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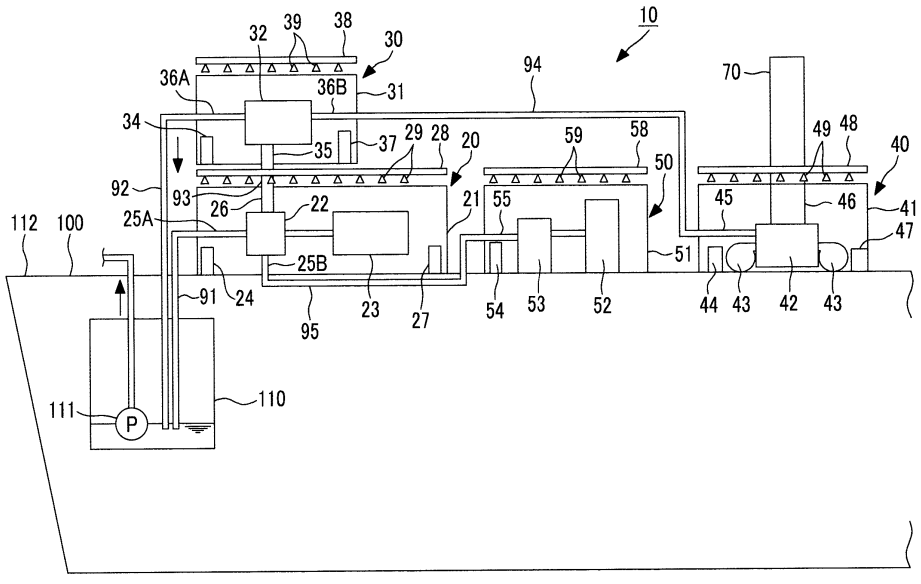
(54) GAS REMOVAL EQUIPMENT, GAS REMOVAL VESSEL, AND METHOD FOR REMOVING GAS FROM TANK

(57) The purpose of the present invention is to perform a procedure for removing gas in a fuel gas tank without causing problems such as securement of an installation space and a rise in cost. By equipping a vessel (100) with gas removal equipment (10) provided with a gas compression unit (20), a gas heater unit (30), a gas combustion unit (40), and an inert gas supply unit (50), fuel gas in a tank (110) is removed even in the vessel (100) not provided with devices for performing a procedure for removing gas.

FIG. 2



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Description

Technical Field

[0001] The present invention relates to gas removal equipment, a gas removal vessel, and a method for removing gas from (a) tank(s)_ that removes fuel gas remaining in the tank(s).

Background Art

[0002] In the related art, heavy oil or gas oil has been used as fuel in vessels. In recent years, however, the number of vessels using fuel gas, such as liquefied natural gas (LNG), as fuel is increasing from a viewpoint of environmental preservation (for example, refer to PTL 1). In such vessels, the fuel gas is stored in (a) tank(s) installed inside the vessel or on the vessel. When the fuel gas is equipped as cargo, a portion of the cargo may be used as fuel.

Citation List

Patent Literature

[0003] [PTL 1] Japanese Unexamined Patent Application Publication No. 2010-23776

Summary of Invention

Technical Problem

[0004] When such a vessel enters a repair yard for periodic inspection, repair, or the like, in order to secure the safety of work using fire, such as welding, it is necessary to remove the fuel gas within the tank and to replace the inside of the tank with inert gas, and it is desirable to replace the inert gas with air (such a procedure is appropriately referred to as a gas removal procedure).

[0005] In order to perform such a gas removal procedure on the fuel gas tank, it is necessary to equip devices required for the gas removal procedure in addition to devices for propelling the vessel, using the fuel gas as fuel. Therefore, a space for installing the devices for the gas removal procedure that is not always required for the vessel using the fuel gas as fuel should be secured for the vessel, and it is natural that cost is also required for that purpose.

[0006] The invention has been made in view of the above circumstances, and an object thereof is to provide gas removal equipment, a gas removal vessel, and a method for removing gas from (a) tank(s), which can perform a gas removal procedure for the fuel gas from the tank, without causing problems, such as securement of an installation space and a rise in cost.

Solution to Problem

[0007] Gas removal equipment related to a first aspect of the invention is gas removal equipment having portability capable of being equipped on a vessel using fuel gas as fuel. The gas removal equipment includes a gas compression section that compresses the gas extracted from the inside of (a) tank(s) of the vessel; a gas heater section that heats the gas extracted from the inside of the tank of the vessel; a gas combustion section that combusts the gas discharged from the inside of the tank by being gasified or the gas expanded in volume through heating in the gas heater section; and an inert gas supply section that delivers inert gas into the tank. At least one of the sections is housed in a casing.

[0008] In such gas removal equipment, while the gas extracted from the tank is compressed and the compressed gas is returned to the tank, the gas is heated, whereby the liquid-phase fuel gas that remains within the tank is evaporated and the temperature of the tank is raised. Then, a portion of the gas that is gasified and expanded in volume is delivered into and combusted in the gas combustion section, and is discharged therefrom. Then, if the inert gas is delivered into the tank, the inside of the tank can be replaced with the inert gas.

[0009] Here, at least one of the gas compression section, the gas heater section, the gas combustion section, and the inert gas supply unit may be provided, and a configuration in which some of the sections are excluded may be adopted according to equipment on the vessel side. The tank is, for example, a fuel tank.

[0010] At least one of such a gas compression section, the gas heater section, the inert gas supply unit, and the gas combustion section can be easily equipped on a vessel using fuel gas as fuel, using cranes equipped on vessels or in ports, by being housed in the casing.

[0011] Here, although the gas compression section, the gas heater section, the inert gas supply unit, and the gas combustion section are collectively housed in one casing, the gas compression section, the gas heater section, the inert gas supply unit, and the gas combustion section may be respectively housed in individual casings.

[0012] When devices that can perform some functions of the gas removal equipment are equipped on the vessel side, things other than the devices may be housed in the casing and equipped on the vessel. In this case, if the gas compression section, the gas heater section, the inert gas supply unit, and the gas combustion section are individually housed in the casings, only casings that house required devices may be selected and equipped on the vessel.

[0013] The gas removal equipment may further include a water spray device that sprays water onto the casing. Accordingly, the casing can be cooled, and fire prevention performance can be enhanced. Here, as for water, it is preferable to pump and use sea water around the vessel, using a pump or the like.

[0014] Additionally, a gas-detecting device may be

provided within the casing, and actuation of the tank is stopped when the gas is detected using the gas-detecting device. This increases safety.

[0015] A gas removal vessel related to a second aspect of the invention includes gas removal equipment having portability that removes fuel gas within (a) tank(s) of a vessel using the fuel gas as fuel; and a barge having the gas removal equipment equipped thereon and being capable of approaching the vessel. The gas removal equipment includes at least one of a gas compression section that compresses the gas extracted from the inside of the tank; a gas heater section that heats the gas extracted from the inside of the tank of the vessel; a gas combustion section that combusts the gas discharged from the inside of the tank by being gasified or expanded in volume through heating in the gas heater section; and an inert gas supply section that delivers inert gas into the tank. The gas compression section, the gas heater section, the inert gas supply section, and the gas combustion section are housed in a casing. As such a vessel, a barge vessel is suitable.

[0016] Additionally, the method for removing gas from a tank related to a third aspect of the invention is a method for removing gas from a tank, which is equipped on a vessel and stores a fuel gas, using the gas removal equipment as described above. The method includes a process of connecting the gas removal equipment to the tank of the vessel; a process of compressing the gas within the tank in the gas compression section to circulate the gas within the tank while heating the gas within the tank in the gas heater section; a process of combusting the gas pushed out from the tank in the gas combustion section and discharging the combusted gas to the outside, as the gas is heated and expanded in volume in the gas heater section; and a process of delivering inert gas into the tank.

Advantageous Effects of Invention

[0017] According to the invention, since it is not necessary to equip the gas removal equipment on the vessel side, a gas removal procedure for the fuel gas from the tank can be performed without causing problems, such as securement of an installation space and a rise in cost.

Brief Description of Drawings

[0018]

Fig. 1 is a perspective view illustrating respective units that constitute gas removal equipment related to an embodiment of the invention.

Fig. 2 is a view illustrating a state where the gas removal equipment related to the embodiment of the invention is installed on a vessel.

Fig. 3 is a view illustrating a modification example in which the gas removal equipment related to the embodiment of the invention is installed on a barge.

Description of Embodiments

[0019] Hereinafter, gas removal equipment, a gas removal vessel, and a method for removing gas from a tank related to an embodiment of the invention will be described with reference to Figs. 1 and 2.

[0020] As illustrated in Figs. 1 and 2, gas removal equipment 10 is provided with a gas compression unit (gas compression section) 20, a gas heater unit (gas heater section) 30, a gas combustion unit (gas combustion section) 40, and an inert gas supply unit (inert gas supply section) 50.

[0021] The gas compression unit 20 has, in a container-like casing 21, a compressor 22, a drive motor 23 that drives the compressor 22, and a control panel 24 that controls the operation of the drive motor 23. A suction pipe 25A connected to a suction side of the compressor 22, a discharge pipe 26 connected to a discharge side of the compressor 22, and an inert gas suction pipe 25B that allows inert gas to be suctioned therethrough using the compressor 22 are respectively provided in the casing 21 so as to penetrate from the inside of the casing 21 to the outside thereof.

[0022] Since the safety of the drive motor 23 is improved if the drive motor has explosion-proof specifications, it is preferable.

[0023] The gas heater unit 30 has, in a container-like casing 31, a gas heater 32, and a control panel 34 that controls the operation of the gas heater 32. A suction pipe 35 connected to a suction side of the gas heater 32, and a first discharge pipe 36A and a second discharge pipe 36B connected to discharge sides of the gas heater 32 are respectively provided in the casing 31 so as to penetrate from the inside of the casing 31 to the outside thereof.

[0024] The gas combustion unit 40 has, within a container-like casing 41, a gas combustion furnace 42, a blower 43 that sends combustion air into the gas combustion furnace 42, and a control panel 44 that controls the actuation of the gas combustion furnace 42 and the blower 43. A supply pipe 45 that allows gas to be delivered into the gas combustion furnace 42 therethrough, and a gas discharge pipe 46 that allows the exhaust gas of the gas combustion furnace 42 to be discharged therethrough are respectively provided in the casing 41 so as to penetrate from the inside of the casing 41 to the outside thereof.

[0025] The inert gas supply unit 50 has, in a container-like casing 51, an inert gas generator 52 that generates inert gas, such as nitrogen gas or carbon dioxide, an inert gas tank 53 in which the inert gas generated by the inert gas generator 52 is stored, and a control panel 54 that controls the actuation of the inert gas generator 52 and the inert gas tank 53. An inert gas delivery tube 55 that allows the inert gas to be delivered therethrough from the inert gas tank 53 is provided in the casing 51 so as to penetrate from the inside to the outside. Here, as the inert gas generator 52, for example, inert gas generators

of types, such as a type in which nitrogen gas that is inert gas is generated by separating carbon dioxide (CO_2) using an absorber and separating oxygen through low-temperature separation, a membrane separation type, and a type using a pressure swing adsorption (PSA) method, can be appropriately used.

[0026] All of the casings 21, 31, 41, and 51 of the gas compression unit 20, the gas heater unit 30, the gas combustion unit 40, and the inert gas supply unit 50 are formed to have structures, sizes, and strengths such that the casings can be hoisted and moved by hoisting equipment, such as cranes provided on vessels or in ports, and more preferably have suitable sizes, that is, minimum sizes such that excessive margins are not provided for devices to house the casings.

[0027] The "container-like" means that the outer periphery of each of the casings 21, 31, 41, and 51 constitutes a rectangular parallelepiped structure based on a quadrangular shape. Additionally, if the periphery of each of the casings 21, 31, 41, and 51 is surrounded by a wall surface, environments inside and outside the casings 21, 31, 41, and 51 can be delimited. Thus, since the insides of the casings 21, 31, 41, and 51 are made to have an explosion-proof structure of an inert gas atmosphere or there is the cutoff effect from external heat input, this is more preferable.

[0028] Additionally, gas-detecting devices 27, 37, and 47 are respectively provided within the casings 21, 31, and 41 of the gas compression unit 20, the gas heater unit 30, and the gas combustion unit 40, and are adapted to output abnormal signals to the control panels 24, 34, and 44 when gas leakage is detected using the gas-detecting devices 27, 37, and 47. The control panels 24, 34, and 44 are adapted to stop the operation of the respective units when the abnormal signals are received.

[0029] Additionally, water spray devices 28, 38, 48, and 58 that spray water onto outer surfaces of the casings 21, 31, 41, and 51 are provided on external upper surfaces of the casings 21, 31, 41, and 51 of the gas compression unit 20, the gas heater unit 30, the gas combustion unit 40, and the inert gas supply unit 50. The water spray devices 28, 38, 48, and 58 are adapted to spray the sea water pumped by a pump (not illustrated) to the upper surfaces of the casings 21, 31, 41, and 51 from a plurality of nozzles 29, 39, 49, and 59. Accordingly, temperature rises of the respective units can be suppressed, and fire prevention measures can be taken.

[0030] In order to perform a gas removal procedure in (a) fuel gas tank(s) 110 of the vessel 100 using the gas removal equipment 10 as described above before the vessel 100 arrives at a repair yard, work is performed through the following flow.

[0031] First, a liquid-phase portion of fuel gas within the tank 110 is bled by a pump 111 provided in the tank 110 of the vessel 100. Since the liquid remains below a suction port of the pump 111 within the tank 110 even after the liquid is bled, this liquid is removed by the gas removal equipment 10.

[0032] For this purpose, the gas compression unit 20, the gas heater unit 30, the gas combustion unit 40, and the inert gas supply unit 50, which are housed by the respective casings, are hoisted using a crane or the like, and are installed on a deck 112 of the vessel 100. Then, the suction pipe 25A of the gas compression unit 20 and the first discharge pipe 36A of the gas heater unit 30 are connected to the tank 110 of the vessel 100 via pipes 91 and 92. Additionally, the discharge pipe 26 of the gas compression unit 20 and the suction pipe 35 of the gas heater unit 30 are coupled together via a pipe 93. Moreover, the second discharge pipe 36B of the gas heater unit 30 and the supply pipe 45 of the gas combustion unit 40 are coupled together via a pipe 94. In addition, the inert gas delivery tube 55 of the inert gas supply unit 50 and the inert gas suction pipe 25B of the gas compression unit 20 are coupled together via a pipe 95. Additionally, a chimney 70 is connected to the gas discharge pipe 46 of the gas combustion unit 40. Here, since the gas compression unit 20, the gas heater unit 30, the gas combustion unit 40, and the inert gas supply unit 50 are housed in the container-like casings 21, 31, 41, and 51, these units may be arranged in close contact with each other in a range where there is no hindrance to pipes or piping. Additionally, the invention is not limited to the planar arrangement, such as installing the gas heater unit 30 at an upper portion of the gas compression unit 20, and a three-dimensional arrangement in an up-down direction is also allowed. For this reason, it is possible to suitably arrange these units in a limited space, such as on the deck 112.

[0033] Thus, a procedure for removing gas is executed as follows by controlling the operation of the respective units using the control panels 24, 34, 44, and 54 of the gas compression unit 20, the gas heater unit 30, the gas combustion unit 40, and the inert gas supply unit 50 after the respective units of the gas removal equipment 10 are installed.

[0034] First, the compressor 22 of the gas compression unit 20, the gas heater 32 of the gas heater unit 30, and the gas combustion furnace 42 are actuated. Accordingly, after gas in a gas-phase portion of the fuel gas within the tank 110 is suctioned from the pipe 91, and a suction pipe 25A on the suction side of the compressor 22, and this gas is compressed using the compressor 22, the gas is delivered into the gas heater 32 through the discharge pipe 26, the pipe 93, and the suction pipe 35. In the gas heater 32, the gas compressed using the compressor 22 is heated and gasified. The heated and gasified gas is returned to the inside of the tank 110 via the first discharge pipe 36A and the pipe 92. If the above operation is continued, the gas within the tank 110 circulates through the compressor 22 of the gas compression unit 20, and the gas heater 32 of the gas heater unit 30, while passing therethrough and is gradually heated. Accordingly, a liquid-phase component of the fuel gas that remains within the tank 110 is gradually gasified.

[0035] Since the volume increases as the fuel gas is

gasified, the fuel gas equivalent to the volume increase is delivered into the gas combustion unit 40 through the second discharge pipe 36B, the pipe 94, and the supply pipe 45 from the gas heater 32 of the gas heater unit 30.

[0036] In the gas combustion unit 40, the fuel gas delivered from the gas heater unit 30 is mixed with the air taken in from the outside by the blower 43 within the gas combustion furnace 42, and this mixture is combusted. The exhaust gas generated as the fuel gas is combusted using the gas combustion furnace 42 and is discharged to the outside through the gas discharge pipe 46 and the chimney 70.

[0037] By performing the above processing continuously, the fuel gas within the tank 110 is gasified and is removed from the inside of the tank 110. Additionally, the temperature of the tank 110 also rises.

[0038] Thereafter, the inert gas generated using the inert gas generator 52 of the inert gas supply unit 50 is delivered into the compressor 22 through the inert gas delivery tube 55, the pipe 95, and the inert gas suction pipe 25B of the gas compression unit 20 from the inert gas tank 53. In the compressor 22, the delivered inert gas is compressed (when the inert gas generated using the inert gas generator 52 has a required pressure, inert gas compression using the compressor 22 may not be performed), and is delivered into the tank 110 (when the inert gas generated using the inert gas generator 52 has a required temperature, inert gas heating using the gas heater unit 30 may not be performed) through the gas heater unit 30. If the inert gas is sent in this way, the gas-phase component of the fuel gas that remains within the tank 110 is pushed out. By continuing such delivery of the inert gas into the tank 110, the inside of the tank 110 is replaced with the inert gas from the fuel gas. Here, the fuel gas pushed out from the tank 110 by the inert gas is combusted by the gas combustion unit 40 as described above.

[0039] Thereafter, the inert gas within the tank 110 can also be further replaced with air.

[0040] By equipping the gas removal equipment 10 on the vessel 100 as described above, even in the vessel 100 that is not provided with devices for performing the procedure for removing gas, the fuel gas within the tank 110 can be removed by equipping the gas removal equipment 10. Accordingly, it is possible to perform a gas removal procedure in the fuel gas tank 110 on the vessel 100 side, without causing problems, such as securement of an installation space and a rise in cost.

[0041] Additionally, the respective devices including the gas compression unit 20, the gas heater unit 30, the gas combustion unit 40, and the inert gas supply unit 50, are housed in the casings 21, 31, 41, and 51, respectively. Therefore, the casings 21, 31, 41, and 51 can be made to have an explosion-proof structure.

[0042] In addition, the gas compression unit 20, the gas heater unit 30, the gas combustion unit 40, and the inert gas supply unit 50 can be easily handled using a crane or the like by including the casings 21, 31, 41, and 51, respectively.

[0043] Meanwhile, in the above embodiment, the gas removal equipment 10 is configured to include the gas compression unit 20, the gas heater unit 30, the gas combustion unit 40, and the inert gas supply unit 50. However, all of these units are not necessarily equipped on the vessel 100. For example, when the compressor is used for the vessel 100 side in advance, the gas heater unit 30, the gas combustion unit 40, and the inert gas supply unit 50 excluding the gas compression unit 20 are equipped on the vessel 100 as the gas removal equipment 10. Additionally, when the vessel 100 is provided with an inert gas generation device, the above gas removal equipment 10 excluding the inert gas supply unit 50 is equipped on the vessel 100. In addition to this, units excluding some units of the gas removal equipment 10 may be equipped on the vessel 100 according to devices built into the vessel 100 side.

[0044] In the gas removal equipment 10 of the above embodiment, the gas compression unit 20, the gas heater unit 30, the gas combustion unit 40, and the inert gas supply unit 50 are unitized according to functions. Therefore, necessary minimum units can be selected and equipped according to equipment on the vessel 100 side.

[0045] Additionally, in the above embodiment, the gas removal equipment 10 is configured to include the gas compression unit 20, the gas heater unit 30, the gas combustion unit 40, and the inert gas supply unit 50. However, it is also possible to make these units into one unit. In that case, as described above, when some of the functions of the gas removal equipment 10 are provided on the vessel 100 side, some functions may not be actuated in the gas removal equipment 10.

[0046] In short, The invention illustrated in the above embodiment is a method for removing fuel gas on a vessel in which the gas removal equipment 10 having portability stored in the casing is equipped on the deck 112 of the vessel 100, the gas removal equipment 10 and a fuel gas pipe system on the vessel 100 side are connected together, and the fuel gas on the vessel is removed.

Modification example

[0047] In the above embodiment, the gas compression unit 20, the gas heater unit 30, the gas combustion unit 40, and the inert gas supply unit 50 that constitute the gas removal equipment 10 are respectively equipped on the deck 112 of the vessel 100 by a crane. However, as illustrated in Fig. 3, the gas removal vessel may be configured by equipping the gas compression units 20, the gas heater unit 30, the gas combustion unit 40, and the inert gas supply unit 50 on a deck 201 of a barge vessel (barge) 200. In this case, the respective units that constitute the gas removal equipment 10 are connected together in advance, similar to those illustrated in Fig. 2.

[0048] Also, when the procedure for removing the fuel gas is performed, the barge vessel 200 is made to approach the vessel 100, the gas compression unit 20 and

the gas heater unit 30 of the gas removal equipment 10 on the barge vessel 200 are connected to the tank 110 of the vessel 100 via the pipes 91 and 92, and the procedure for removing gas illustrated in the above embodiment is executed.

Reference Signs List

[0049]

10: GAS REMOVAL EQUIPMENT
20: GAS COMPRESSION UNIT (GAS COMPRESSION SECTION)
21, 31, 41, 51: CASING
22: COMPRESSOR
23: DRIVE MOTOR
24, 34, 44, 54: CONTROL PANEL
25A: SUCTION PIPE
25B: INERT GAS SUCTION PIPE
26: DISCHARGE PIPE
27, 37, 47: GAS-DETECTING DEVICE
28, 38, 48, 58: WATER SPRAY DEVICE
29, 39, 49, 59: NOZZLE
30: GAS HEATER UNIT (GAS HEATER SECTION)
32: GAS HEATER
35: SUCTION PIPE
36A: FIRST DISCHARGE PIPE
36B: SECOND DISCHARGE PIPE
40: GAS COMBUSTION UNIT (GAS COMBUSTION SECTION)
42: GAS COMBUSTION FURNACE
43: BLOWER
45: SUPPLY PIPE
46: GAS DISCHARGE PIPE
50: INERT GAS SUPPLY UNIT (INERT GAS SUPPLY SECTION)
52: INERT GAS GENERATOR
53: INERT GAS TANK
55: INERT GAS DELIVERY TUBE
70: CHIMNEY
100: VESSEL
110: TANK
111: PUMP
200: BARGE VESSEL (BARGE)

Claims

1. Gas removal equipment having portability capable of being equipped on a vessel using fuel gas as fuel, the gas removal equipment comprising:

a gas compression section that compresses the gas extracted from the inside of a tank of the vessel;
a gas heater section that heats the gas extracted from the inside of the tank of the vessel;
a gas combustion section that combusts the fuel gas discharged from the inside of the tank by being gasified or expanded in volume through heating in the gas heater section; and
an inert gas supply section that delivers inert gas into the tank,
wherein at least one of the sections is housed in casing.

2. The gas removal equipment according to Claim 1, wherein the gas compression section, the gas heater section, the inert gas supply section, and the gas combustion section are housed in individual casings, respectively.

3. The gas removal equipment according to Claim 1 or 2, further comprising:

a water spray device that sprays water onto the casing.

4. The gas removal equipment according to any one of Claims 1 to 3,
wherein a gas-detecting device is provided within the casing, and
wherein the gas removal equipment is stopped when the gas is detected using the gas-detecting device.

5. A gas removal vessel comprising:

gas removal equipment having portability that removes fuel gas within (a) tank(s)_ of a vessel using the fuel gas as fuel; and
a barge having the gas removal equipment equipped thereon and being capable of approaching the vessel,
wherein the gas removal equipment includes at least one of:

a gas compression section that compresses the gas extracted from the inside of the tank;
a gas heater section that heats the gas extracted from the inside of the tank of the vessel;
a gas combustion section that combusts the fuel gas discharged from the inside of the tank by being gasified or expanded in volume through heating in the gas heater section; and
an inert gas supply section that delivers inert gas into the tank,

wherein the gas compression section, the gas heater section, the inert gas supply section, and the gas combustion section are housed in a casing.

6. A method for removing gas from a tank, which is equipped on a vessel and stores a fuel gas, using

the gas removal equipment according to any one of Claims 1 to 4, the method comprising:

a process of connecting the gas removal equipment to the tank of the vessel;
a process of compressing the gas within the tank in the gas compression section to circulate the gas within the tank while heating the gas within the tank in the gas heater section;
a process of combusting the gas pushed out from the tank in the gas combustion section and discharging the combusted gas to the outside, as the gas is heated and expanded in volume in the gas heater section; and
a process of delivering inert gas into the tank.

FIG. 1

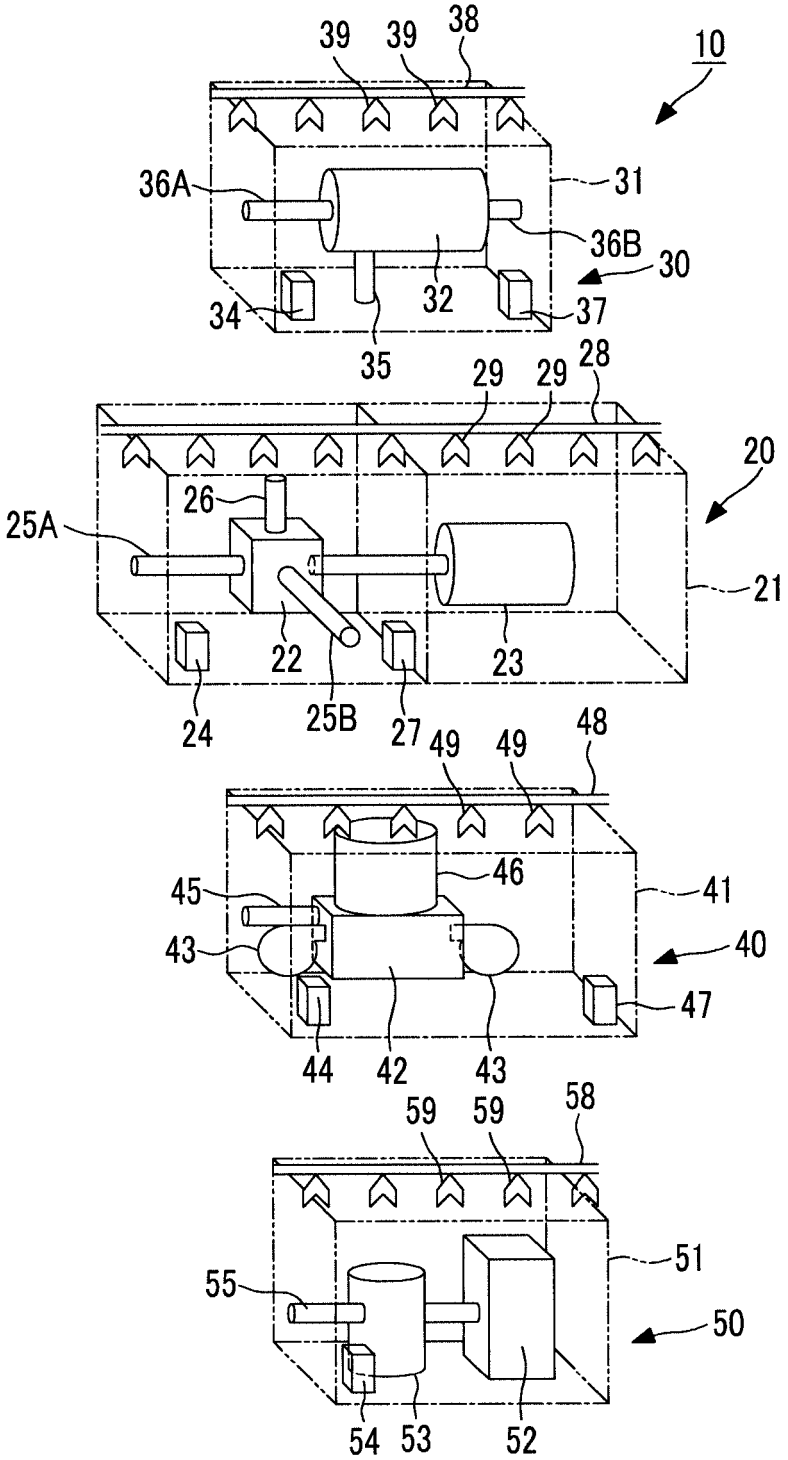
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FIG. 2

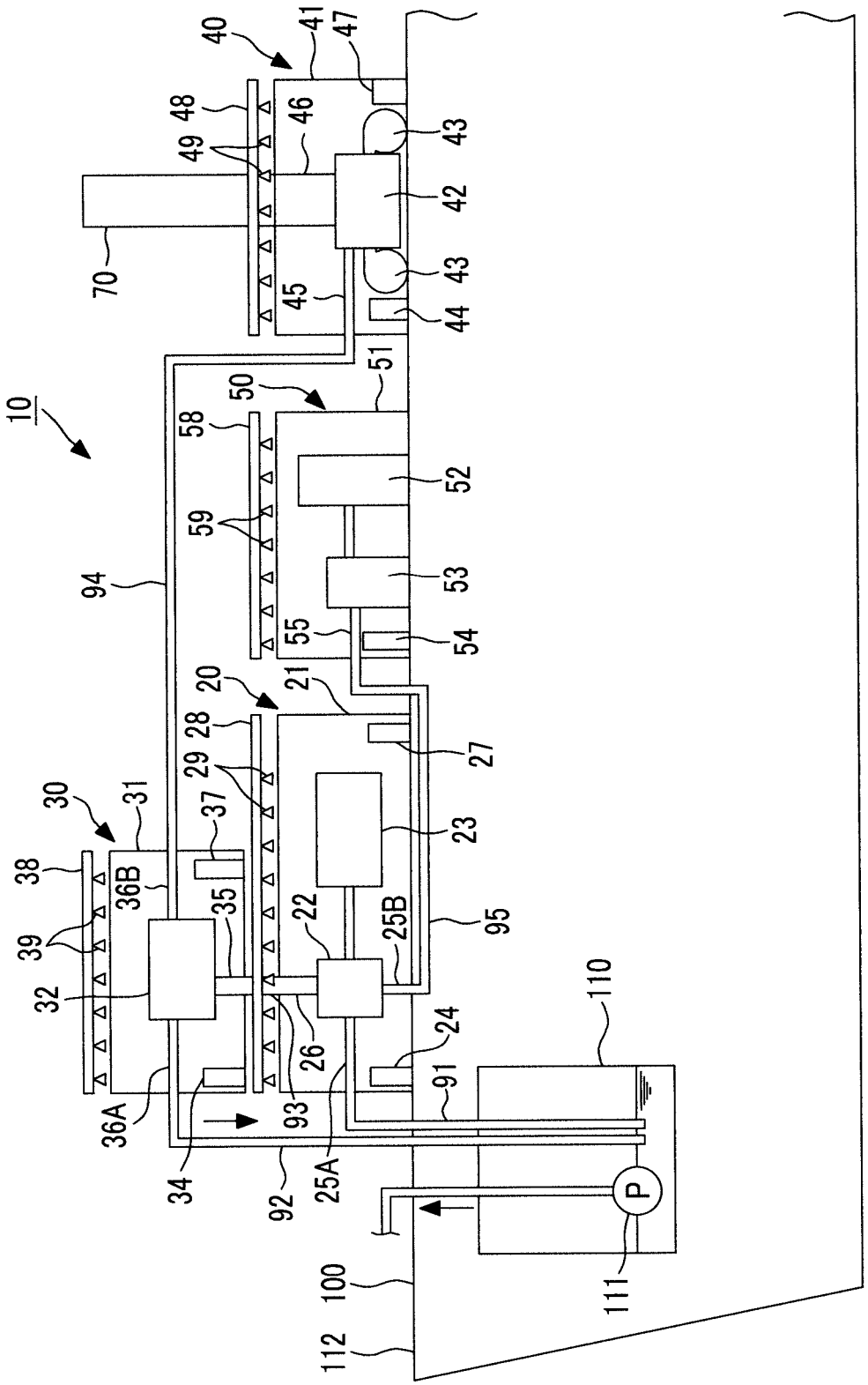
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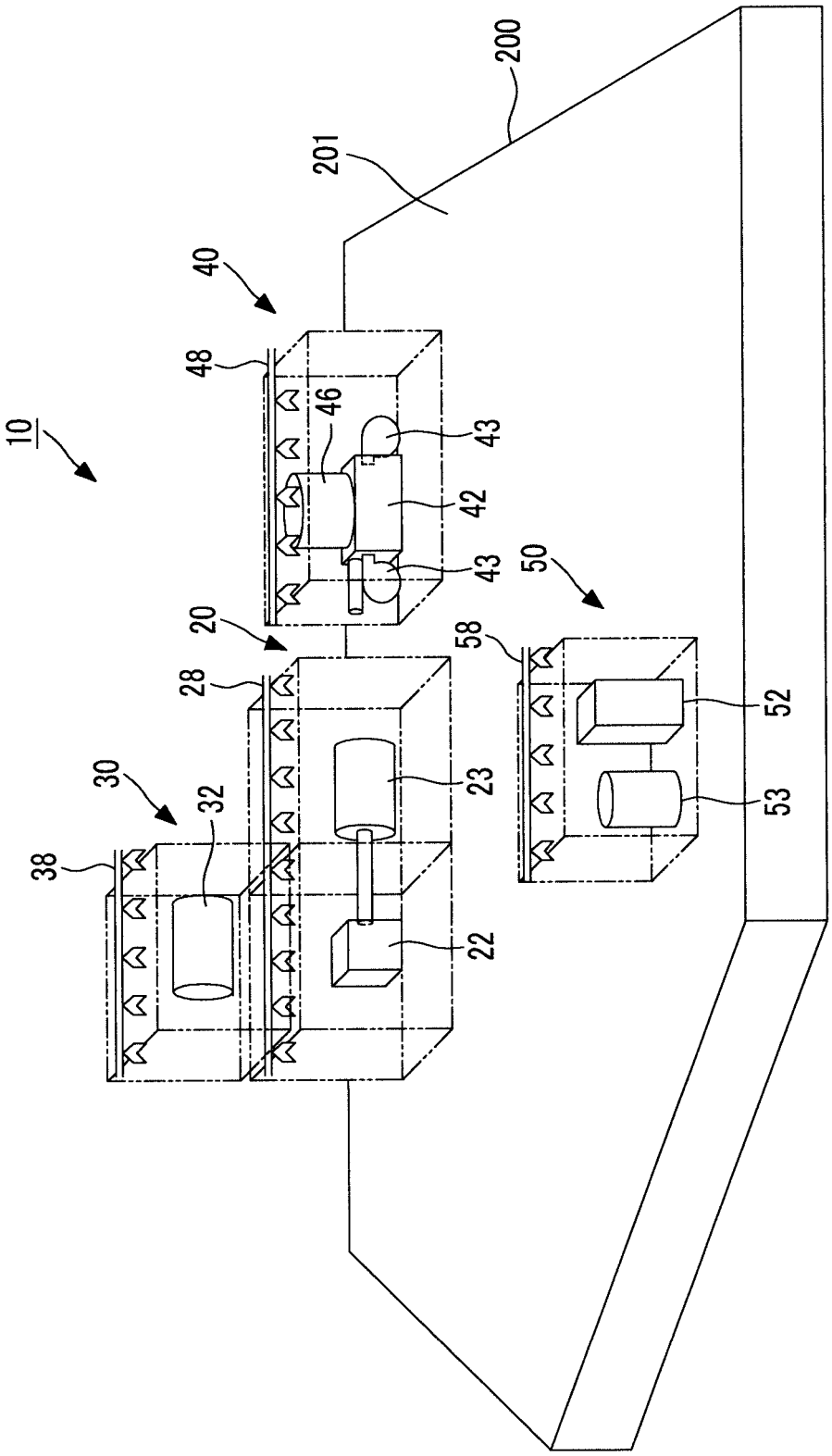
FIG. 3



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/085013

A. CLASSIFICATION OF SUBJECT MATTER
B63J2/08(2006.01)i, *B63B11/04*(2006.01)i, *B63B25/16*(2006.01)i, *B63B35/00*(2006.01)i, *F17C7/04*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B63J2/08, B63B11/04, B63B25/16, B63B35/00, F17C7/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2014
Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2012-76561 A (Mitsubishi Heavy Industries, Ltd.), 19 April 2012 (19.04.2012), paragraphs [0020] to [0037]; fig. 1 & WO 2012/043259 A1	1-6
Y	JP 52-35082 A (Mitsubishi Heavy Industries, Ltd.), 17 March 1977 (17.03.1977), page 3, upper right column, line 4 to lower left column, line 3; fig. 1 (Family: none)	1-6

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
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27 March, 2014 (27.03.14)	08 April, 2014 (08.04.14)
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2011-162038 A (Mitsubishi Heavy Industries, Ltd.), 25 August 2011 (25.08.2011), paragraphs [0002] to [0003], [0046] to [0047]; fig. 1, 4 & WO 2011/099184 A1 & CN 102224066 A & KR 10-2011-0110705 A	1-6

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REFERENCES CITED IN THE DESCRIPTION

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