(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 536 599 A1

# (12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
**11.09.2019 Bulletin 2019/37**

(21) Application number: **19382160.0**

(22) Date of filing: **05.03.2019**

(51) Int Cl.:
***B63B 25/00*** *(2006.01)* ***B63B 25/12*** *(2006.01)*
***B63B 25/14*** *(2006.01)* ***B63B 27/00*** *(2006.01)*
***B63B 27/34*** *(2006.01)* ***B63B 35/28*** *(2006.01)*
***B63H 21/38*** *(2006.01)*

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**
Designated Extension States:
**BA ME**
Designated Validation States:
**KH MA MD TN**

(30) Priority: **06.03.2018 ES 201830217**

(71) Applicant: **Naturgy Energy Group S.A.**
**28033 Madrid (ES)**

(72) Inventors:
- **DUVISON SANTIAGO, Miguel**
  **28045 MADRID (ES)**
- **CERRATO ORTEGA, Roberto**
  **28045 MADRID (ES)**
- **GALLO CARRASCO, Francisco, Javier**
  **28045 MADRID (ES)**
- **ROMERO BLANCO, Juan**
  **28045 MADRID (ES)**
- **ESPARBE MAINAR, Jordi, Josep**
  **08960 SANT JUST DESVERN (Barcelona) (ES)**
- **GARCÍA DÍAZ, Piedad**
  **28045 MADRID (ES)**
- **BONAUT PRIETO, Mario**
  **28400 VILLALBA (Madrid) (ES)**

(74) Representative: **Herrero & Asociados, S.L.**
**Cedaceros, 1**
**28014 Madrid (ES)**

## (54) REFUELING TANKER SHIP FOR SHIPS POWERED BY LIQUEFIED NATURAL GAS (LNG), AS WELL AS A LIQUEFIED NATURAL GAS LNG LOADING STATION

(57) The invention consists of an LNG tanker ship which is used as a liquefied natural gas LNG loading station for operations for refueling ships powered by liquefied gas LNG, in operations which are commonly known as bunkering.

When used as a liquefied natural gas loading station, the ship is supplied from an LNG carrier which refills the tanks of the ship; when approaching the coast, these tanks are unloaded for supplying end consumers.

In bunkering or the operation for refueling ships powered by liquefied natural gas LNG, the tanks themselves and their pumping equipment, or by means of a central pumping system in the ship, transfer the gas from the tanks to the ship to be refueled.

EP 3 536 599 A1

## Description

### Technical Field of the Invention

**[0001]** The invention is comprised in the technical field of natural gas transport and logistics systems, more specifically in the transport of liquefied natural gas LNG from gas deposits or gas-producing countries to the end consumers or clients, when said consumers are in hard-to-access marine locations.

**[0002]** The transport and distribution ship of the invention is likewise comprised in the field of marine means used for the transport and distribution of liquefied natural gas between end consumers or clients who may be located close to or far from the coast, but are scatter about in a large are of islands, between which logistic transport can be done at sea.

**[0003]** The ship of the invention is also comprised in the technical field of refueling other ships, more specifically ships powered with liquefied natural gas LNG.

### Prior State of the Art

**[0004]** The transport of liquefied natural gas LNG from natural gas-producing countries to consumer countries is done through large ships called gas carriers. In these carriers, the gas must be kept at a temperature of -161° C for long journeys, with the gas natural being transported in liquid state at a pressure greater than atmospheric pressure. The large gas carriers have a cargo capacity of between 30,000 and 266,000 $m^3$.

**[0005]** LNG is transported in tanks that withstand these low temperatures, with the LNG being kept at the temperature at which it has been loaded, i.e., at about -161°C throughout the entire voyage, but depending on its temperature and pressure, part of the liquid evaporates due to boiling. The evaporated gas is normally used to drive the carrier, either consuming it in boilers or using it in engines which use the gas as fuel.

**[0006]** Usually when the transported gas is unloaded at a port, a small amount of the load is left in the tanks which, as it gradually evaporates during the journey, will keep the tanks cold, and only a more intense final cooling is needed before loading the LNG again. This is achieved with that same remaining load, removing it from the tanks, which, when it evaporates, cools it at the temperature required for loading.

**[0007]** These large gas carriers need ports with a deep draft, and furthermore, due to the load they transport, both the loading and unloading of liquefied natural gas are performed at loading terminals far from ports, which are connected with land through pipelines.

**[0008]** For transporting LNG to end consumers or clients, there are basically two systems, the first system in which the pipelined gas reaches a large number of consumers such as homes, industries, shopping centers, etc., and comes from regasification plants, or directly from gas pipelines connected to gas extraction plants. However, in areas far away from large points of consumption or isolated from the gas pipeline network, investing in pipelined supply networks is not cost-effective, so large LNG storage tanks are used and they are generally supplied by tanker trucks which regularly fill such tanks. The invention described herein relates to providing service to clients of this type.

**[0009]** PCT patent application WO2016/036690 is known, which relates to a system for small scale marine transportation of cryogenic hydrocarbons, i.e., it relates to small scale liquefied natural gas transportation, said system including a plurality of swap barges each having a cryogenic hydrocarbon capacity of 25,000 $m^3$ or less, and a transfer ship, where the plurality of small scale LNG swap barges and the transfer ship cooperate to distribute gas to facilities on land, where the liquefied gas is unloaded and regasified. This system facilities the supply of natural gas to coastal regions which a shallow draft, rendering their use suitable in these circumstances, but there is still a need for a port infrastructure for the storage of liquefied natural gas and even a regasification plant from where the gas is distributed through pipelines to the end consumer or client.

**[0010]** One problem that may arise is when end consumers or clients are located, for example, on very scattered islands or archipelagos, where it is not cost-effective to build those port facilities in each and every one of those places, because it is not worth it economically, making it impossible to enable supplying liquefied natural gas to a very numerous group of clients who are scattered around those islands.

**[0011]** A second problem in this type of consumers is that although they have port facilities for unloading LNG, they do not have large LNG tanker trucks; furthermore they lack pipelines distributing LNG among consumers. An LNG transport and distribution system which does not depend on each specific island or area to be supplied, which is a completely autonomous system, is therefore advisable.

**[0012]** Spanish patent application P201730936 belonging to the same applicant discloses a carrier for liquefied natural gas (LNG) tanker trucks provided solely for being supplied by a small LNG carrier and for the tanker trucks in the carrier to be loaded through the loading posts. Once the ship approaches land, the tanker trucks are distributed on land to supply users, and return to the carrier to be consequently filled and to subsequently initiate the cycle.

**[0013]** The need to enable said ship to be used as an LNG bunkering ship, i.e., liquefied natural gas (LNG) refueling means for other ships powered with liquefied natural gas (LNG), has been observed.

### Description of the Invention

**[0014]** For the purpose of optimizing LNG supply in remote areas such as islands, which lack port areas adapted for LNG supply, and the supply from these is-

lands to the rest of the island by means of trucks or by means of pipelines, and furthermore being able to offer the possibility of refueling other ships, has been developed the object of the invention consisting of a ship for refueling ships powered by liquefied natural gas (LNG), as well as of a liquefied natural gas LNG loading station, comprising:

- at least one liquefied natural gas LNG tanker truck, located on the deck of the ship;
- a single connection module which allows connecting the ship to the LNG supply from a supply source or the ship to the carrier that is going to be refueled;
- at least one loading/unloading module for loading/unloading the LNG in/from the tanker trucks;
- at least one distribution module for distributing the LNG linking the connection module for connecting the ship to the LNG supply or to the carrier to be refueled and the loading/unloading module for loading/unloading the LNG in/from the tanker trucks;
- means of access for the tanker trucks to the ship;
- means of exit for the tanker trucks from the ship;

said ship being characterized in that

- the connection module of the ship has a liquefied natural gas connection which allows both the inlet of liquefied natural gas into the ship and the outlet of liquefied natural gas from the ship, as well as a boil-off gas (BOG) connection;
- the distribution module being able to transfer the liquefied natural gas between the connection module and the loading module, while the boil-off gas (BOG) flows between the loading module and the connection module in operations for loading tanker trucks. During operations for refueling other ships, the liquefied natural gas flows between the loading module and the connection module and the boil-off gas (BOG) of the tanker trucks is connected to the boil-off gas (BOG) manifold to control pressure.
- the loading module for loading LNG in the tanker trucks is a loading/unloading module for loading/unloading the LNG in/from the tanker trucks.

**[0015]** In liquefied natural gas LNG operations for refueling other ships which are powered by gas, internationally referred to as bunkering operations, there is at least one pump for the transfer of liquefied natural gas between the tanker trucks and the ship to be refueled with liquefied natural gas, this pump being for the transfer of liquefied natural gas between the tanker trucks and the ship to be refueled, each tanker truck has at least one pump for the transfer of liquefied natural gas, preferably as many transfer pumps as there tanker trucks supplying LNG to the ship to be refueled being used.

**[0016]** Optionally the ship has a circuit in the ship itself, formed by a manifold joining the loading/unloading modules of the bays with the connection module linked to the ship to be refueled, which circuit has its own pump for the transfer of liquefied natural gas between the tanker trucks and the ship to be refueled with liquefied natural gas.

**[0017]** The means of access and means of exit for the tanker trucks can be the same, or the means of access can be located at the end opposite the means of exit for the tanker trucks in the ship, whereby small sized tanker trucks which can be maneuvered on the deck of the ship and can exit through the access through which they entered can be used, or when larger sized tanker trucks are used, which are difficult to maneuver as they require a large space, the most suitable arrangement would be the trucks entering at one end of the carrier and exiting at the opposite end according to the orientation of the tanker truck tractor heads.

**[0018]** The means of access and exit for the tanker trucks consist of drive-on ramps for the tanker trucks, as it will facilitate getting the trucks on and off the deck of the ship, with each tanker truck being located at its loading post for loading LNG.

**[0019]** In operations for filling tanker trucks, the ship, with its empty tanker trucks, will approach the small LNG carrier, which performs the functions of a mother ship, and the ship is connected to the small LNG carrier through the connection module for connecting the ship to the LNG supply, which comprises:

- at least one connection for an LNG pipe through which LNG is supplied to the ship carrying the tanker trucks, located on the deck of the ship;
- at least one unloading connection for unloading gases coming from the vaporized natural gas;
- loading hoses between the ship and the small LNG carrier, which can be used for the transfer of LNG and of the gases coming from LNG vaporization;
- at least one instrumentation and control module for the transferred LNG and unloading of gases performed, which monitor and control the entire loading process.

**[0020]** In operations for refueling other ships, or bunkering, the ship, with its tanker trucks filled, will approach the ship to be refueled and is connected through the connection module for connecting the ship to the LNG supply, which comprises:

- a connection module incorporating the LNG manifold receiving the liquefied natural gas LNG from the tanker trucks;
- a distribution module formed by two manifolds, an LNG manifold connecting the connection module with the carrier to be refueled, with the unloading module of each truck, and the other being a boil-off gas BOG manifold connecting the boil-off gas BOG system of the tanker trucks to control pressure;
- a pumping equipment for pumping the liquefied natural gas between the tanker trucks and the ship to be refueled, said pumping equipment being formed

by the LNG transfer pumps themselves on the tanker trucks, or pumping equipment of the carrier itself, formed by a manifold joining the loading/unloading modules of the trucks with the connection module linked to the ship to be refueled, is used;
- loading/unloading hoses for the liquefied natural gas LNG;
- at least one fiscal control and instrumentation module for the transferred LNG.

**[0021]** This ship does not have LNG tanks for supplying fuel to a third party, but rather it is a means of transferring and distributing LNG from the small LNG carrier and the tanker trucks arranged on its deck.

**[0022]** The deck of the ship is divided into one or multiple loading posts for tanker trucks, since deck space can be optimized for loading multiple tanker trucks, where it can adopt configurations with four, six, nine, or more loading posts for tanker trucks, adapted to the size of the ship. Each loading post for tanker trucks corresponds to at least one loading/unloading module for loading/unloading LNG in/from the tanker trucks. These loading/unloading modules for loading/unloading LNG in or from the tanker trucks comprise:

- an LNG loader/unloader for loading/unloading LNG in or from the tanker trucks;
- a boil-off gas (BOG) unloader for unloading BOG from the tanker trucks;
- control and safety valves;
- a fiscal control, instrumentation, and measurement system for the process of loading/unloading LNG in or from the tanks of the trucks;
- loading/unloading hoses and connection/disconnection systems between hoses and tanks of the trucks.

**[0023]** To make the ship reversible and to enable the trucks to enter and exit at both ends of the ship, a configuration has been used in which the number of loading modules aligned with the axis of the ship is equal to the number of loading posts for tanker trucks plus one, making the ship reversible as regards both the loading and the unloading of tanker trucks.

**[0024]** A final detail to be taken into account is the discharge conduit for the gases coming from LNG vaporization of the tanker trucks, which in a preferable arrangement of the invention is removed from the ship to be liquefied outside of same, although being able to liquefy it in the ship itself or being able to use it for consumption of the drive engines thereof in the event they are powered by gas is not ruled out.

**[0025]** The refueling ship for ships powered by liquefied natural gas LNG, as well as a liquefied natural gas LNG loading station, is completed with the inclusion of systems that are essential for handling the ship and the products transported in it:

- emergency systems for the rapid disconnection of the aerial hoses connecting the ship and the small LNG carrier or the ship to be refueled;
- emergency systems interrupting the operation for loading/unloading LNG in/from the tanker trucks in the event of an abnormality or leak;
- fire detection and extinction systems;
- accidental LNG spill management system.

## Brief Description of the Drawings

**[0026]** For the purpose of helping to better understand the features of the invention according to a preferred practical embodiment thereof, a set of drawings is attached as an integral part of said description in which the following has been depicted with an illustrative and non-limiting character:

Figures 1 to 3 respectively depict a profile view (Figure 1), plan view (Figure 2), and cross-section view (Figure 3) of a refueling ship for ships powered by liquefied natural gas LNG, as well as a liquefied natural gas LNG loading station, such as the one proposed by the invention.

Figure 4 depicts a schematic bird's eye perspective view of a ship like that of the invention loading tanker trucks on the deck of the ship.

Figures 5 and 6 depict schematic plan views of the process of loading and unloading the trucks on and off the deck of the ship.

Figure 7 depicts a diagram of the layout of conduits existing in the ship for the operation for loading the tanker trucks and when the ship performs operations for refueling other ships.

Figure 8 depicts a diagram of the layout of conduits between the connection module of the ship and a tanker truck.

Figure 9 depicts a diagram of the layout of conduits between the loading/unloading posts for loading/unloading the trucks, the liquefied natural gas pumping equipment, and the supply of the liquefied natural gas to the ship to be refueled.

## Detailed Description of a Preferred Embodiment of the Invention

**[0027]** Figures 1 to 3 respectively depict a profile view, plan view, and cross-section view of a ship (1) for carrying tanker trucks (3) such as the one proposed by the invention, in which said ship has a planar surface which is the deck (2), which is accessed from either the bow access (4) or from the stern access (5), which bow (4) and stern (5) are indifferent in this case as the ship can navigate anyway as it has having propulsion systems (6) on both sides and is thus able to increase maneuverability.

**[0028]** To facilitate access of the tanker trucks (3) to the deck (2) of the ship, there are bow ramps (7) and stern ramps (8) which facilitate tanker trucks (3) driving on and off the ship.

**[0029]** It can be seen in these figures that said ship has nine loading posts (9) for tanker trucks, where the trucks are located in rows of three by three, covering the deck of the ship. In the cross-section view of the ship, which is shown in Figure 3, three of the tanker trucks (3) can be seen aligned with the loading/unloading modules (10) for the tanker trucks.

**[0030]** Figure 4 depicts a schematic bird's eye perspective view of a ship (1) like that of the invention loading or unloading tanker trucks (3) on or off the deck (2) of the ship. This depiction allows seeing how a tanker truck (3) accesses the bow access (4) through the bow ramp (7) and how another tanker truck (3) is already placed in its loading/unloading post (9) so that the LNG tanker truck can be filled from the loading/unloading module (10) or LNG can be unloaded for refueling another ship. These operations are carried out when the ship approaches the small LNG carrier and is connected to it for the operations for loading tanker trucks, or if another ship to be refueled in bunkering operations approaches, the tanks are unloaded to the ship to be refueled.

**[0031]** In this same depiction and when dealing with operations for loading LNG in the tanker trucks, it can be seen how, once the tanker trucks (3) are filled with LNG, the ship heads for port, being placed such that the stern ramp (8) is deployed, the tanker trucks exiting in the direction of travel through the stern access (5).

**[0032]** It can be observed in this same Figure 4 that while there are nine loading/unloading posts (9) on the deck of the ship, there are twelve loading modules (10) and that is due to the reversibility of the ship, which could allow access to or exit from the ship from both the bow and the stern, so it is necessary to provide an aligned configuration of loading modules in a number such that it is the number of loading posts plus one defining the loading modules to be aligned longitudinally with the axis of the ship (1). In this case, as there are three parallel alignments of loading posts, there will be three more loading modules than there are number of loading posts, as can be observed in the mentioned figure.

**[0033]** Figures 5 and 6 depict schematic plan views of the process of loading and unloading the trucks on the deck of the ship. In Figure 6, they are observed by means of arrows the flow of empty trucks entering in the ship (1) through the stern access (5), and it can also be observed how each tanker truck is located in its loading/unloading post (9) for being connected to the loading/unloading modules (10). When the ship (1) reaches port, its bow and the bow access (4) are facing the dock of the port, so that the trucks follow a flow without maneuvers on the ship (1), i.e., if the tanker trucks enter at the bow, they must exit through the stern (5), thereby avoiding maneuvers of the tanker trucks on the deck of the ship (2).

**[0034]** Figure 7 depicts a diagram of the layout of conduits existing in the ship (1) and how it is connected to the small LNG carrier (11) or to the ship to be refueled (11') through the connection module (12) of the ship. This same figure shows the twelve loading modules (10), each of which will have

- an LNG loader/unloader (13) for loading or unloading LNG in and from the tanker trucks (3);
- a boil-off gas BOG unloader (14) for unloading BOG from the tanker trucks (3), removing vaporized LNG;
- control valve (27), shut-off valve (31), and safety valve (28) assuring safe filling of the tanks;
- a fiscal control, instrumentation, and measurement system for the process of loading LNG in the tanks of the trucks (29);
- loading hoses and connection/disconnection systems between hoses and tanks of the trucks (30).

**[0035]** These last three elements are not shown in detail in the drawing, but the distribution module (17) for distributing LNG in the ship is, and it is basically made up of LNG feed lines (15) and LNG vapor lines (16), which are connected to the small LNG carrier (11) or to the ship to be refueled (11').

**[0036]** This figure highlights the unloading of the LNG pumping module (18) which is used in bunkering functions when refueling a ship (11'), only when the option of the carrier pumping module and the connection of the pumping module for the boil-off gas BOG (19) are used.

**[0037]** Figure 8 depicts a diagram of the loading and unloading module for a tanker truck (3). In said diagram, the loading/unloading area (20) of the tanker truck (3) has been separated from the area for the connection to the pumping module (21) from the tanker trucks (3) in the event of choosing the operation for refueling carriers by means of the pumping module.

**[0038]** In this diagram, it can be seen how the ship of the invention carries tanks in the two operations that can be performed. In the operation for loading tanks (3), the tanker trucks (3) are filled from an LNG carrier, which is done through area (20) of the loading and unloading module, where the LNG feed line (13) and the LNG vapor return line (14) can be seen.

**[0039]** When the ship is performing refueling operations, LNG is unloaded from the tank (3) through the LNG line consisting of the LNG loader/unloader (13) of area (20), when it uses the pump of the tank for performing a transfer, or it uses the connection to the pumping module (21) when the pumping equipment of the ship of the invention is in charge of removing the LNG from the tanks for the transfer thereof to the ship to be refueled. The vaporized gas connection formed by the boil-off gas BOG unloader (14) for maintaining pressure in the system will be the same in both cases of pumping. This figure shows the control valve (27), the safety valve (28), the fiscal control, instrumentation, and measurement system of the process of loading LNG in the tanks of the trucks (29), the shut-off valve (31), and loading/unloading hoses (32) and connection/disconnection systems between hoses and tanks of the trucks (3). Figure 9 shows a diagram of pipes in the event of using the pumping module (23) for bunkering with the ship that is going to be refueled

through the connection module (12) of the ship. Said figure shows the connection between the loading/unloading posts (10) for the trucks to a manifold (22), the pumping equipment (23) for the liquefied natural gas aspirated from said manifold (22), and LNG pumping connections consisting of the LNG and boil-off gas pumping module (18) consisting of the boil-off gas BOG pumping module (19), to the connection module (12) of the ship as it appears in Figure 7.

## Claims

1. Refueling tanker ship for ships powered by liquefied natural gas LNG, as well as a liquefied natural gas LNG loading station,
comprising:

- at least one liquefied natural gas LNG tanker truck (3), located on the deck (2) of the ship (1);
- a connection module (12) for connecting the ship to the LNG supply from a supply source;
- at least one loading module (10) for loading the LNG in the tanker trucks (3);
- at least one distribution module (17) for distributing the LNG linking the connection module (12) for connecting the ship (1) to the LNG supply and the loading module (10) for loading the LNG in the tanker trucks (3);
- means of access for the tanker trucks to the ship (7);
- means of exit for the tanker trucks from the ship (8);

**characterized in that**

- the connection module (12) of the ship has a liquefied natural gas connection which is the LNG feed line (15) which allows both the inlet of liquefied natural gas into the ship and the outlet of liquefied natural gas from the ship, as well as a boil-off gas (BOG) connection which is the LNG vapor line (16);
- the distribution module (17) being able to transfer the liquefied natural gas between the connection module (12) and the loading module (10), while the boil-off gas (BOG) flows between the loading module (10) and the connection module (12) in operations for loading tanker trucks (3), and in operations for refueling other ships, the liquefied natural gas flows between the loading module (10) and the connection module (12) and the boil-off gas (BOG) of the tanker trucks is connected to the boil-off gas (BOG) manifold through the LNG vapor line (16) to control pressure;
- the loading module for loading LNG in the tanker trucks (3) is a loading/unloading module (10) for loading/unloading the LNG in/from the tanker trucks (3).

2. Refueling tanker ship for ships powered by liquefied natural gas LNG, as well as a liquefied natural gas LNG loading station according to claim 1, **characterized in that** it has at least one piece of pumping equipment (23) for the transfer of liquefied natural gas between the tanker trucks (3) and the ship to be refueled with liquefied natural gas.

3. Refueling tanker ship for ships powered by liquefied natural gas (LNG), as well as a liquefied natural gas LNG loading station according to claim 1, **characterized in that** the pump for the transfer of liquefied natural gas between the tanker trucks and the ship to be refueled with liquefied natural gas consists of the at least one pump each tanker truck has for the transfer of liquefied natural gas.

4. Refueling tanker ship for ships powered by liquefied natural gas (LNG), as well as a liquefied natural gas LNG loading station according to claim 3, **characterized in that** there are as many transfer pumps as there are tanker trucks supplying LNG to the ship to be refueled.

5. Refueling tanker ship for ships powered by liquefied natural gas (LNG), as well as a liquefied natural gas LNG loading station according to claim 1, **characterized in that** the at least one pump for the transfer of liquefied natural gas between the tanker trucks (3) and the ship to be refueled with liquefied natural gas belongs to a circuit of the ship itself, formed by a manifold (22) joining the loading/unloading modules (10) of the bays with the connection module (12) linked to the ship to be refueled.

6. Refueling tanker ship for ships powered by liquefied natural gas LNG, as well as a liquefied natural gas LNG loading station according to claim 1, **characterized in that** the means of access and the means of exit for the tanker trucks are the same.

7. Refueling tanker ship for ships powered by liquefied natural gas LNG, as well as a liquefied natural gas LNG loading station according to claim 1, **characterized in that** the means of access are located at the end opposite the means of exit for the tanker trucks in the ship.

8. Refueling tanker ship for ships powered by liquefied natural gas LNG, as well as a liquefied natural gas LNG loading station according to claims 1, 5, and 7, **characterized in that** the means of access and exit for the tanker trucks consist of drive-on ramps (7), (8) for the tanker trucks (3).

9. Refueling tanker ship for ships powered by liquefied natural gas LNG, as well as a liquefied natural gas LNG loading station according to claim 1, **charac-**

**terized in that** the connection module (12) for connecting the ship to the LNG supply comprises:

- at least one connection for an LNG pipe consisting of the LNG feed line (15);
- at least one boil-off gas (BOG) unloading connection which is the LNG vapor line (16);
- liquefied natural gas LNG loading/unloading hoses (30) when the ship is used for loading tanker trucks or for refueling ships powered with gas; and
- at least one fiscal control and instrumentation module for the transferred LNG, nitrogen and unloading of gases performed (29).

**10.** Refueling tanker ship for ships powered by liquefied natural gas LNG, as well as a liquefied natural gas LNG loading station according to claim 1, **characterized in that** each loading/unloading module (10) for loading/unloading the LNG in or from the tanker trucks (3) comprises:

- an LNG loader/unloader (13) for loading or unloading LNG in or from the tanker trucks (3);
- a boil-off gas (BOG) unloader (14) for unloading BOG from the tanker trucks (3);
- control valve (27), shut-off valve (31), and safety valve (28);
- a fiscal control, instrumentation, and measurement system (29) for the process of loading/unloading LNG in or from the tanks of the trucks; and
- loading/unloading hoses (32) and connection/disconnection systems between hoses and tanks of the trucks (3).

**11.** Refueling tanker ship for ships powered by liquefied natural gas LNG, as well as a liquefied natural gas LNG loading station according to claims 1 to 10, **characterized in that** the ship has multiple loading posts (9) where the LNG tanker trucks (3) are located, and where these loading posts (9) have loading/unloading modules (10) for loading/unloading LNG in or from the tanker trucks (3), adapted to the size of the tanker trucks and to the dimensions of the ship.

**12.** Refueling tanker ship for ships powered by liquefied natural gas LNG, as well as a liquefied natural gas LNG loading station according to claims 1 to 11, **characterized in that** the ship (1) has at least two loading/unloading modules (10) aligned with the axis of the ship.

**13.** Refueling tanker ship for ships powered by liquefied natural gas LNG, as well as a liquefied natural gas LNG loading station according to claims 1 to 11, **characterized in that** the ship (1) has at least two loading/unloading modules (10) aligned along an axis perpendicular to the axis of the ship.

**14.** Refueling tanker ship for ships powered by liquefied natural gas LNG, as well as a liquefied natural gas LNG loading station according to claims 1 to 13, **characterized in that** the number of loading/unloading modules (10) aligned with the axis of the ship is equal to the number of loading posts (9) for tanker trucks (3) plus one, making the ship reversible as regards both the loading and the unloading of tanker trucks (3).

**15.** Refueling tanker ship for ships powered by liquefied natural gas LNG, as well as a liquefied natural gas LNG loading station according to the preceding claims, **characterized in that** the boil-off gas (BOG) of the discharge conduit of the tanker trucks is removed from the ship to be handled outside of same.

**16.** Refueling tanker ship for ships powered by liquefied natural gas LNG, as well as a liquefied natural gas LNG loading station according to claims 1 to 14, **characterized in that** the boil-off gas (BOG) of the discharge conduit of the tanker trucks is liquefied in the ship itself.

**17.** Refueling tanker ship for ships powered by liquefied natural gas LNG, as well as a liquefied natural gas LNG loading station according to claims 1 to 14, **characterized in that** the boil-off gas (BOG) of the discharge conduit of the tanker trucks is consumed by the engines of the ship.

**18.** Refueling tanker ship for ships powered by liquefied natural gas LNG, as well as a liquefied natural gas LNG loading station according to the preceding claims, **characterized in that** it further comprises

- emergency systems for the rapid disconnection of the aerial hoses connecting the ship and the small LNG ship or the ship to be refueled;
- emergency systems interrupting the operation for loading/unloading LNG in/from the tanker trucks in the event of an abnormality or leak;
- fire detection and extinction systems; and
- accidental LNG spill management system.

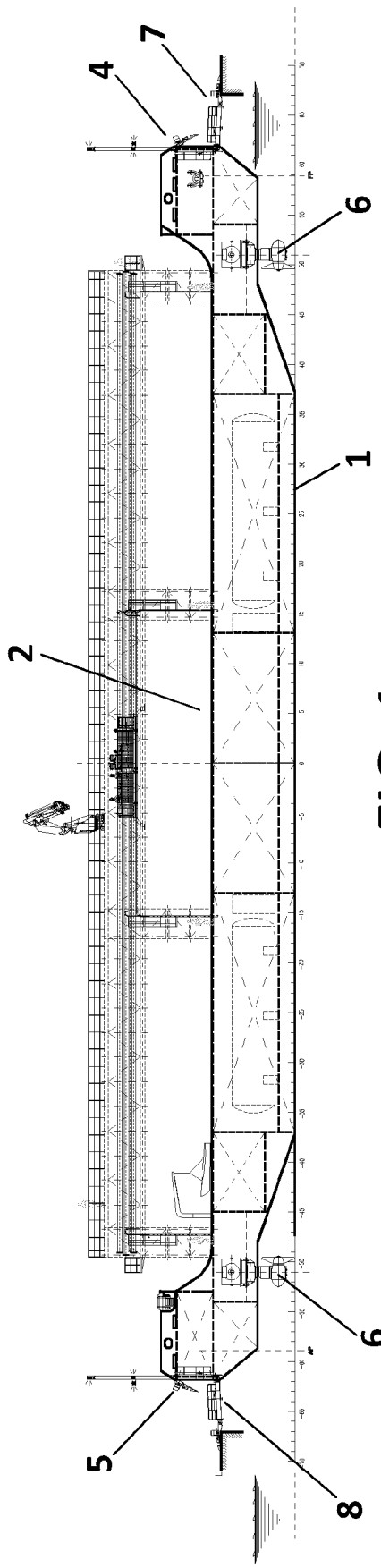


FIG. 1

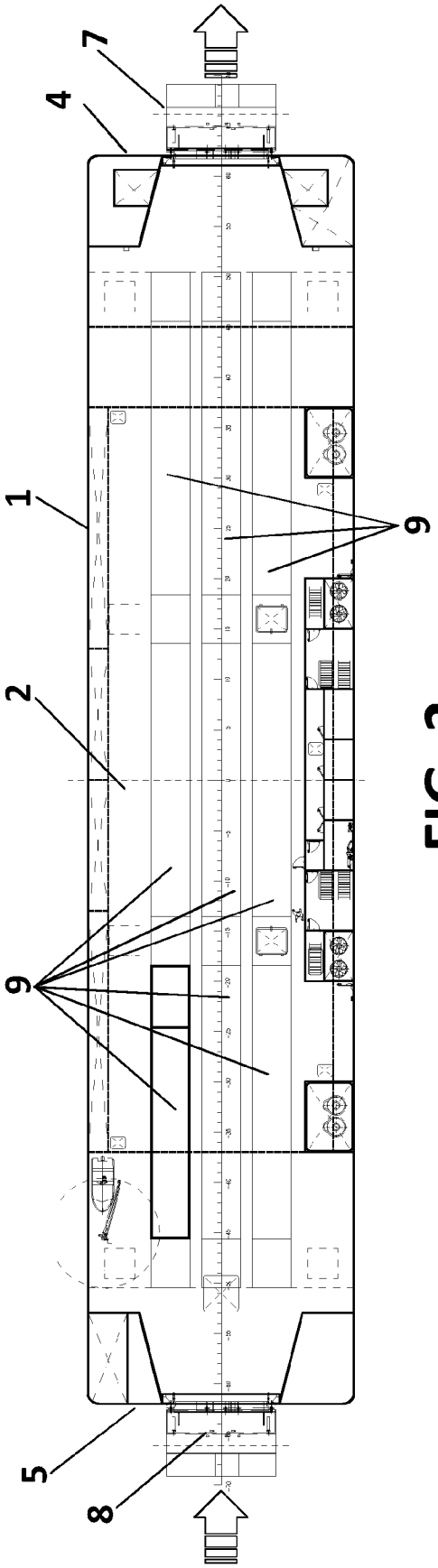


FIG. 2

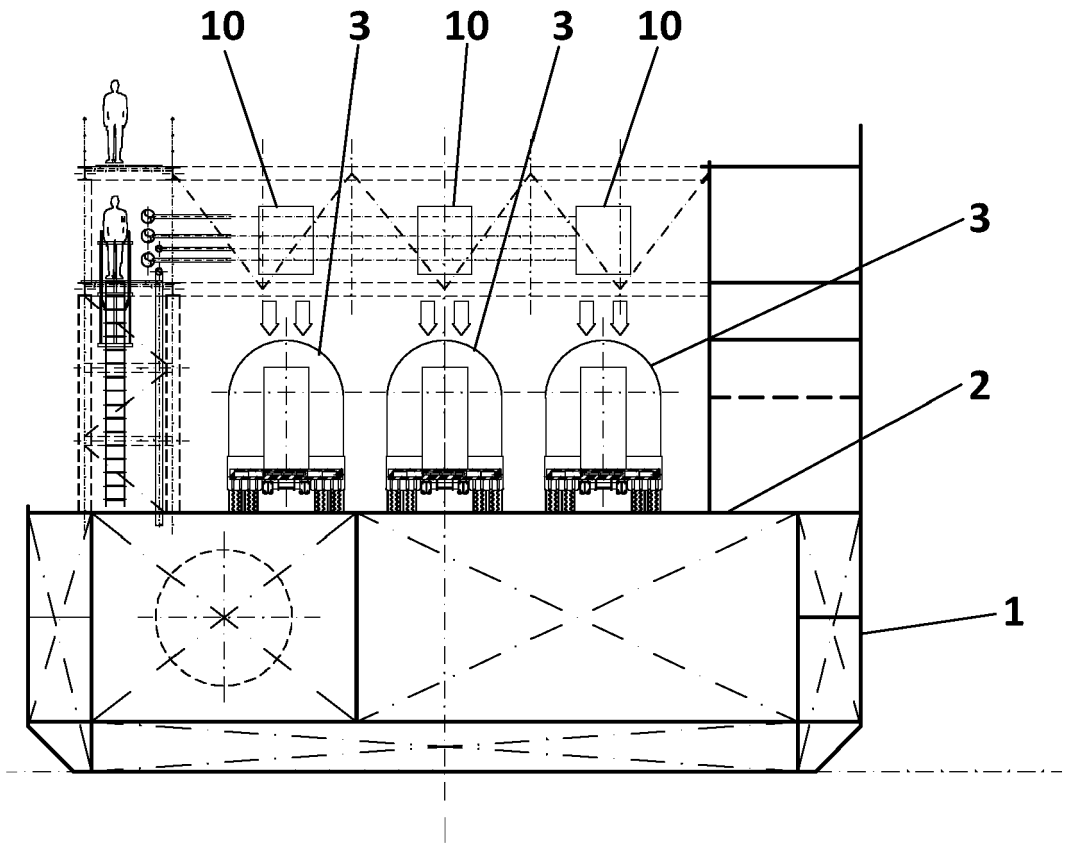


FIG. 3

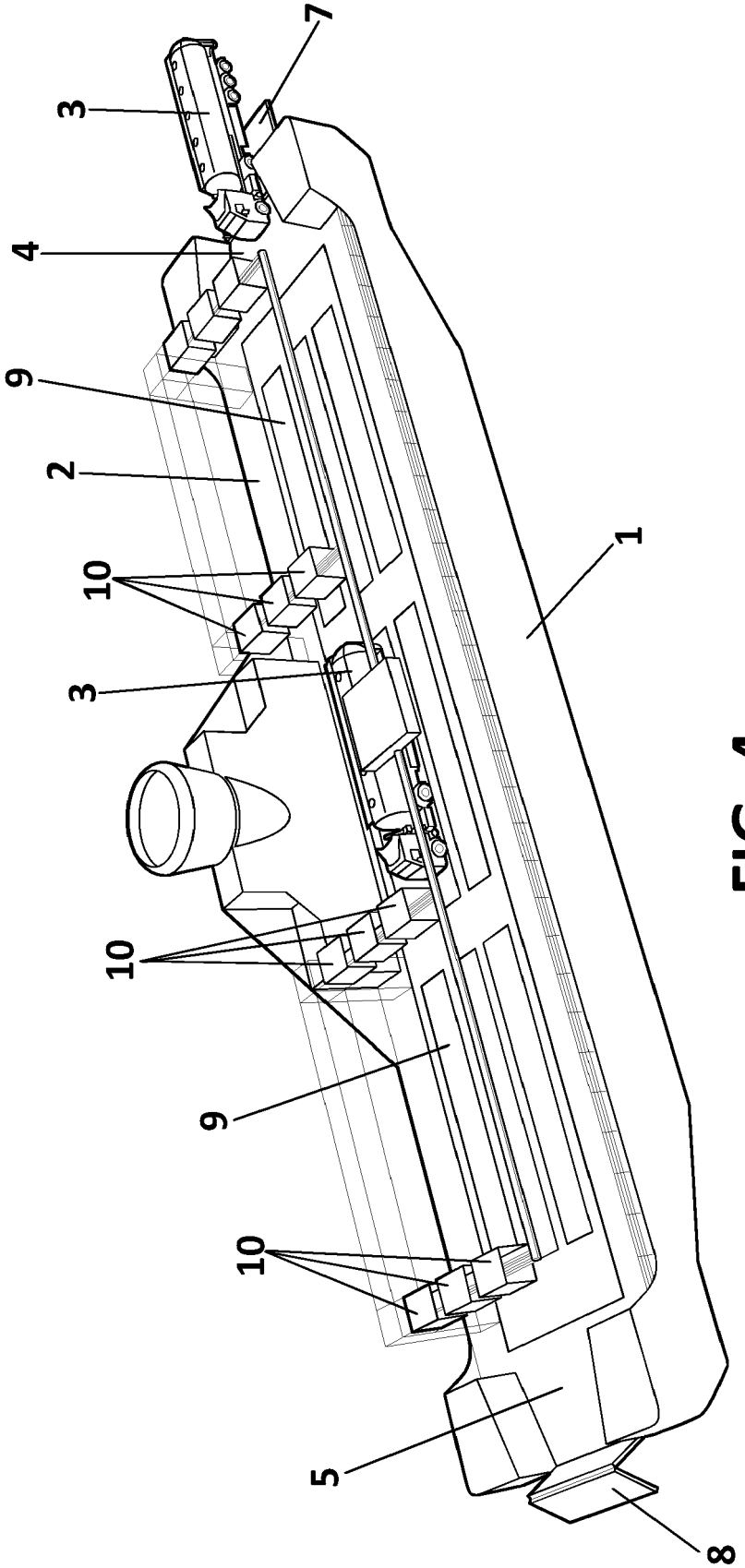


FIG. 4

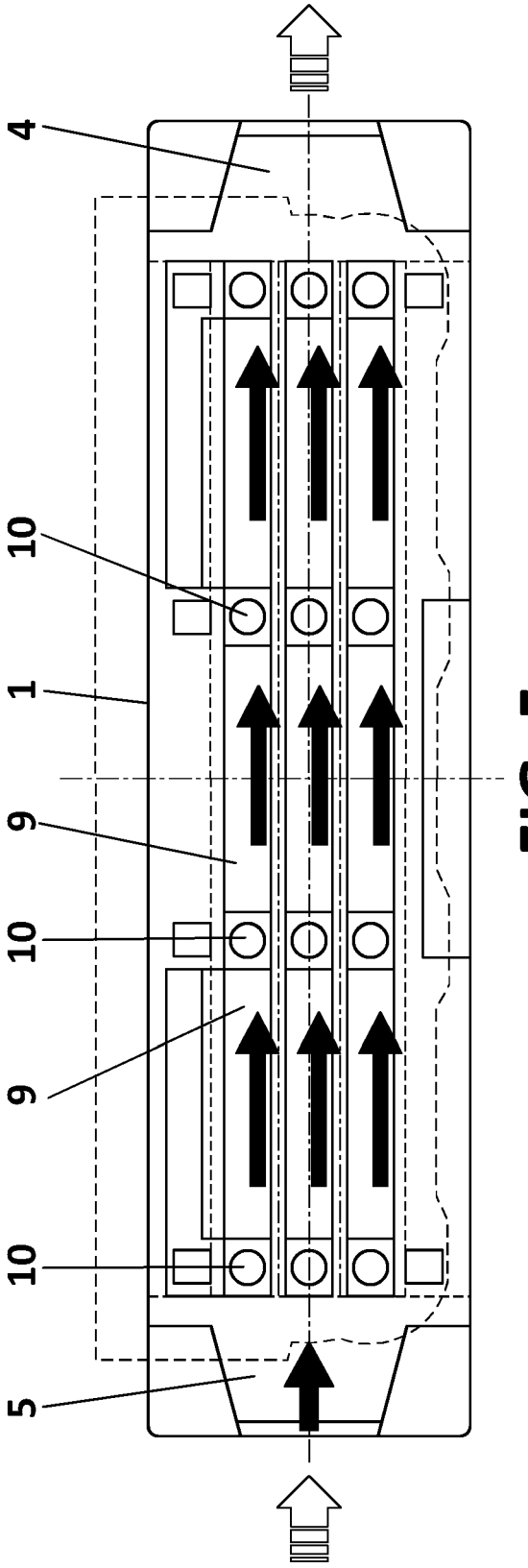


FIG. 5

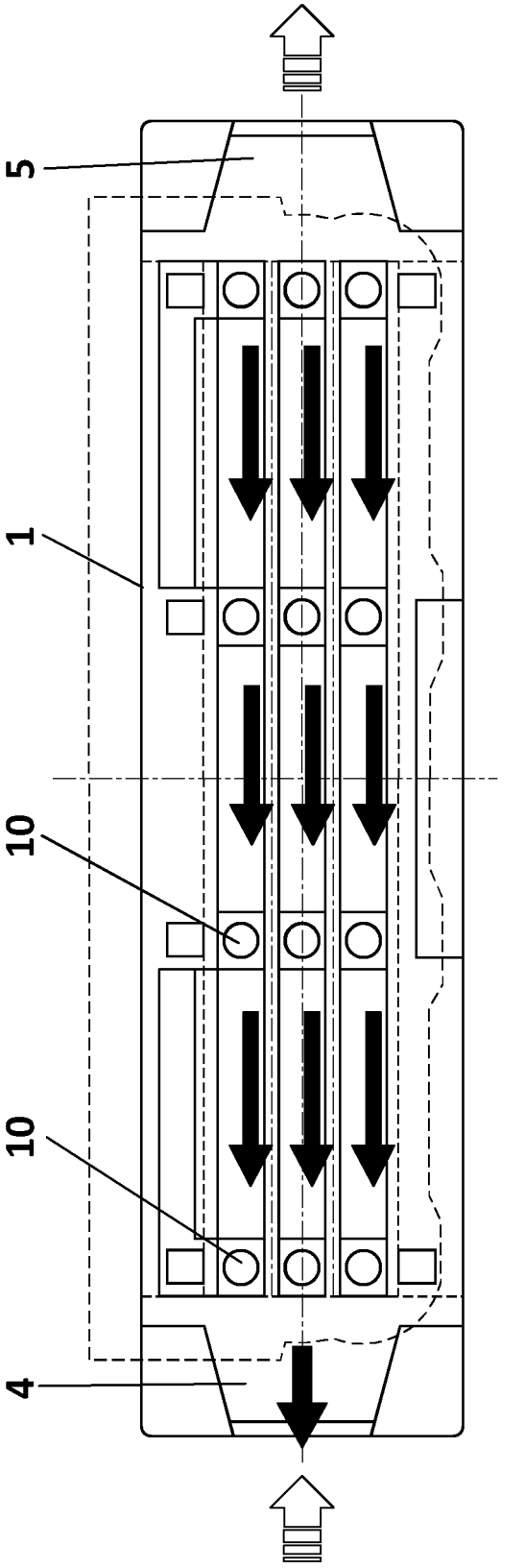


FIG. 6

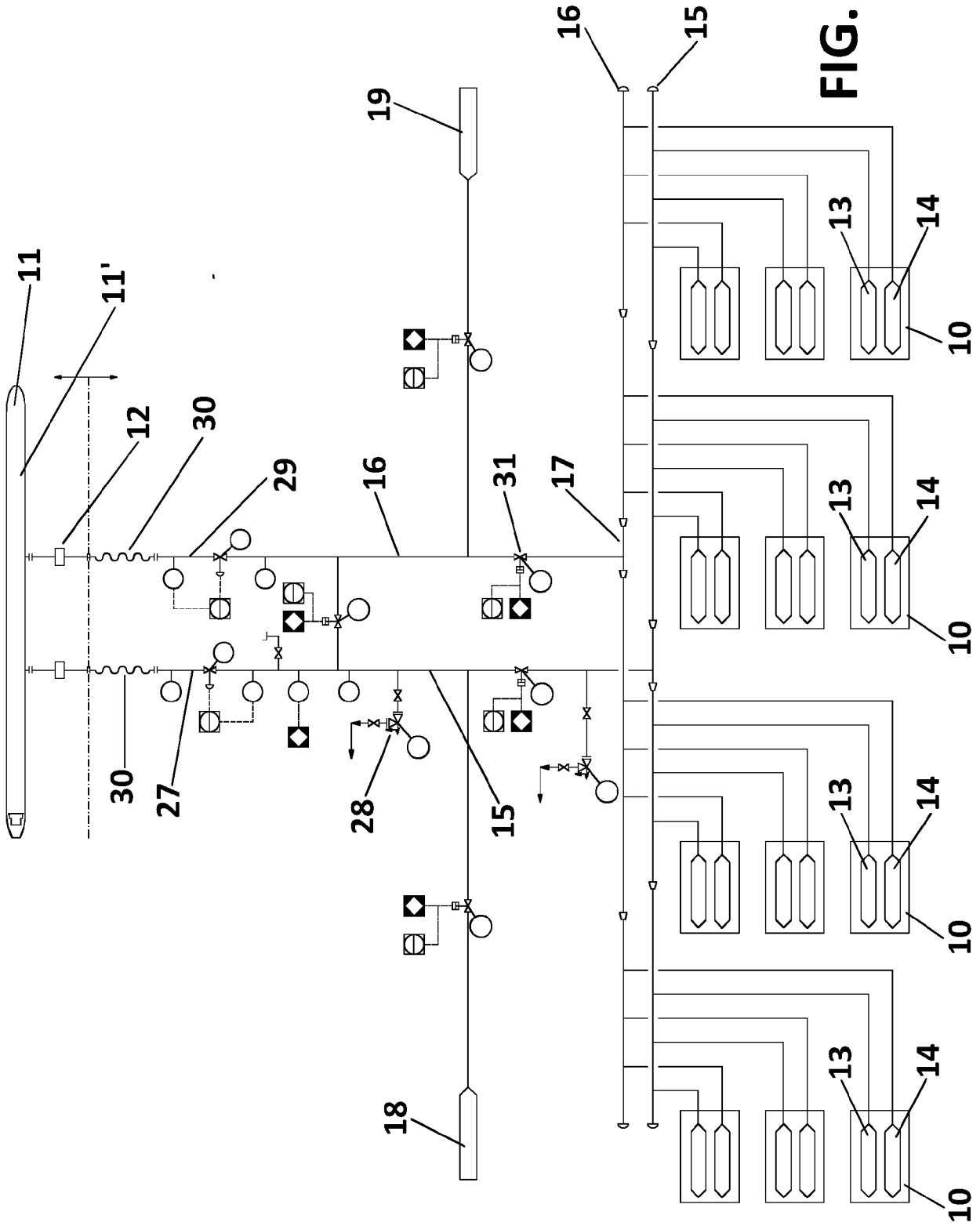


FIG. 7

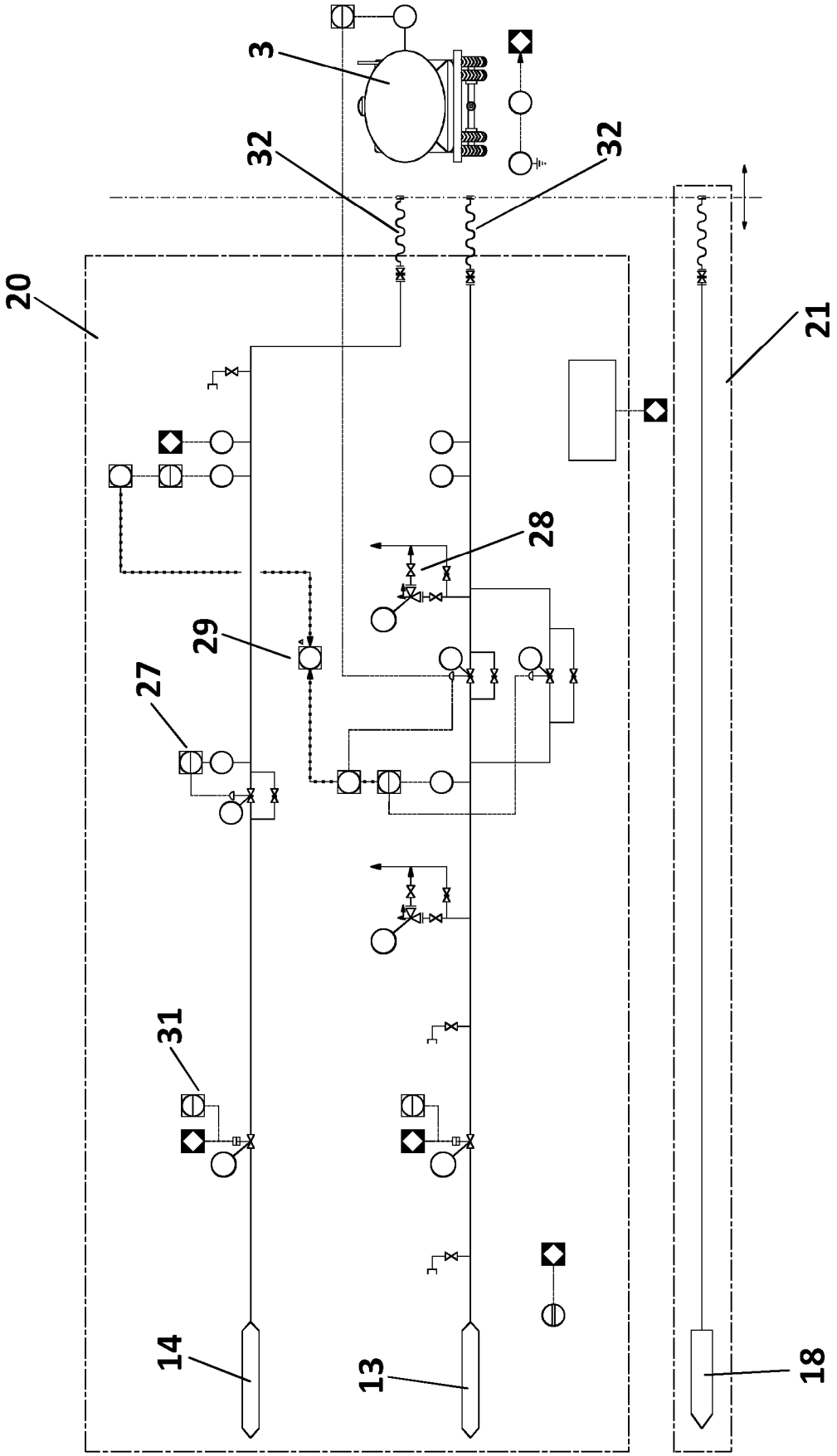


FIG. 8

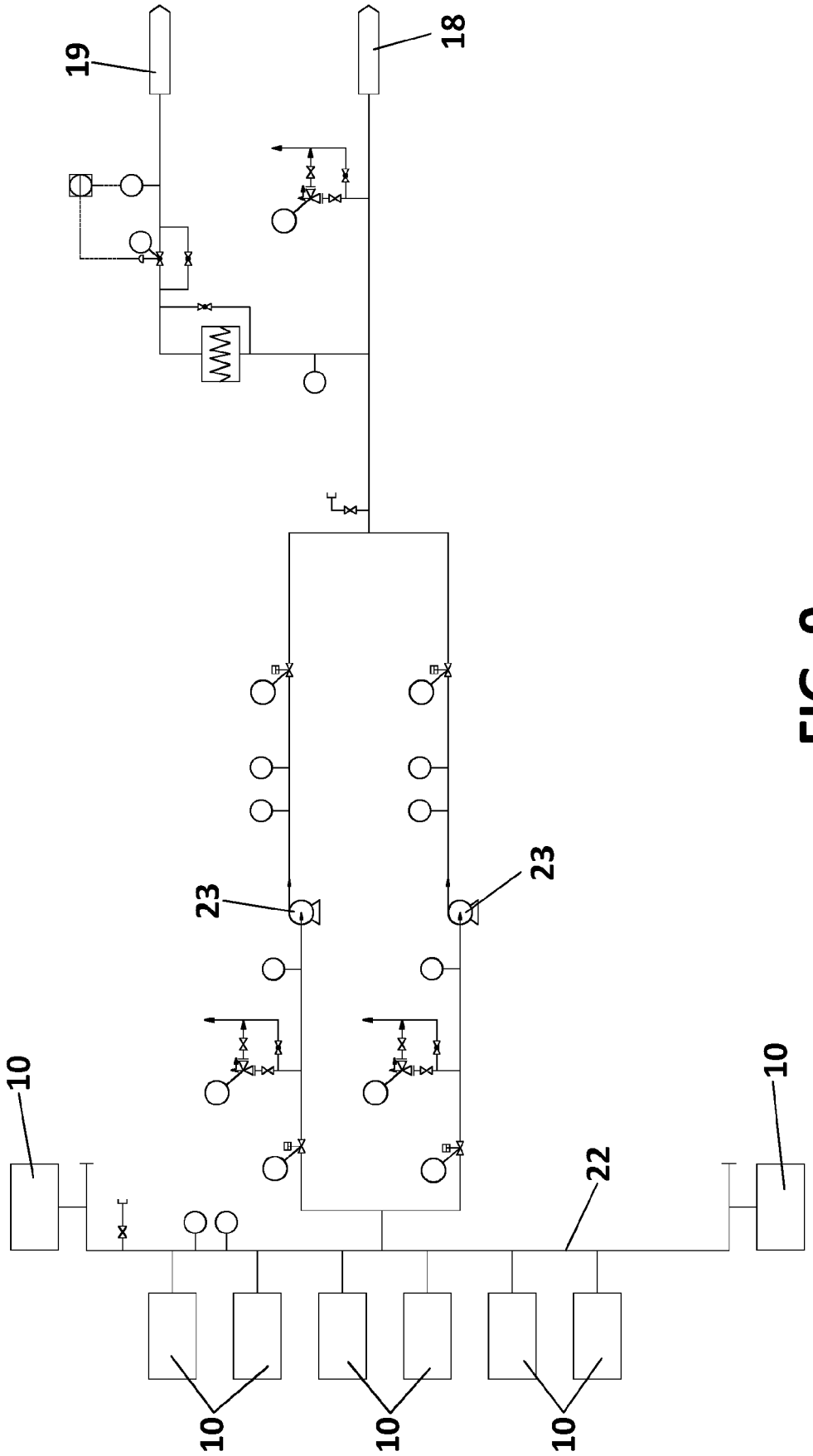


FIG. 9

Europäisches Patentamt
European Patent Office
Office européen des brevets

# EUROPEAN SEARCH REPORT

Application Number
EP 19 38 2160

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|---|---|---|---|
| A | EP 3 012 185 A1 (KRYLOV STATE RES CT [RU]) 27 April 2016 (2016-04-27) * paragraph [0018] - paragraph [0019]; figure 2 * | 1-18 | INV. B63B25/00 B63B25/12 B63B25/14 B63B27/00 B63B27/34 B63B35/28 B63H21/38 |
| A | WO 2015/090327 A2 (COSAN CRISPLANT AS [DK]) 25 June 2015 (2015-06-25) * page 10, line 7 - line 20; figure 3 * | 1-18 | |
| A | KR 101 710 997 B1 (STX OFFSHORE & SHIPBUILDING CO LTD [KR]) 2 March 2017 (2017-03-02) * paragraph [0011] * * paragraph [0045] - paragraph [0046]; figures * | 1-18 | |
| A | WO 2011/046315 A2 (DAEWOO SHIPBUILDING & MARINE [KR]; YOO SEONG JIN [KR] ET AL.) 21 April 2011 (2011-04-21) * abstract; figures * | 1-18 | |
| | | | TECHNICAL FIELDS SEARCHED (IPC) |
| | | | B63B F17C B63H |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| The Hague | 21 June 2019 | Schmitter, Thierry |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 19 38 2160

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

21-06-2019

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| EP 3012185 A1 | 27-04-2016 | DK 3012185 T3 | 02-01-2019 |
| | | EP 3012185 A1 | 27-04-2016 |
| | | WO 2014204354 A1 | 24-12-2014 |
| WO 2015090327 A2 | 25-06-2015 | CA 2928566 A1 | 25-06-2015 |
| | | DK 201370790 A1 | 29-06-2015 |
| | | EP 3084286 A2 | 26-10-2016 |
| | | ES 2701248 T3 | 21-02-2019 |
| | | KR 20160117442 A | 10-10-2016 |
| | | US 2016281927 A1 | 29-09-2016 |
| | | WO 2015090327 A2 | 25-06-2015 |
| KR 101710997 B1 | 02-03-2017 | NONE | |
| WO 2011046315 A2 | 21-04-2011 | AU 2010307574 A1 | 07-06-2012 |
| | | CN 102648123 A | 22-08-2012 |
| | | EP 2489585 A2 | 22-08-2012 |
| | | JP 5584768 B2 | 03-09-2014 |
| | | JP 5801912 B2 | 28-10-2015 |
| | | JP 2013508204 A | 07-03-2013 |
| | | JP 2014129086 A | 10-07-2014 |
| | | KR 100967818 B1 | 05-07-2010 |
| | | US 2012240874 A1 | 27-09-2012 |
| | | WO 2011046315 A2 | 21-04-2011 |

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

## REFERENCES CITED IN THE DESCRIPTION

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

### Patent documents cited in the description


- WO 2016036690 A **[0009]**
- ES P201730936 **[0012]**