(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
8 January 2015 (08.01.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/001093 A1

(51) International Patent Classification:
B63H 21/14 (2006.01) *B63H 21/38* (2006.01)

(21) International Application Number:
PCT/EP2014/064342

(22) International Filing Date:
4 July 2014 (04.07.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
PA201370380 5 July 2013 (05.07.2013) DK
61/876,047 10 September 2013 (10.09.2013) US

(71) Applicant: **MÆRSK OLIE OG GAS A/S** [DK/DK]; Esplanaden 50, DK-1263 København K (DK).

(72) Inventor: **BROCK, Michael**; c/o MÆRSK OLIE OG GAS A/S, Esplanaden 50, DK-1263 København K (DK).

(74) Agent: **ZACCO DENMARK A/S**; Arne Jacobsens Allé 15, DK-2300 Copenhagen S (DK).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

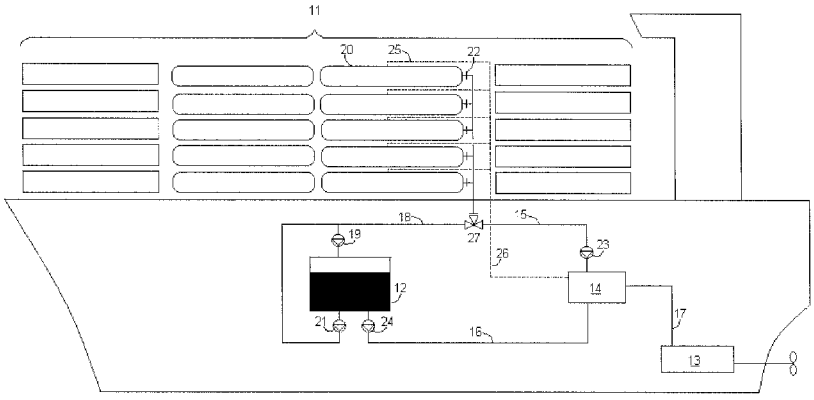
(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

(54) Title: A CARGO VESSEL AND A METHOD OF REFUELLING SAID VESSEL

Fig. 2



(57) Abstract: A supply system (1) for distribution of natural gas, said supply system comprising a plurality of LNG fuel containers (11, 12) adapted for storing liquefied natural gas; at least one natural gas provider (10) being able to provide natural gas (LNG) for filling or refilling LNG fuel containers (11,12); at least one displaced exchange area (20a, 20b); one or more vessels (30a, 30b, 30c) powered by natural gas; wherein said one or more vessels and said LNG fuel containers comprise(s) complementary coupling means, whereby said vessels can be powered by natural gas; wherein said one or more vessels are loaded with a first and a second subset (31, 32) of LNG fuel containers (11, 12), whereby natural gas stored in said first subset (31) of said loaded LNG fuel containers is used for powering said one or more vessels; simultaneously said second subset (32) is transported on said one or more vessels (30a, 30b, 30c) for distribution.

WO 2015/001093 A1

A cargo vessel and a method of refuelling said vessel

Field of the Invention

The invention relates to a cargo vessel adapted to be powered by LNG, said cargo vessel being in particular a maritime vessel and having a hull, a stern, a bow, sides, and a propulsion system. Such vessels generally comprise an LNG fuel tank in the vessel's designated engine bay area, with space for cargo containers in the designated cargo area of the vessel.

Many maritime vessels today use oil as fuel, so-called bunker fuel, but oil is expensive and pollutes the environment, particularly the heavy oils often used as bunker fuel. Natural gas used as fuel is cheaper and more environmentally friendly, and therefore natural gas as bunker fuel is a preferable alternative to the use of oil as a bunker fuel. The liquefied natural gas (LNG) industry has developed globally over the past decades. Natural gas can be compressed and stored as liquefied natural gas. Worldwide there are only a few LNG bunker filling facilities for refuelling LNG powered vessels. Therefore, vessels intending to use LNG as fuel are facing considerable supply problems. Since natural gas is a desirable alternative, there is already spent a lot of resources on studying and developing marine LNG supply chains, for instance on bunkering vessel to vessel, i.e. refuelling between vessels.

One problem associated with the use of gas as a fuel is to overcome the limited availability of natural gas as fuel due to the lack of infrastructure and the provision of a safe technical setup for the retrofit and operation of existing fleets.

Background of invention

By converting natural gas into liquefied natural gas, it is possible to transport gas over long distances without the need for pipelines, and it is possible to secure energy supplies to the rapidly increasing demand.

Today LNG is condensed natural gas that is cooled to its liquid form at approximately -160 Degrees Celsius, and in its liquid form, LNG occupies approximately 1/600th of the volume of natural gas in its gaseous form. The significant difference in density makes it profitable to transport gas in its liquid form from remote and isolated gas fields to markets worldwide.

The transporting of LNG by means of vessels utilizing the waterways is common practice today. Usually the LNG is transported by relatively large so-called LNG carriers from a producer such as e.g. Qatar Gas to its destination where the LNG is off-loaded in a dedicated LNG storage facility which could hold anywhere from 10.000-500.000 cubic meters of LNG or more. From the LNG storage facility, the LNG is further distributed either by smaller LNG carriers, or it could be used in the form of bunker fuel e.g. in cargo vessels using LNG for propulsion, or the LNG could be gasified and distributed through a natural gas grid.

US2010/0162939 discloses an LNG tanker able to transport LNG by means of dedicated insulated tanks positioned in the cargo area of the tanker.

WO 2011/053164 discloses an LNG fuel tank system for at least one gas engine used for ship propulsion comprising at least one LNG fuel tank and an intermediate gas pressure vessel. The LNG tank may be bunkered from an onshore LNG pressure tank filling facility (such as a LNG storage facility) by means of a LNG filling line. The ship may be operated using fuel from the LNG tank or e.g. accumulated boil-off gas (BOG).

US2009/0253318 discloses a marine vessel with gaseous fuel, having at least one gas powered engine, which vessel is provided with a fuel tank arrangement in which the fuel is stored in liquid phase.

US6640554 discloses a portable self-contained liquid natural gas (LNG) dispensing system which is housed in a container. A bulk tank positioned within the container contains a supply of LNG.

Summary of the invention

It is an object of the present invention to facilitate the use of LNG for propelling maritime vessels even while the available LNG bunkering facilities worldwide are limited.

This is achieved by a cargo vessel adapted to be powered by LNG, said cargo vessel having a hull, a stern, a bow, sides, and an engine, said vessel comprising: a fuel distribution system being adapted for preparing and distribution of LNG to be used as fuel; a cargo area designated for storage of one or more containers such as ISO containers; said cargo area being designated for storage of one or more LNG containers, an engine adapted to be powered by LNG for powering said cargo vessel; an LNG tank positioned within said hull and being in fluid communication with said engine via said fuel distribution system; an LNG tank-pipeline connecting said LNG tank to said fuel distribution system; and an engine-pipeline connecting said fuel distribution system to said engine. The vessel according to the invention comprises a manifold having a manifold inlet and a manifold outlet, said manifold inlet having couplings configured to be connected to complementary couplings on one or more LNG containers positioned in said cargo area; said vessel comprising a first supply pipeline connecting said manifold outlet to said LNG fuel tank. In this way, the vessel's LNG tank may be connected to one or more LNG containers in the vessel's cargo area.

This provides the advantage that LNG can be distributed between the LNG fuel containers and the vessel's own LNG tank and thereby it is also possible to distribute the transferred LNG further to the distribution system for supply to the ship's engine (i.e. its propulsion system). Hereby a simple, flexible and cost effective supply system for natural gas is established. The supply system renders possible a more easy access to and use of natural gas aboard maritime type vessels. The manifold may preferably have multiple inlets and a single outlet. In some embodiments, the manifold may have more than one outlet.

In one embodiment said vessel may comprise a second supply pipeline connecting said manifold outlet to said fuel distribution system.

By this, it is made possible to transfer LNG directly from one or more of the LNG containers to the fuel distribution system. This entails that the vessel can be powered by LNG originating from the LNG fuel containers even when the vessel's LNG tank is empty.

In one embodiment, the vessel comprises a manifold outlet valve being capable of switching the manifold outlet between said first supply pipeline and said second supply pipeline.

This entails that one may choose either to transfer the LNG from the LNG containers to the fuel distribution system or to the vessel's internal LNG tank.

In one embodiment, the manifold outlet valve may be capable of connecting said manifold outlet with both said first supply pipeline and said second supply pipeline simultaneously. This allows the possibility of transferring LNG from (or to) the LNG fuel containers to the distribution system and to the internal LNG tank simultaneously. Such an arrangement may be beneficial in order to rapidly deplete the LNG stored in the LNG containers. These, when

empty, may be exchanged, at an appropriate docking and loading location, for filled LNG containers.

In one embodiment the vessel comprises a first distribution pump being capable of pumping LNG through said first supply pipeline in a direction from said one or more LNG fuel containers stored in said cargo area to said LNG fuel tank. In another embodiment, said vessel comprises a second distribution pump being capable of pumping LNG through said first supply pipeline in a direction from said LNG fuel tank to said one or more containers containing LNG stored in said cargo area. These measures make it possible to pump LNG from the vessel's LNG tank to one or more of the containers that are either containing LNG or are able to contain LNG or vice versa. This allows increased flexibility as to refilling of LNG containers, especially at a facility allowing LNG tank refuelling, which may then also be exploited by the vessel of the present embodiment for the purpose of refuelling LNG containers avoiding the need for exchanging them using loading or unloading facilities.

In one embodiment said distribution pumps may be a same pump, which may be a reversible pump. The invention may therefore allow a single pump to provide the function of either pumping LNG from the vessel's LNG tank to one or more of the containers containing LNG or in the opposite direction, and thereby cost as well as space could be saved while essentially maintaining the corresponding function.

In one embodiment said manifold inlet may comprise valve means capable of selectively connecting said one or more LNG container stored in said cargo area to said manifold inlet. In this way, the engine can be supplied with LNG originating from one or more selected containers containing LNG being placed in said cargo area. Furthermore this also entails that LNG can be

supplied to the engine from selected containers being placed in the cargo area.

In one embodiment, the vessel comprises a first fuel supply pump being capable of pumping LNG through said second supply pipeline from said one or more LNG fuel containers stored in said cargo area via said manifold to said distribution system. In further embodiment, the vessel comprises a second fuel supply pump capable of pumping LNG from said LNG fuel tank to said fuel distribution system. These measures allow LNG to be supplied at a high pressure for ensuring optimum operation of the engine, i.e. of the vessel's propulsion system.

In a further aspect the invention comprises a method for refuelling a cargo with LNG, said method comprising the steps of;

- loading said cargo vessel with one or more containers containing LNG;
- coupling one or more of said LNG fuel containers to said manifold
- transferring LNG from one or more containers containing LNG to said LNG tank.

By said method, it is made possible to freely exchange the LNG containers e.g. in case said containers are empty, not needed onboard or only have been placed in the cargo area for transport to other destination. It is also made possible to freely select which LNG containers LNG should be connected to the manifold. By said method, it is also made possible to bunker LNG into the LNG tank by the transfer of LNG from one or more LNG containers to the LNG tank.

In this specification, following phrases are use to describe containers containing LNG: "LNG containing containers" or "LNG containers". They are

all to be understood as covering the same subject matter. These may be otherwise known in the art as “tanktainers” or “LNG tanktainers”.

In this specification, following phrases/words are used to describe the LNG tank positioned within the hull: “LNG tank”, “stationary LNG tank” or “internal LNG tank”, they are all to be understood as covering the same subject matter, notably, a vessel’s own LNG tank. A vessel may in particular comprise more than one such LNG tank. Typically, a vessel’s LNG tank has a considerably greater capacity (volume) than a standard (e.g. ISO) LNG tanktainer.

In this specification, reference is made to an engine. Such an engine could be any suitable ship’s propulsion system and may in particular include a dual-fuel piston engine able to operate not only on commercial fuel such as marine diesel, bunker oil or like but also gas, such as vaporized LNG. However, the engine could also, by way of example, be a gas turbine or a steam engine using e.g. a boiler as heat source.

As LNG is a liquid and a combustion engine normally does not run on liquid fuel but rather gasified fuel, it should be understood that when it is mentioned in the description or in the claims relating to the present invention that the engine is supplied with LNG, it is normally meant that the engine is supplied with a gas originating from gasified LNG mixed with air, thereby providing a gaseous fuel on which the engine can operate.

The invention will be explained with reference to non-limiting embodiments including appended drawings in which:

FIG. 1 shows a schematic drawing of one embodiment of the system.

FIG. 2 shows a schematic drawing of an embodiment of a cargo vessel according to the invention.

Detailed description of the embodiments

One embodiment of the invention is shown in figure 2 showing a cargo vessel (10) adapted to be powered by LNG. The cargo vessel (10) has a fuel distribution system (14) which is adapted for the preparing and distribution of LNG to be used as fuel in the vessel's main propulsion system. Furthermore, the cargo vessel (10) is equipped with an engine (13) for propulsion of the vessel adapted to be powered by LNG. The cargo vessel (10) further has a cargo area (11) designated for storage of one or more containers such as ISO containers. The cargo area may have designated spaces/slots for containers containing LNG (20).

Within the hull of the cargo vessel (10) there is a stationary LNG tank (12) positioned, the LNG tank is in fluid communication with the engine (13) via the fuel distribution system (14).

The fuel distribution system (14) is able to convert LNG into gas suitable for powering the engine (13) by e.g. using heat from the engine (13) to vaporize the LNG. However, heat may also be supplied by seawater, air conditioning system or like refrigerating system onboard the cargo vessel (10).

The cargo vessel (10) comprises an LNG tank-pipeline (16) which connects the LNG tank (12) to the fuel distribution system (14) and furthermore, also an engine-pipeline (17) connecting said fuel distribution system (14) to the engine (13).

In the cargo area (11), where the containers containing LNG (20) are stored, there is a manifold (25), having couplings configured to be connected to complementary couplings on one or more LNG containers (20). Thereby is it achieved that containers containing LNG (20) can be connected in parallel when connected to the inlet side of the manifold (25).

The cargo vessel (10) shown in figure 2 is also equipped with a first supply pipeline (18) which connects one or more LNG containers (20) stored in the cargo area (11) to the LNG fuel tank (12) via the manifold outlet (25).

The manifold outlet (25) is also connected to a second supply pipeline (15) connecting said manifold (25) to the fuel distribution system (14) such that the engine (13) can be supplied with LNG originating from one or more LNG containing containers being placed in the cargo area (11).

A valve (27) may be positioned between the first and second supply pipelines (18, 15) such that it is possible to select which pipeline is supplied with LNG from the LNG containing containers. In one embodiment, the valve (27) may allow both the first and second supply pipelines to be selected simultaneously.

The cargo vessel (10) has a first distribution-pump (19) capable of pumping LNG through the first supply pipeline (18) in a direction from one or more containers containing LNG (20) stored in said cargo area to the LNG fuel tank (12).

The cargo vessel (10) may also be equipped with a second distribution-pump (21) being capable of pumping LNG through the first supply pipeline (18) in a direction from the LNG fuel tank (12) to one or more containers containing LNG (20) stored in the cargo area (11). However, in some embodiments, a single distribution pump may constitute both the first distribution pump (19) and the second distribution pump (21).

Thereby it is achieved that LNG can be distributed freely between the containers containing LNG (20) and the LNG tank (12).

In one embodiment, the cargo vessel (10) is provided with a manifold (25) having more than one valve means (22). Each such valve means (22) is capable of selectively connecting a relevant LNG container with the manifold outlet.

The selecter valve (27) is additionally capable of selectively connecting said LNG container manifold (25) with the fuel distribution system (14) via the second supply pipeline (15). This entails that the engine (13) can be supplied with vaporized LNG originating from one or more selected LNG containing containers being placed in said cargo area. The selecter valve (27) is further capable of selectively connecting said LNG container manifold (25) with the LNG tank (12) via the first supply pipeline (18). This entails that LNG can be distributed between any or all containers (20) connected to the manifold (25) and either or both of the LNG tank and the engine's fuel distribution system (14).

Even though the vessel is only described as having one manifold (25) it will easily be understood by a person skilled in the art that the vessel could be provided with two or more manifolds and furthermore, that these manifolds can be interconnected.

Furthermore, the vessel is only described as being bunkered via the LNG containers. The person skilled in the art, will understand that bunkering (fuelling) of LNG could as well be done according to common practise, from a fuel supply facility directly into the internal LNG tank.

The vessel may additionally comprise a system (not shown) for collecting boil-off gas. The system may be capable of selectively collecting boil-off gas from one or more containers containing LNG (20) and supplying the boil-off gas to the fuel distribution system (14) so that the engine (13) can be powered by boil-off gas from anyone of the containers.

With reference to figure 1 a method for refuelling a cargo vessel according to the invention will be explained.

The LNG fuel containers for storing the liquefied natural gas are preferably portable containers, transportable by road or rail or ship. The LNG fuel container is preferably shaped as an ISO standard container, wherein the LNG fuel container may be a specialized type of container designed to carry cryogenic natural gas on standard intermodal equipment. According to one design, the tank may be held within a box-shaped frame having the same size and shape as a standard container, such as a tanktainer or IMDG container, which provides efficient storage, loading and transport facilities.

According to the invention, containers storing LNG are connected up onboard vessels to an internal LNG tank in order to provide fuel to the vessel´s engine.

According to the invention, the vessel and the LNG fuel containers comprise complementary coupling means for coupling said LNG fuel containers to a fuel supply system of said vessel, whereby the vessel can be powered by LNG provided by the portable LNG fuel containers. Thereby the LNG fuel containers may serve as a dispensing fuel bunker on board a vessel. This may be of special benefit in case an LNG bunkering facility is not available.

By way of example: a the vessel (10) may travel between two destinations, a first destination (70) and a second destination (80). The first destination (70) may be connected with a natural gas grid or may comprise a LNG storage and bunkering facility and the second may be a destination without any connection to a LNG grid and without LNG bunkering facilities.

The cargo vessel (10) at the first destination (70) is loaded with containers containing LNG (20). After the vessel (10) has been loaded at location (70)

the vessel can be powered by natural gas from some of the containers containing LNG. When reaching the second destination (80), the containers containing LNG (20) which are not empty can be off-loaded and the vessel (10) will continue its journey or go back to the first destination (70).

The off-loaded containers containing LNG (20) can thereby be used as bunker fuel on another vessel disembarking the second destination (80) to a third destination (90)

The numbers of containers containing LNG in the figure is for illustration purpose only, and the actual number of LNG fuel containers may vary.

Hereby the containers containing LNG (20) are part of a distribution system and are able to circulate in the LNG supply chain created by a network of LNG powered vessels.

By having a plurality of natural gas powered vessels, there may be created a network of vessels capable of being powered by natural gas and of transferring natural gas. As will be appreciated, the vessel and method according to the invention thus provide a system for onboard storage, distribution and consumption of LNG wherein said system and method increases the flexibility in handling of and use of LNG.

Although the present invention has been described with different embodiments, a multitude of changes, variations, alterations, transformations, and modifications may be suggested to one skilled in the art, and it is intended that the present invention encompasses such changes, variations, alterations, transformations, and modifications as fall within the scope of the appended claims.

Even though the invention has only been described with a LNG tank (12), the cargo vessel (10) can however be provided with an additional tank for the containing of oil as e.g. crude oil for powering the main engine. The main engine being able to conduct fuel-switching.

List of items:

10. Cargo vessel
11. Cargo area
12. LNG Tank
13. Engine / boiler
14. Fuel distribution system
15. Second supply pipeline
16. LNG Tank-pipeline
17. Engine pipeline
18. First supply pipeline
19. First distribution pump
20. Containers containing LNG
21. Second distribution pump
22. Valve means
23. First fuel supply pump
24. Second fuel supply pump
25. Manifold
26. Boil-off gas system
27. Selecter valve

Claims

1. A cargo vessel (10) adapted to be powered by LNG, said cargo vessel having a hull, a stern, a bow, sides, and an engine, said vessel comprising:

- a fuel distribution system being adapted for preparing and distribution of LNG to be used as fuel by said engine
- a cargo area designated for storage of one or more containers such as ISO containers; said cargo area being designated for storage of one or more containers containing LNG (20),
- an engine (13) adapted to be powered by LNG for powering said cargo vessel;
- a LNG tank positioned within said hull and being in fluid communication with said engine via said fuel distribution system;
- a LNG tank pipeline (16) connecting said LNG tank (12) to said fuel distribution system (14);
- an engine pipeline (17) connecting said fuel distribution system (14) to said engine;

characterized by said vessel comprising a manifold (25), having a manifold inlet and a manifold outlet, said manifold inlet having couplings configured to be connected to complementary couplings on one or more LNG containers in said cargo area; said vessel comprising a first supply pipeline (15) connecting said manifold (25) outlet to said LNG fuel tank (12).

2. A cargo vessel according to claim 1, **characterized by,** a second supply pipeline (18) connecting said manifold (25) outlet to said fuel distribution system.

3. A cargo vessel according to claims 1 and 2, **characterized by,** a selecter valve (27) at said manifold (25) outlet, said selecter valve (27) being capable of switching the manifold (25) outlet between said first supply pipeline and said second supply pipeline.

4. A cargo vessel according to claim 3, **characterized by,** said selecter valve (27) being capable of connecting said manifold (25) outlet with said first supply pipeline and said second supply pipeline simultaneously.

5. A cargo vessel according to any of the claims 1-4, **characterized by,** said vessel comprising a distribution pump (19) being capable of pumping LNG through said first supply pipeline (18) in a direction from said one or more LNG fuel containers stored in said cargo area to said LNG fuel tank (12).

6. A cargo vessel according to any of the claims 1-5, **characterized by,** said vessel comprising a distribution pump (21) being capable of pumping LNG through said first supply pipeline (18) in a direction from said LNG fuel tank (12) to said one or more LNG fuel containers (20) stored in said cargo area.

7. A cargo vessel according to claims 5 and 6, **characterized by** said distribution pumps being a single bi-directional pump.

8. A cargo vessel according to claims 1-7, **characterized by,** said manifold inlet comprising valve means (22) capable of selectively connecting said one or more LNG container (20) stored in said cargo area to said manifold inlet.

9. A cargo vessel according to claims 2-8, **characterized by,** said vessel comprising a first fuel supply pump (23) being capable of pumping LNG through said second supply pipeline (15) from manifold (25) to said distribution system (14).

10. A cargo vessel according to claims 1-9, **characterized by,** said vessel comprising a second fuel supply pump (24) being capable of pumping LNG from said LNG fuel tank to said fuel distribution system (14).

11. Method for refuelling LNG to a cargo vessel in accordance with any claim 1-10, said method comprising the steps of;

- loading said cargo vessel with one or more containers (20) containing LNG;
- coupling one or more of said LNG fuel containers (20) to said manifold (25)
- transferring LNG from one or more LNG containers to said LNG tank (12).

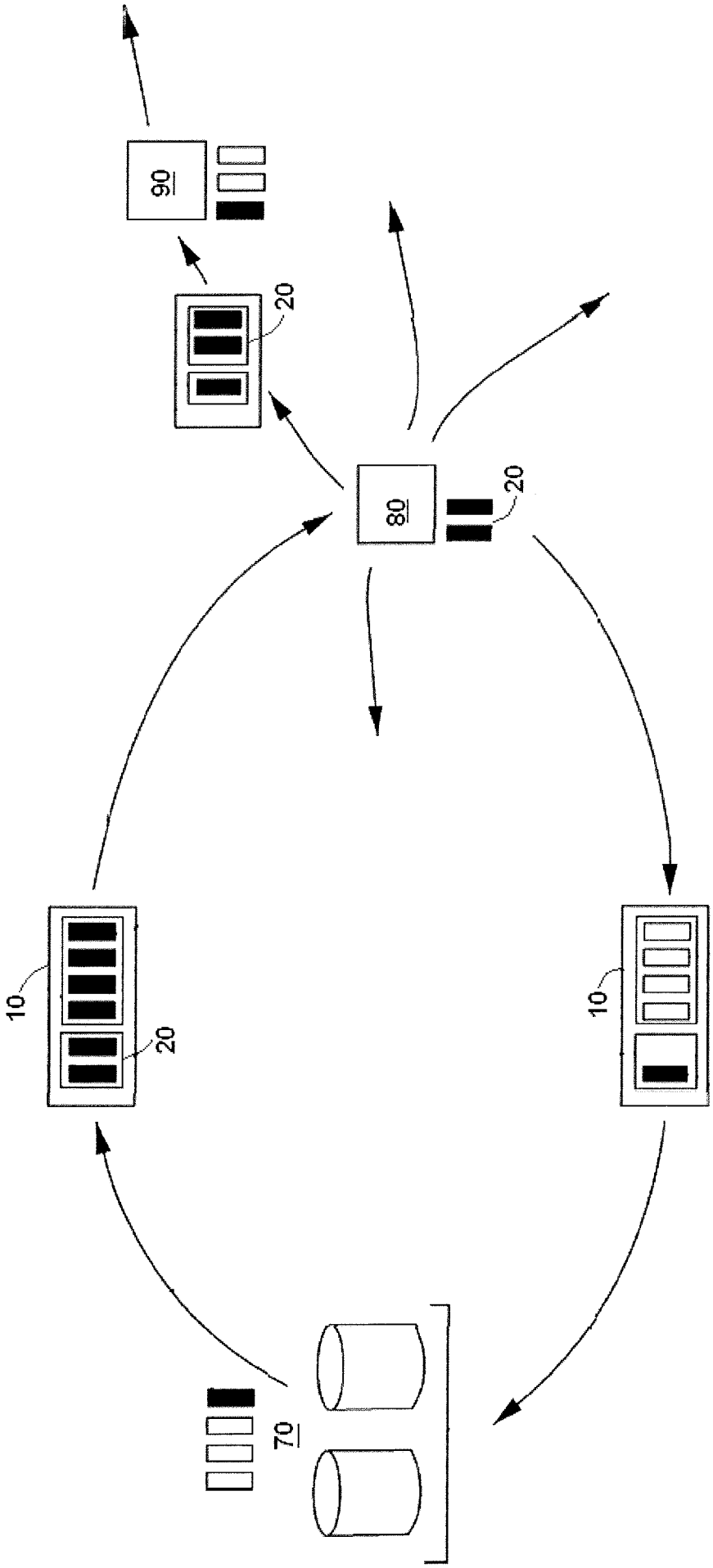
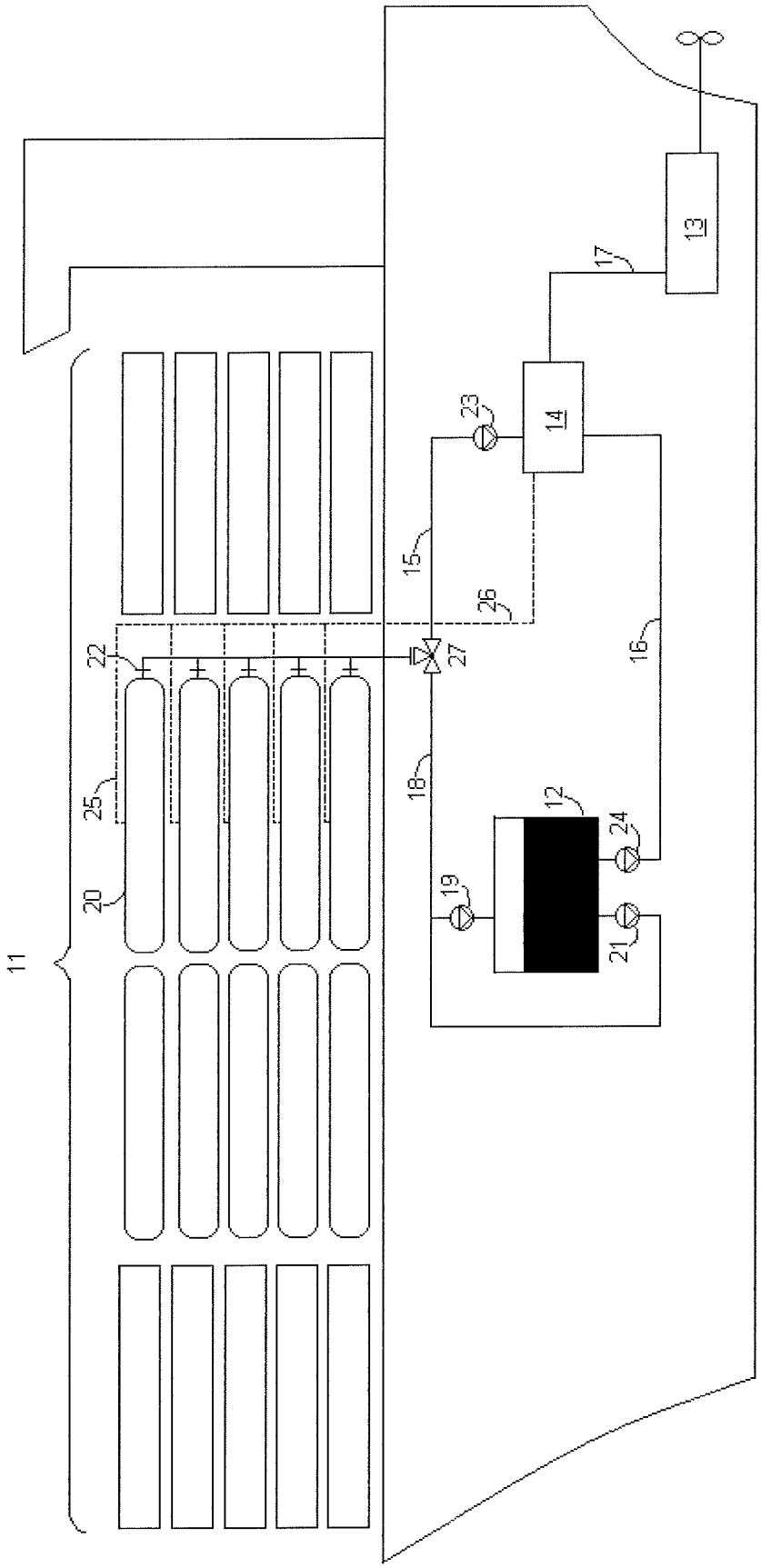


FIG. 1

Fig. 2



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/064342

A. CLASSIFICATION OF SUBJECT MATTER
INV. B63H21/14 B63H21/38
ADD.

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)
B63B B63H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 2013 0050820 A (SAMSUNG HEAVY IND [KR]) 16 May 2013 (2013-05-16)	1,5-7,11
A	the whole document -----	2-4,8-10

☐ 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

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 October 2014	21/10/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	De Sena Hernandorena

3

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2014/064342

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 20130050820 A	16-05-2013	NONE	