

【DESCRIPTION】**【Invention Title】**

APPARATUS FOR PRESSURIZING AND DELIVERING LOW-TEMPERATURE LIQUEFIED MATERIAL USING MULTISTAGE HEATING TYPE PRESSURIZER

【Technical Field】

[0001] The present invention relates to an apparatus for pressurizing and delivering low-temperature liquefied material using multistage heating type pressurizers, and more particularly, to an apparatus for pressurizing and delivering a low-temperature liquefied material using multistage heating type pressurizers, capable of receiving a liquefied material from a large storage tank, pressurizing the received liquefied material by multiple stages, and discharging the pressurized liquefied material.

【Background Art】

[0002] In order to supply a low-temperature liquefied material such as a liquefied natural gas (LNG) to where the high pressure gas is to be used, a low-temperature liquefied material pressurizing apparatus is required to pressurize or heat the low-temperature liquefied material to a liquid and a gas having higher pressure and a higher temperature.

[0003] In a general method according to a related art, a low-temperature liquefied material passes through a low-

pressure pump and a high pressure pump and is vaporized by an evaporator/heater into a high pressure gas and subsequently supplied to where the high pressure gas is to be used.

[0004] However, this method is disadvantageous in that two pumps need to be connected in series to be used, and since the low-temperature liquefied material stored in a large storage tank moves to a low-pressure pump, an evaporation gas is generated in a pipe to cause mechanical damage to the pumps.

[0005] Thus, in order to prevent this, an extra tank needs to be installed to separate a liquid and a gas, and in addition, it is not desirable to increase in the number of high-priced pumps having a high failure rate.

[0006] As another related art device for pressurizing a low-temperature liquefied material, an apparatus for pressurizing and delivering a low-temperature liquefied material and an operating method thereof were proposed in Korean Patent Laid-Open Publication No. 10-2012-0133694 as illustrated in FIGS. 1 and 2.

[0007] The method illustrated in FIG. 1 is used when required pressure is low and the apparatus thereof includes two or more small heaters to heat a low-pressure liquefied material received from a large storage tank to a liquefied material having appropriate pressure.

[0008] The method illustrated in FIG. 1, however, has a problem in that an increase in discharge pressure causes a large amount of steam to relatively increase pressure of the large storage tank, which results in an increase in design pressure of the large storage tank.

[0009] In addition, since two heating type pressurizers are alternately operated, when the pressurizers take turns, a flow rate and pressure of the liquefied material supplied to an evaporator may be rapidly changed, which causes a problem in operation.

[0010] The method illustrated in FIG. 2 is used when required pressure is high, in which the low-pressure pump in the related method of using two pumps is replaced with a heating type pressurizer.

[0011] However, in the method illustrated in FIG. 2, in a case in which a saturated liquid generated through the heating type pressurizer is supplied as is to a high pressure pump, a flashing phenomenon occurs to cause damage to the pump, and thus, a supercooler is provided to allow the saturated liquid to pass therethrough to be supercooled and subsequently supplied to a high pressure pump.

[0012] However, in the above method, the installation of the supercooler increases a volume of the overall system, since an extra tank should be installed, installation cost is increased as well.

[0013] In addition, since two or more pressurizers alternately operate, when a pressurizer in operation is changed, a flow rate and pressure of the liquefied material supplied to an evaporator may be significantly changed.

[0014] [Related Art Document]

[0015] [Patent Document] Korean Patent Publication No. 1254103 (April 8, 2013)

[0016]

【Disclosure】

【Technical Problem】

[0017] An object of the present invention is to provide an apparatus for pressurizing and delivering a low-temperature liquefied material using multistage heating type pressurizers, capable of continuously supplying a low-pressure and high pressure gas or a liquefied material, stabilizing supply of a liquefied material, and easily controlling a flow rate and pressure of a delivered liquefied material.

[0018] Another object of the present invention is to provide an apparatus for pressurizing and delivering a low-temperature liquefied material, capable of facilitating an operation through an pressurization apparatus using a multistage heating type pressurizers connected in series, compared with a parallel connection of the related art, and obtaining economical efficiency by omitting an installation

of an extra tank other than nth pressurizing units using N number of heating type pressurizers.

[0019] Another object of the present invention is to provide an apparatus for pressurizing and delivering a low-temperature liquefied material using multistage heating type pressurizers, capable of causing a liquefied material to be supercooled according to a supercooling effect using head pressure in the process of delivering the liquefied material, by placing an Nth pressurizing unit at a high position, to thus prevent damage to a high pressure pump installed at a rear stage of the Nth pressurizing unit.

【Technical Solution】

[0020] In one general aspect, an apparatus for pressurizing and delivering a low-temperature liquefied material using multistage heating type pressurizers includes: a large storage tank storing a low-temperature liquefied material; and a device for pressurizing a low-temperature liquefied material using multistage heating type pressurizers pressurizing a liquefied material received from the large storage tank through a first liquid supply pipe and delivering the pressurized liquefied material to a liquefied material consumer through a rear end, wherein the device for pressurizing a low-temperature liquefied material using multistage heating type pressurizers includes N number of nth pressurizing units

($n=1, \dots, N$, and N is a natural number of 2 or greater) repressurizing a liquefied material received through an n th liquid supply pipe from the outside and discharging the repressurized liquefied material to the outside through an $(N+1)$ th liquid supply pipe, the N number of n th pressurizing units being connected in series, the n th pressurizing unit includes an n th pressurizer for pressurization, and an N th pressurizing unit supplies the pressurized liquefied material to the rear end through the $(N+1)$ th liquid supply pipe.

[0021] In particular, the n th pressurizing unit may include an n th heater heating a portion of a liquefied material supplied from the n th pressurizer to generate an evaporation gas, causing the generated evaporation gas to be introduced back to the n th pressurizer, and pressurizing the generated evaporation gas introduced back to the n th pressurizer.

[0022] Also, the device for pressurizing a low-temperature liquefied material using multistage heating type pressurizers may include an n th gas valve formed in an n th pressure control pipe connecting the large storage tank and the n th pressurizer of the n th pressurizing unit and discharging an evaporation gas from the n th pressurizer to the large storage tank to control pressure of the n th pressurizer.

[0023] Also, when n is 1, the n th liquid supply pipe may include an n th liquid supply valve controlling a flow rate of the liquefied material supplied from the large storage tank to the n th pressurizing unit.

[0024] In addition, when n is 2 or greater, the n th liquid supply pipe may include an n th liquid supply valve controlling a flow rate of a liquefied material supplied from an $(n-1)$ th pressurizing unit to the n th pressurizing unit.

[0025] Also, the $(N+1)$ th liquid supply pipe may include an $(N+1)$ th liquid supply valve controlling a flow rate of the pressurized liquefied material supplied to the rear end.

[0026] The n th pressurizing unit may be disposed relatively lower than an $(n+1)$ th pressurizing unit.

[0027] In addition, the N th pressurizing unit may be disposed to be relatively higher than the rear end.

[0028] Also, the n th pressurizing unit may include an upper circulation pipe causing a light gas generated upon being heated by the n th heater formed outside of the n th pressurizer to be introduced to an upper portion of the n th pressurizer and causing a relatively heavy gas to circulate back to the n th pressurizer.

[0029] Also, the n th pressurizing unit may include a lower circulation pipe causing a light gas generated upon

being heated by the nth heater formed outside of the nth pressurizer to be introduced to an upper portion of the nth pressurizer and causing a relatively heavy gas to circulate back to the nth pressurizer.

[0030] In addition, the nth heater is provided within the nth pressurizer of the nth pressurizing unit.

[0031] In another general aspect, a pressurization method using an apparatus for pressurizing and delivering a low-temperature liquefied material includes: a liquefied material supply operation of supplying a low-temperature liquefied material stored in the large storage tank to the device for pressurizing a low-temperature liquefied material using multistage heating type pressurizers through the first liquid supply pipe; a liquefied material pressurizing operation of pressurizing the liquefied material N number of times by using the nth pressurizing units connected in series in the device for pressurizing a low-temperature liquefied material using multistage heating type pressurizers; a liquefied material discharging operation of discharging the liquefied material discharged from the device for pressurizing a low-temperature liquefied material using multistage heating type pressurizers to the rear end disposed below the Nth pressurizing unit of the device for pressurizing a low-temperature liquefied material using multistage heating

type pressurizers through the (N+1)th liquid supply pipe; and a liquefied material delivering operation of supplying the liquefied material from the rear end to a liquefied material consumer.

[0032] Also, in the liquefied material supply operation, after the first gas valve formed in the first pressure control pipe connecting the large storage tank and the first pressurizer of the first pressurizing unit is opened to cause the large storage tank and the first pressurizer to be balanced in pressure, the first liquid supply valve formed in the first liquid supply pipe may be opened to cause a low-temperature liquefied material to be supplied to the first pressurizer of the first pressurizing unit due to a difference in head pressure.

[0033] In addition, in the liquefied material pressurizing operation, after the first gas valve formed in the first pressure control pipe connecting the large storage tank and the first pressurizer of the first pressurizing unit and the first liquid supply valve formed in the first liquid supply pipe are closed, the liquefied material may be pressurized, while being evaporated through the first heater of the first pressurizing unit.

[0034] Also, in the liquefied material pressurizing operation, when n is 2 or greater, after an nth gas valve formed in an nth pressure control pipe connecting the large

storage tank and an nth pressurizer of the nth pressurizing unit and an nth liquid supply valve formed in the nth liquid supply pipe connecting an (n-1)th pressurizer and the nth pressurizer are closed, the liquefied material may be pressurized, while being evaporated through the nth heater of the nth pressurizing unit.

[0035] Also, when the nth pressurizer has pressure equal to or greater than a specific value, the nth pressurizer may open the nth gas valve to deliver a gas within the nth pressurizer to the large storage tank.

[0036] In addition, in the liquefied material pressurizing operation, when n is 2 or greater, the nth liquid supply valve may be opened and the liquefied material may be supplied from the (n-1)th pressurizer to the nth pressurizer due to a difference in pressure between the (n-1)th pressurizer and the nth pressurizer.

[0037] Also, in the liquefied material discharging operation, an (N+1)th liquid supply valve formed in the (N+1)th liquid supply pipe connecting an Nth pressurizer of the Nth pressurizing unit and the rear end may be opened to supply a supercooled liquefied material to the rear end through the (N+1)th liquid supply pipe due to a difference in head pressure.

[0038] Also, in the liquefied material delivering operation, the supercooled liquefied material may be

supplied to the liquefied material consumer through the rear end.

【Advantageous Effects】

[0039] Since the apparatus for pressurizing and delivering a low-temperature liquefied material using multistage heating type pressurizers according to the present invention includes the device for pressurizing a low-temperature liquefied material using multistage heating type pressurizers connected in series, a low-pressure and high pressure gas or a liquefied material may be continuously supplied, supply of a liquefied material is stable, and a flow rate and pressure of a delivered liquefied material may be easily controlled.

[0040] In particular, since the apparatus for pressurizing and delivering a low-temperature liquefied material using multistage heating type pressurizers according to the present invention includes the device for pressurizing a low-temperature liquefied material using multistage heating type pressurizers connected in series, an operation may be facilitated, compared with the related art parallel connection, and since an extra tank, other than the nth pressurizing unit using N number of heating type pressurizers, is not installed, economical efficiency may be obtained.

[0041] Also, in the apparatus for pressurizing and

delivering a low-temperature liquefied material using multistage heating type pressurizers according to the present invention, since the Nth pressurizing unit is placed at a high position, a liquefied material is supercooled due to a supercooling effect using head pressure in the process of delivering the liquefied material, whereby a gaseous evaporation gas is prevented from being introduced to a high pressure pump installed at a rear stage of the Nth pressurizing unit, preventing damage to the pump.

[0042] In addition, the device for pressurizing a low-temperature liquefied material using multistage heating type pressurizers according to the present invention may be advantageously applied to a low-pressure gas engine, as well as to a high pressure gas engine.

【Description of Drawings】

[0043] FIG. 1 is a view schematically illustrating an apparatus for pressurizing and delivering a low-temperature liquefied material using heating type pressurizers according to the related art when required pressure is low.

[0044] FIG. 2 is a view schematically illustrating an apparatus for pressurizing and delivering a low-temperature liquefied material using heating type pressurizers according to the related art when required pressure is high.

[0045] FIG. 3 is a view schematically illustrating an

apparatus for pressurizing and delivering a low-temperature liquefied material using multistage heating type pressurizers according to the present invention when required pressure is low.

[0046] FIG. 4 is a view schematically illustrating an apparatus for pressurizing and delivering a low-temperature liquefied material using multistage heating type pressurizers according to the present invention when required pressure is high.

[0047] FIG. 5 is a view schematically illustrating an embodiment of an apparatus for pressurizing and delivering a low-temperature liquefied material using multistage heating type pressurizers according to the present invention when required pressure is high.

[0048] FIG. 6 is a view schematically illustrating an nth pressurizing unit of an apparatus for pressurizing and delivering a low-temperature liquefied material using multistage heating type pressurizers according to the present invention.

[0049] FIG. 7 is a view schematically illustrating an embodiment 1 of an nth pressurizing unit of an apparatus for pressurizing and delivering a low-temperature liquefied material using multistage heating type pressurizers according to the present invention.

[0050] FIG. 8 is a view schematically illustrating an

embodiment 2 of an nth pressurizing unit of an apparatus for pressurizing and delivering a low-temperature liquefied material using multistage heating type pressurizers according to the present invention.

[0051] FIG. 9 is a view schematically illustrating an embodiment 3 of an nth pressurizing unit of an apparatus for pressurizing and delivering a low-temperature liquefied material using multistage heating type pressurizers according to the present invention.

[0052] FIG. 10 is a view schematically illustrating a method of operating an apparatus for pressurizing and delivering a low-temperature liquefied material using multistage heating type pressurizers according to the present invention.

[Best Mode]

[0053] Hereinafter, an apparatus for pressurizing and delivering a low-temperature liquefied material using multistage heating type pressurizers and an operation method thereof according to the present invention have the aforementioned features will be described in detail with reference to the accompanying drawings.

[0054] Terms or words used in the specification and claims should not be limited and construed as common or dictionary meanings, and should be construed as meanings and concepts according to the technical spirit of the

present invention based on the principle that the inventor can appropriately define the concept of each term for describing the invention in the best way.

[0055] The exemplary embodiment described in the present invention and the configuration illustrated in the drawings are merely the most preferred embodiment of the present invention, rather than representing all the technical concepts of the present invention, so the present invention is meant to cover all modifications, similarities and alternatives which are included in the spirit and scope of the present invention at the time of filing of the present invention.

[0056]

[0057] FIG. 1 is a view schematically illustrating an apparatus for pressurizing and delivering a low-temperature liquefied material using heating type pressurizers according to the related art when required pressure is low, FIG. 2 is a view schematically illustrating an apparatus for pressurizing and delivering a low-temperature liquefied material using heating type pressurizers according to the related art when required pressure is high, FIG. 3 is a view schematically illustrating an apparatus for pressurizing and delivering a low-temperature liquefied material using multistage heating type pressurizers according to the present invention when required pressure

is low, FIG. 4 is a view schematically illustrating an apparatus for pressurizing and delivering a low-temperature liquefied material using multistage heating type pressurizers according to the present invention when required pressure is high, FIG. 5 is a view schematically illustrating an embodiment of an apparatus for pressurizing and delivering a low-temperature liquefied material using multistage heating type pressurizers according to the present invention when required pressure is high, FIG. 6 is a view schematically illustrating an nth pressurizing unit of an apparatus for pressurizing and delivering a low-temperature liquefied material using multistage heating type pressurizers according to the present invention, FIG. 7 is a view schematically illustrating an embodiment 1 of an nth pressurizing unit of an apparatus for pressurizing and delivering a low-temperature liquefied material using multistage heating type pressurizers according to the present invention, FIG. 8 is a view schematically illustrating an embodiment 2 of an nth pressurizing unit of an apparatus for pressurizing and delivering a low-temperature liquefied material using multistage heating type pressurizers according to the present invention, FIG. 9 is a view schematically illustrating an embodiment 3 of an nth pressurizing unit of an apparatus for pressurizing and delivering a low-temperature liquefied material using

multistage heating type pressurizers according to the present invention, and FIG. 10 is a view schematically illustrating a method of operating an apparatus for pressurizing and delivering a low-temperature liquefied material using multistage heating type pressurizers according to the present invention.

[0058] As illustrated in FIGS. 3 through 5, a device 200 for pressurizing a low-temperature liquefied material using multistage heating type pressurizers according to the present invention pressurizes a liquefied material supplied through a first liquid supply pipe 13 from a large storage tank 100 storing a low-temperature liquefied material, and discharges the pressurized liquefied material to a rear end 300.

[0059] In other words, the device 200 for pressurizing a low-temperature liquefied material using multistage heating type pressurizers is formed by connecting a first pressurizing unit 10, which pressurizes a low-temperature liquefied material supplied through the first liquid supply pipe 13 from the large storage tank 100 where it is stored, and N number of nth pressurizing units 50 (when n is 2 or greater), which re-pressurize the liquefied material supplied through an nth liquid supply pipe 53, and discharge the re-pressurized liquefied material to the outside through an (N+1)th liquid supply pipe 33, in series.

[0060] Here, $n=1, \dots, N$, and N is a natural number equal to or greater than 2, and various numbers of n th pressurizing unit 50 may be formed selectively according to a pressurization environment and an operation.

[0061] Also, in the device 200 for pressurizing a low-temperature liquefied material using multistage heating type pressurizers, a first pressurizer 11 of the first pressurizing unit 10 receives a low-temperature liquefied material through the first liquid supply pipe 13 from the large storage tank 100, and here, the first pressurizing unit 10 is disposed relatively lower than the large storage tank 100.

[0062] Also, the n th pressurizing unit 50 is disposed relatively lower than an $(n+1)$ th pressurizing unit.

[0063] In other words, the first pressurizing unit 10 is disposed relatively lower than the large storage tank 100, and as the order of n is increased, corresponding pressurizing units are disposed at a higher position, so that the N th pressurizing unit 20, a last pressurizing unit of the n th pressurizing units 50 which are connected to each other in series, is formed at the highest position.

[0064] The rear end 300 receives the liquefied material pressurized by the N th pressurizing unit 20 through the $(N+1)$ th liquid supply pipe 33, and is disposed relatively lower than the N th pressurizing unit 20.

[0065] Here, unlike the aforementioned positions of the nth pressurizing unit 50 and the Nth pressurizing unit 20, the positions of the nth pressurizing unit 50 and the Nth pressurizing unit 20 may be selectively disposed according to use purposes of a low-pressure gas engine, a high pressure gas engine, and the like.

[0066] As illustrated in FIGS. 3 through 5, when n is 2 or greater, an nth pressurizer 51 of the nth pressurizing unit 50 may be formed to be greater in volume than an (n-1)th pressurizer.

[0067] As described above, since the nth pressurizer 51 is formed to be greater than the (n-1)th pressurizer, a liquefied material may be intermittently received and stably delivered.

[0068] In other words, it aims at preventing supply of the liquefied material to a liquefied material consumer 400 (i.e., where the liquefied material is to be consumed) from being stopped, increasing the safety of the apparatus for pressurizing and delivering a low-temperature liquefied material using multistage heating type pressurizers of the present invention, as well as increasing time for a worker to cope with an accident at the time it occurs.

[0069] As illustrated in FIGS. 3 through 5, the nth pressurizing unit 50 includes an nth heater 52 heating a portion of a liquefied material supplied from the nth

pressurizer 51 to generate an evaporation gas, causing the generated evaporation gas to be introduced back to the nth pressurizer 51, and pressurizing the generated evaporation gas introduced back to the nth pressurizer 51.

[0070] Here, the nth heater 52 may perform heating through heat-exchange with an internal or external heating medium, and here, electricity, as well as a high-temperature fluid, may be used as the heating medium source.

[0071] Also, the device 200 for pressurizing a low-temperature liquefied material using multistage heating type pressurizers includes an nth pressure control pipe 55 connecting the large storage tank 100 and the nth pressurizer 51 of the nth pressurizing unit 50.

[0072] Here, the nth pressure control pipe 55 includes an nth gas valve 56 discharging the evaporation gas of the nth pressurizer 51 to the large storage tank 100 to control pressure of the nth pressurizer 51.

[0073] The nth liquid supply pipe 53 of the device 200 for pressurizing a low-temperature liquefied material using multistage heating type pressurizers includes an nth liquid supply valve 54 controlling a flow rate of a liquefied material supplied to the nth pressurizing unit 50.

[0074] Also, the (N+1)th liquid supply pipe 33 supplying the pressurized liquefied material from the Nth pressurizing unit 20 formed at the highest position of the

nth pressurizing unit 50 to the rear end 300 includes an (N+1)th liquid supply valve 34 controlling a flow rate of the pressurized liquefied material.

[0075] The rear end 300 includes a high pressure pump 310 and an evaporator 320. When required pressure is low, only the evaporator 320, excluding the high pressure pump 310, is disposed as illustrated in FIG. 3, and when required pressure is high, both the high pressure pump 310 and the evaporator 320 are disposed as illustrated in FIGS. 4 and 5.

[0076] In other words, the device 200 for pressurizing a low-temperature liquefied material using multistage heating type pressurizers according to the present invention may also be applied to a low-pressure gas engine, as well as to a high pressure gas engine.

[0077] As illustrated in FIG. 6, in the nth pressurizing unit 50, a liquefied material loaded in the nth pressurizer 51 flows along a pipe and is heated by the nth heater 52 installed outside of the pipe.

[0078] Here, generated steam flows upwardly along the pipe to pressurize the liquefied material within the nth pressurizer 51.

[0079]

[0080] <Embodiment 1 of nth pressurizing unit 50>

[0081] As illustrated in FIG. 7, the nth pressurizing

unit 50 includes an upper circulation pipe 1 disposed above the nth heater 52 and connected to the nth pressurizer 51.

[0082] In other words, a gas generated upon being heated within the pipe and having a composition having a relatively low boiling point is introduced into an upper portion of the nth pressurizer 51, and a gas having a composition having a relatively high boiling point circulates to the nth pressurizer 51 by the upper circulation pipe 1.

[0083] In the nth pressurizing unit 50 of Embodiment 1, since the liquefied material of the pipe where the external heater is installed continues to circulate, gases having a composition having a relatively high boiling point are prevented from being accumulated in the pipe, whereby a load of the nth heater 52 may be reduced and a sufficient vaporized gas may be obtained.

[0084]

[0085] <Embodiment 2 of nth pressurizing unit 50>

[0086] Embodiment 2 of the nth pressurizing unit 50 is an improved version of the pipe of Embodiment 1. As illustrated in FIG. 8, the nth pressurizing unit 50 includes a lower circulation pipe 2 disposed below the pipe in which a liquefied material is introduced from the nth pressurizer 51 to the nth heater 52.

[0087] In other words, a gas generated upon being

heated within the pipe and having a composition having a relatively low boiling point is introduced to an upper portion of the nth pressurizer 51 and a gas having a composition having a relatively high boiling point circulates to the nth pressurizer 51 by the lower circulation pipe 2.

[0088] In the nth pressurizing unit 50 of Embodiment 2, since the gas having a composition having a relatively high boiling point flows to the lower side of the pipe and is introduced to the nth pressurizer 51, a heavy gas may advantageously circulate therein.

[0089]

[0090] <Embodiment 3 of nth pressurizing unit 50>

[0091] As illustrated in FIG. 9, in the nth pressurizing unit 50, the nth heater 52 is formed within the nth pressurizer 51.

[0092] The nth heater 52 is mounted on the pipe installed at the center within the nth pressurizer 51.

[0093] A liquefied material introduced to the pipe within the nth pressurizer 51 is heated by the nth heater 52, and a vaporized gas having a composition having a relatively low boiling point is discharged to an upper portion within the nth pressurizer 51 to serve as a piston pressurizing the liquefied material and a gas having a composition having a relatively high boiling point is

discharged to a lower portion of the nth pressurizer 51 to assist circulation of the heated liquefied material.

[0094] In the nth pressurizing unit 50 of Embodiment 3, since the liquefied material within the nth pressurizer 51 continues to circulate, the gas having a composition having a relatively high boiling point is prevented from being accumulated and performance of the nth heater 52 may be stably maintained.

[0095] Here, a hole discharging the gas having a composition having a relatively high boiling point as generated by the nth heater 52 installed within the nth pressurizer 51 may be selectively used, and even without the hole, the gas having a composition having a relatively high boiling point boils up to fall to the outside of the hole, and thus, the liquefied material continues to circulate.

[0096] As illustrated in FIG. 10, a method for operating the device 200 for pressurizing a low-temperature liquefied material using multistage heating type pressurizers includes a liquefied material supply operation S10 of supplying a low-temperature liquefied material stored in the large storage tank 100 to the device 200 for pressurizing a low-temperature liquefied material using multistage heating type pressurizers disposed below the large storage tank 100 through the first liquid supply pipe

13, a liquefied material pressurizing operation S20 of pressurizing the liquefied material N number of times by using the nth pressurizing units 50 connected in series in the device 200 for pressurizing a low-temperature liquefied material using multistage heating type pressurizers, a liquefied material discharging operation S30 of discharging the liquefied material discharged from the device 200 for pressurizing a low-temperature liquefied material using multistage heating type pressurizers to the rear end 300 disposed below the Nth pressurizing unit 20 of the device 200 for pressurizing a low-temperature liquefied material using multistage heating type pressurizers through the (N+1)th liquid supply pipe 33, and a liquefied material delivering operation S40 of supplying the liquefied material from the rear end 300 to the liquefied material consumer 400.

[0097] In detail, as illustrated in FIGS. 3 through 5, in the liquefied material supply operation S10, the first gas valve 16 formed in the first pressure control pipe 15 connecting the large storage tank 100 and the first pressurizer 11 of the first pressurizing unit 10 is opened.

[0098] As the first gas valve 16 is opened, the large storage tank 100 and the first pressurizer 11 are balanced in pressure, and in this state, the first liquid supply valve 14 formed in the first liquid supply pipe 13 is

opened.

[0099] As the first liquid supply valve 14 is opened, a low-temperature liquefied material stored in the large storage tank 100 disposed to be relatively higher than the first pressurizing unit 10 is supplied to the first pressurizer 11 of the first pressurizing unit 10 due to a difference in head pressure.

[00100] As illustrated in FIGS. 3 through 5, in the liquefied material pressurizing operation S20, the first gas valve 16 formed in the first pressure control pipe 15 connecting the large storage tank 100 and the first pressurizer 11 of the first pressurizing unit 10 and the first liquid supply valve 14 formed in the first liquid supply pipe 13 and controlling a flow rate of the low-temperature liquefied material supplied from the large storage tank 100 are closed.

[00101] In a state in which the first gas valve 16 and the first liquid supply valve 14 are closed, the first heater 12 of the first pressurizing unit 10 operates to pressurize the liquefied material, while evaporating the liquefied material.

[00102] The liquefied material pressurized in the first pressurizing unit 10 is supplied to the second pressurizing unit, and regarding the supplied liquefied material, when n is 2 or greater, the n th gas valve 56 formed in the n th

pressure control pipe 55 connecting the large storage tank 100 and the nth pressurizer 51 of the nth pressurizing unit 50 and the nth liquid supply valve 54 formed in the nth liquid supply pipe 53 connecting the (n-1)th pressurizer and the nth pressurizer 51 and controlling a flow rate of the liquefied material supplied from the (n-1)th pressurizer are closed.

[00103] In this manner, in a state in which the nth gas valve 56 and the nth liquid supply valve 54 are closed, the nth heater 52 of the nth pressurizing unit 50 operates to pressurize the liquefied material, while evaporating the liquefied material.

[00104] Also, when n is 2 or greater, the nth liquid supply valve 54 is opened and the liquefied material is supplied to the nth pressurizer 51 formed above the (n-1)th pressurizer due to a difference in pressure between the (n-1)th pressurizer and the nth pressurizer 51.

[00105] That is, the first pressurizing unit 10 is supplied with the low-temperature liquefied material from the large storage tank 100 disposed to be relatively higher than the first pressurizing unit 10 due to a difference in head pressure, and when n is 2 or greater, since the nth pressurizing unit 50 is disposed to be relatively higher than the (n-1)th pressurizing unit, the nth pressurizing unit 50 is supplied with the liquefied material from the

(n-1)th pressurizing unit having pressure increased through pressurization due to a difference in pressure.

[00106] As illustrated in FIGS. 3 through 5 and 10, when the nth pressurizer 51 has pressure equal to or higher than a specific value, the nth pressurizer 51 opens the nth gas valve 56 to deliver a gas therein to the large storage tank 100 to thus control pressure thereof.

[00107] That is, the nth pressurizer 51 is intermittently supplied with the liquefied material from the (n-1)th pressurizer and adjusts pressure by itself, and the nth pressurizer 51 increases pressure using the nth heater 52 or decreases pressure using the nth gas valve 56.

[00108] In other words, the (n-1)th pressurizer is used for the purpose of charging the liquefied material to the nth pressurizer 51.

[00109] As illustrated in FIGS. 3 through 5 and 10, in the liquefied material discharging operation S30, the liquefied material supplied as the Nth liquid supply valve 24 of the Nth liquid supply pipe 23 is opened is pressurized again through the Nth pressurizer 21 of the Nth pressurizing unit and the Nth heater 22 of the Nth pressurizer 21 and subsequently discharged, and as the (N+1)th liquid supply valve 34 formed in the (N+1)th liquid supply pipe 33 connected to the rear end 300 is opened, the discharged liquefied material is supplied to the rear end

300.

[00110] The Nth pressurizing unit 20 is formed at a highest position of among other nth pressurizing units 50, and may supply the supercooled liquefied material to the rear end 300 formed therebelow due to a difference in head pressure.

[00111] In other words, once the liquefied material leaves from the Nth pressurizer 21 of the Nth pressurizing unit 20, the liquefied material is originally discharged with pressure corresponding to the sum of head pressure and the pressure of the Nth pressurizer 21, and here, since pressure is increased by the head pressure without a change in temperature, a supercooling effect is generated.

[00112] That is, even though the supercooled liquefied material is introduced to a device such as the high pressure pump 310 of the rear end 300, a gas is not generated, thereby preventing mechanical damage to the pump due to a flashing phenomenon.

[00113] Finally, in the liquefied material delivering operation S40, the supercooled liquefied material is supplied to a liquefied material consumer 400 through the rear end 300 including the high pressure pump 310 and the evaporator 320.

[00114] As described above, in the device 200 for pressurizing a low-temperature liquefied material using

multistage heating type pressurizers, since the nth pressurizing units 50 are connected in series, a problem arising when the nth pressurizing units 50 are connected in parallel may be prevented.

[00115] In other words, a rapid change in a flow rate and pressure of a liquefied material made when a pressurizer in operation is changed may be prevented.

[00116] [Detailed Description of Main Elements]

[00117] 100: large storage tank

[00118] 200: device for pressurizing a low-temperature liquefied material using multistage heating type pressurizers

[00119] 10: first pressurizing unit

[00120] 11: first pressurizer

[00121] 12: first heater

[00122] 13: first liquid supply pipe

[00123] 14: first liquid supply valve

[00124] 15: first pressure control pipe

[00125] 16: first gas valve

[00126] 20: Nth pressurizing unit

[00127] 21: Nth pressurizer

[00128] 22: Nth heater

[00129] 23: Nth liquid supply pipe

[00130] 24: Nth liquid supply valve

[00131] 25: Nth pressure control pipe

[00132]	26: Nth gas valve
[00133]	50: nth pressurizing unit
[00134]	51: nth pressurizer
[00135]	52: nth heater
[00136]	53: nth liquid supply pipe
[00137]	54: nth liquid supply valve
[00138]	55: nth pressure control pipe
[00139]	56: nth gas valve
[00140]	33: (N+1)th liquid supply pipe
[00141]	34: (N+1)th liquid supply valve
[00142]	300: rear end
[00143]	310: high pressure pump
[00144]	320: evaporator
[00145]	400: liquefied material consumer
[00146]	1: upper circulation pipe
[00147]	2: lower circulation pipe

【CLAIMS】**【Claim 1】**

An apparatus for pressurizing and delivering a low-temperature liquefied material using multistage heating type pressurizers, the apparatus comprising:

a large storage tank (100) storing a low-temperature liquefied material; and

a device (200) for pressurizing a low-temperature liquefied material using multistage heating type pressurizers pressurizing a liquefied material received from the large storage tank (100) through a first liquid supply pipe (13) and delivering the pressurized liquefied material to a liquefied material consumer (400) through a rear end (300),

wherein the device (200) for pressurizing a low-temperature liquefied material using multistage heating type pressurizers includes N number of nth pressurizing units (50) ($n=1, \dots, N$, and N is a natural number of 2 or greater) repressurizing a liquefied material received through an nth liquid supply pipe (53) from the outside and discharging the re-pressurized liquefied material to the outside through an (N+1)th liquid supply pipe (33), the N number of nth pressurizing units (50) being connected in series,

the nth pressurizing unit (50) includes an nth

pressurizer (51) for pressurization, and

an Nth pressurizing unit (20) supplies the pressurized liquefied material to the rear end (300) through the (N+1)th liquid supply pipe (33).

【Claim 2】

The apparatus of claim 1, wherein the nth pressurizing unit (50) includes an nth heater (52) heating a portion of a liquefied material supplied from the nth pressurizer (51) to generate an evaporation gas, causing the generated evaporation gas to be introduced back to the nth pressurizer (51), and pressurizing the generated evaporation gas introduced back to the nth pressurizer (51).

【Claim 3】

The apparatus of claim 1, wherein the device (200) for pressurizing a low-temperature liquefied material using multistage heating type pressurizers includes an nth gas valve 56 formed in an nth pressure control pipe (55) connecting the large storage tank (100) and the nth pressurizer (51) of the nth pressurizing unit (50) and discharging an evaporation gas from the nth pressurizer (51) to the large storage tank (100) to control pressure of the nth pressurizer (51).

【Claim 4】

The apparatus of claim 1, wherein when n is 1, the n th liquid supply pipe (53) includes an n th liquid supply valve (54) controlling a flow rate of the liquefied material supplied from the large storage tank (100) to the n th pressurizing unit (50).

【Claim 5】

The apparatus of claim 1, wherein when n is 2 or greater, the n th liquid supply pipe (53) includes an n th liquid supply valve (54) controlling a flow rate of a liquefied material supplied from an $(n-1)$ th pressurizing unit to the n th pressurizing unit (50).

【Claim 6】

The apparatus of claim 1, wherein the $(N+1)$ th liquid supply pipe (33) includes an $(N+1)$ th liquid supply valve (34) controlling a flow rate of the pressurized liquefied material supplied to the rear end (300).

【Claim 7】

The apparatus of claim 1, wherein the n th pressurizing unit (50) is disposed relatively lower than an $(n+1)$ th pressurizing unit.

【Claim 8】

The apparatus of claim 1, wherein the Nth pressurizing unit (20) is disposed to be relatively higher than the rear end (300).

【Claim 9】

The apparatus of claim 2, wherein the nth pressurizing unit (50) includes an upper circulation pipe (1) causing a light gas generated upon being heated by the nth heater (52) formed outside of the nth pressurizer (51) to be introduced to an upper portion of the nth pressurizer (51) and causing a relatively heavy gas to circulate back to the nth pressurizer (51).

【Claim 10】

The apparatus of claim 2, wherein the nth pressurizing unit (50) includes a lower circulation pipe (2) causing a light gas generated upon being heated by the nth heater (52) formed outside of the nth pressurizer (51) to be introduced to an upper portion of the nth pressurizer (51) and causing a relatively heavy gas to circulate back to the nth pressurizer (51).

【Claim 11】

The apparatus of claim 2, wherein the nth heater (52)

is provided within the nth pressurizer (51) of the nth pressurizing unit (50).

【Claim 12】

A method for pressurizing a low-temperature liquefied material using the multistage heating type pressurizers according to any one of claims 1 to 11, the method comprising:

a liquefied material supply operation (S10) of supplying the low-temperature liquefied material stored in the large storage tank (100) to the device (200) for pressurizing a low-temperature liquefied material using multistage heating type pressurizers through the first liquid supply pipe (13);

a liquefied material pressurizing operation (S20) of pressurizing the liquefied material N number of times by using the nth pressurizing units (50) connected in series in the device (200) for pressurizing a low-temperature liquefied material using multistage heating type pressurizers;

a liquefied material discharging operation (S30) of discharging the liquefied material discharged from the device (200) for pressurizing a low-temperature liquefied material using multistage heating type pressurizers to the rear end (300) disposed below the Nth pressurizing unit

(20) of the device (200) for pressurizing a low-temperature liquefied material using multistage heating type pressurizers through the (N+1)th liquid supply pipe (33); and

a liquefied material delivering operation (S40) of supplying the liquefied material from the rear end (300) to the liquefied material consumer (400).

【Claim 13】

The method of claim 12, wherein, in the liquefied material supply operation (S10), after the first gas valve (16) formed in the first pressure control pipe (15) connecting the large storage tank (100) and the first pressurizer (11) of the first pressurizing unit (10) is opened to cause the large storage tank (100) and the first pressurizer (11) to be balanced in pressure, the first liquid supply valve (14) formed in the first liquid supply pipe (13) is opened to cause the low-temperature liquefied material to be supplied to the first pressurizer (11) of the first pressurizing unit (10) due to a difference in head pressure.

【Claim 14】

The method of claim 12, wherein, in the liquefied material pressurizing operation (S20), after a first gas

valve (16) formed in a first pressure control pipe (15) connecting the large storage tank (100) and a first pressurizer (11) of a first pressurizing unit (10) and a first liquid supply valve (14) formed in the first liquid supply pipe (13) are closed, the liquefied material is pressurized, while being evaporated through the first heater (12) of the first pressurizing unit (10).

【Claim 15】

The method of claim 12, wherein, in the liquefied material pressurizing operation (S20), when n is 2 or greater, after an n th gas valve (56) formed in the n th pressure control pipe (55) connecting the large storage tank (100) and the n th pressurizer (51) of the n th pressurizing unit (50) and the n th liquid supply valve (54) formed in the n th liquid supply pipe (53) connecting an $(n-1)$ th pressurizer and the n th pressurizer (51) are closed, the liquefied material is pressurized, while being evaporated through the n th heater (52) of the n th pressurizing unit (50).

【Claim 16】

The method of claim 15, wherein when the n th pressurizer (51) has pressure equal to or greater than a specific value, the n th pressurizer (51) opens the n th gas

valve (56) to deliver a gas within the nth pressurizer (51) to the large storage tank (100).

【Claim 17】

The method of claim 12, wherein, in the liquefied material pressurizing operation (S20), when n is 2 or greater, the nth liquid supply valve (54) is opened and the liquefied material is supplied from an (n-1)th pressurizer to the nth pressurizer (51) due to a difference in pressure between the (n-1)th pressurizer and the nth pressurizer (51).

【Claim 18】

The method of claim 12, wherein, in the liquefied material discharging operation (S30), the (N+1)th liquid supply valve (34) formed in the (N+1)th liquid supply pipe (33) connecting an Nth pressurizer (21) of the Nth pressurizing unit (20) and the rear end (300) is opened to supply a supercooled liquefied material to the rear end (300) through the (N+1)th liquid supply pipe (33) due to a difference in head pressure.

【Claim 19】

The method of claim 12, wherein, in the liquefied material delivering operation (S40), a supercooled

liquefied material is supplied to the liquefied material consumer (400) through the rear end (300).