or natural gas in the vaporizer 3300 may be obtained. Even if liquefied natural gas or natural gas leaks from the vaporizer 3300, the leaked liquefied natural gas or natural gas does not escape from
15 the auxiliary circulation module 4200, thereby improving safety. In addition, the flow of the intermediate thermal medium to the heater 4300 is controlled by the regulation valve 4217 without regulating the flow rate of the intermediate thermal medium flowing through the auxiliary circulation module 4200, so that the temperature of the intermediate thermal medium at the rear
20 end side of the heater 4300 is regulated, so there is provided an advantage of easy control.

[206] As described above, the fuel gas supply system of the present invention can control the temperature of the heat source introduced into the

vaporizer by providing the temperature regulation unit. In addition, the fuel gas supply system of the present invention does not provide a system for circulating a separate thermal fluid or refrigerant for vaporizing liquefied gas or cooling air supplied to the gas turbine, and uses a cooling fluid circulated
5 by a conventional cooling module, so that it is possible to improve the cooling and heating efficiency.

[207] While the present invention has been particularly shown and described with reference to exemplary embodiments illustrated in the accompanying drawings, it will be apparent to those skilled in the art that
10 various modifications and variations can be made from the foregoing descriptions. Accordingly, the scope of the invention should be determined only by the appended claims.

CLAIMS

1. A fuel gas supply system comprising:
- a storage unit configured to contain a liquefied gas and a boil-off gas
- 5 generated from the liquefied gas;
- a compression unit configured to compress the boil-off gas generated in the storage unit and transfer the compressed boil-off gas;
- a re-condensation unit configured to re-condense the boil-off gas compressed in the compression unit by using a super-cooled liquefied gas of
- 10 the storage unit;
- a high-pressure pump unit installed on a consumer supply line connected from the re-condensation unit to a consumer to pressurize the liquefied gas of the re-condensation unit at a pressure requested by the consumer or more; and
- 15 a heat-exchange unit including a vaporizer configured to heat the liquefied gas pressurized in the high-pressure pump unit to re-vaporize the liquefied gas,
- wherein the re-condensation unit includes:
- a first condensation part configured to mix the liquefied gas
- 20 transferred from the storage unit and the boil-off gas compressed in the compression unit to re-condense the boil-off gas; and
- a second condensation part configured to exchange heat between the liquefied gas which is pressurized in and transferred from the high-pressure

pump unit and the boil-off gas compressed in the compression unit to re-condense the boil-off gas.

2. The fuel gas supply system of claim 1,

5 wherein the compression unit includes:

a first compression part configured to compress the boil-off gas transferred from the storage unit and transfer the compressed boil-off gas to the first condensation part;

a second compression part configured to compress the boil-off gas
10 and transfer the compressed boil-off gas to the second condensation part when the boil-off gas is generated more than a re-condensation capacity of the first condensation part; and

a high-pressure compression part configured to compress a part of the boil-off gas generated in the storage unit to transfer the compressed part
15 of the boil-off gas to the consumer supply line on a rear end of the vaporizer.

3. The fuel gas supply system of claim 1, further comprising:

a minimum flow line branched from a rear end of the high-pressure pump unit and circulated to the first condensation part,

20 wherein the second condensation part is installed on a condensation line branched from the minimum flow line and connected to the rear end of the high-pressure pump unit such that heat exchange between the liquefied

gas passing through the condensation line and the boil-off gas flowing from the compression unit to the first condensation part is performed, and

wherein the boil-off gas re-condensed in the second condensation part is collected in the first condensation part.

5

4. The fuel gas supply system of claim 1, wherein the first condensation part mixes the liquefied gas pressurized by a supply pump of the storage unit with the boil-off gas compressed by a first compression part of the compression unit, and re-condenses all or a part of the boil-off gas.

10

5. A fuel gas supply system comprising:

a liquefied gas supply line configured to transfer a liquefied gas contained in a storage unit to a first condensation part;

a boil-off gas first supply line configured to transfer boil-off gas contained in the storage unit to the first condensation part through a first compression part;

a boil-off gas second supply line configured to transfer the boil-off gas contained in the storage unit to a second condensation part through a second compression part;

a consumer supply line configured to transfer the liquefied gas stored in the first condensation part to a consumer through a high-pressure pump unit and a vaporizer; and

a condensation line branched from a rear end of the high-pressure pump unit of the consumer supply line and rejoined with consumer supply line to bypass the liquefied gas pressurized in the high-pressure pump unit,

wherein the second condensation part allows heat to be exchanged
5 between the boil-off gas of the boil-off gas second supply line and the liquefied gas of the condensation line to re-condense the boil-off gas of the boil-off gas second supply line.

6. The fuel gas supply system of claim 5, wherein the liquefied
10 gas supply line includes a liquefied gas first supply line and a liquefied gas second supply line, and

wherein the first condensation part is configured to spray the liquefied gas supplied from the liquefied gas second supply line to the boil-off gas stored in the first condensation part to re-condense the boil-off gas.

15

7. The fuel gas supply system of claim 5, further comprising:

a minimum flow line connected from the rear end of the high-pressure pump unit of the consumer supply line to the first condensation part,

wherein the condensation line is branched from the minimum flow line
20 and rejoined with the rear end of the high-pressure pump unit of the consumer supply line.

8. The fuel gas supply system of claim 7, further comprising:

a boil-off gas high-pressure supply line configured to shut off a fluid flow from the boil-off gas second supply line, the condensation line and the consumer supply line to the consumer when being driven at a minimum flow rate,

5 wherein the boil-off gas high-pressure supply line is configured to allow the liquefied gas stored in the first condensation part to circulate through the high-pressure pump unit and the minimum flow line, thereby enabling continuous operation of the high-pressure pump unit,

 shut off the fluid flow to the boil-off gas second supply line and the
10 condensation line during normal operation and disable the operation of the second condensation part,

 open the fluid flow to the boil-off gas second supply line and the condensation line during loading operation and operate the second condensation part, thereby being operated differently according to an
15 operation mode, and

 pressurize an excessive boil-off gas using the high-pressure compression part to directly supply the excessive boil-off gas to a rear end of the vaporizer when an amount of the boil-off gas generated in the storage unit exceeds an amount that is capable of being re-condensed in the first and
20 second condensation parts during the loading operation.

9. The fuel gas supply system of claim 1, further comprising:

a vaporization reduction module configured to reduce a vaporization amount of the liquefied gas in the storage unit,

wherein the vaporization reduction module includes a cooling unit configured to cool a storage tank of the storage unit.

5

10. The fuel gas supply system of claim 9,

wherein the cooling unit includes:

a spray member configured to spray the liquefied gas stored in the storage tank into the storage tank;

10 a spray pump configured to supply the liquefied gas stored in the storage tank to the spray member; and

a spray line configured to connect the spray member and the spray pump.

15 11. The fuel gas supply system of claim 9, further comprising:

a shipment unit configured to transfer a liquefied gas from a liquefied gas carrier to the storage tank,

wherein the vaporization reduction module further includes a controller configured to control the cooling unit to cool the storage tank before
20 the shipment unit transfers the liquefied gas.

12. The fuel gas supply system of claim 11,

wherein the vaporization reduction module further includes a pressure regulating unit configured to regulate a pressure in the storage tank, and

wherein the controller is configured to:

control the cooling unit to cool the storage tank while the shipment
5 unit transfers the liquefied gas, control the pressure regulating unit to
pressurize an inside of the storage tank for a first time before or after the
shipment unit starts a liquefied gas transfer and to maintain a pressure inside
the storage tank for a second time after the first time, and control the
pressure regulating unit to depressurize the inside of the storage tank for a
10 third time after the second time.

13. The fuel gas supply system of claim 12, further comprising:

a boil-off gas supply line through which a boil-off gas is transferred
from the storage tank to the re-condensation unit,

15 wherein the pressure regulating unit includes a pressure regulating
valve configured to regulate an opening rate of the boil-off gas supply line,

wherein the consumer includes a gas generating module provided
with a gas turbine configured to generate electricity by using a liquefied gas,
and

20 wherein the fuel gas supply system further includes an excess gas
supply unit configured to compress a part of the boil-off gas in the boil-off gas
supply line and supply the compressed part of the boil-off gas to the gas
turbine.

14. The fuel gas supply system of claim 11, further comprising:
a boil-off gas transfer unit configured to transfer a part of the boil-off gas generated in the storage tank to the liquefied gas carrier,
5 wherein the boil-off gas transfer unit includes:
a transfer line provided to transfer a part of the boil-off gas generated in the storage tank to the liquefied gas carrier;
a transfer gas pressurizer configured to pressurize the boil-off gas in the transfer line toward the liquefied gas carrier;
10 a bypass line provided to transfer the boil-off gas from the storage tank to the liquefied gas carrier by bypassing the transfer gas pressurizer;
and
a pressure regulating member configured to regulate a pressure of a liquefied gas storage tank in which the liquefied gas of the liquefied gas
15 carrier is stored.

15. The fuel gas supply system of claim 1, further comprising:
a circulation module configured to circulate a cooling fluid,
wherein the circulation module includes:
20 a main circulation module configured to circulate the cooling fluid to cool an cooling object; and
an auxiliary circulation module configured to branch the cooling fluid circulated by the main circulation module to circulate the cooling fluid to flow

into the vaporizer, thereby heat-exchanging with the liquefied gas in the vaporizer.

16. The fuel gas supply system of claim 15,
5 wherein the consumer includes a gas generating module provided with a gas turbine configured to generate electricity by using the liquefied gas, wherein the gas generating module includes an air cooler configured to cool an outside air flowing into the gas turbine, and
wherein the auxiliary circulation module is configured to circulate the
10 cooling fluid such that the cooling fluid after heat exchange with the liquefied gas in the vaporizer flows into the air cooler to exchange heat with the outside air.

17. The fuel gas supply system of claim 16,
15 wherein the main circulation module includes:
a cooling unit configured to cool the cooling fluid;
a main circulation pipe through which the cooling fluid flows to circulate between the cooling unit and the cooling object; and
a main pump configured to pressurize the cooling fluid such that the
20 cooling fluid flows through the main circulation pipe.

18. The fuel gas supply system of claim 17,
wherein the auxiliary circulation module includes:

a temperature regulating unit for regulating a temperature of the cooling fluid flowing into the vaporizer; and

a bypass flow path provided to allow the cooling fluid to flow and bypass the air cooler, and

5 wherein the temperature regulating unit includes:

a mixing member in which a first fluid as the cooling fluid flowing from the cooling unit to the cooling object is mixed with a second fluid as the cooling fluid flowing from the cooling object to the cooling unit; and

a controller configured to control the mixing member to adjust a
10 mixing ratio between the first fluid and the second fluid according to a temperature of the outside air and the temperature of the cooling fluid flowing into the vaporizer.

19. The fuel gas supply system of claim 18,

15 wherein a third fluid, which is a cooling fluid having completed heat exchange with the liquefied gas in the vaporizer, is mixed with the first fluid and the second fluid in the mixing member,

wherein the auxiliary circulation module is configured to circulate the cooling fluid such that the cooling fluid passing through the air cooler or the
20 bypass flow path is mixed with the first fluid and supplied to the cooling object, and

wherein the controller is configured to control the mixing member to adjust a mixing ratio between the first fluid, the second fluid and the third fluid

according to the temperature of the outside air and the temperature of the cooling fluid flowing into the vaporizer, and to adjust a flow rate of the cooling fluid flowing into the vaporizer according to the temperature of the outside air and the temperature of the cooling fluid flowing into the vaporizer.

5

20. The fuel gas supply system of claim 1, further comprising:

a circulation module configured to circulate a cooling fluid and an intermediate heat medium,

wherein the circulation module includes:

10 a main circulation module configured to circulate the cooling fluid to cool a cooling object;

an auxiliary circulation module configured to circulate the intermediate heat medium to vaporize the liquefied gas in the vaporizer; and

15 a heater configured to heat the intermediate heat medium by exchanging heat between the cooling fluid circulated by the main circulation module and the intermediate heat medium circulated by the auxiliary circulation module.

21. The fuel gas supply system of claim 20,

20 wherein the consumer includes a gas generating module provided with a gas turbine configured to generate electricity by using the liquefied gas,

wherein the gas generating module includes an air cooler configured to cool an outside air introduced into the gas turbine, and

wherein the auxiliary circulation module is configured to circulate the intermediate heat medium such that the intermediate heat medium flows into the air cooler to exchange heat with the outside air after exchanging heat with the liquefied gas in the vaporizer.

5

22. The fuel gas supply system of claim 20,

wherein the auxiliary circulation module includes a temperature regulating unit configured to regulate a temperature of the intermediate heat medium flowing into the vaporizer,

10

wherein the temperature regulating unit includes:

a bypass pipe provided to allow the intermediate heat medium to bypass the heater;

a regulating valve configured to control a flow of the intermediate heat medium bypassed to the bypass pipe; and

15

a controller configured to control the flow of the intermediate heat medium by controlling the regulating valve according to a temperature of an outside air and a temperature of the intermediate heat medium heated by the heater and flowing into the vaporizer.

20