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(54) **Fluid supply assemblage, a floating transportation vessel, method of assembling a fluid supply assemblage, and method of transferring a fluid**

(57) A fluid may be transferred using a fluid supply assemblage involving a plurality of intermodal containers (10) and a transfer manifold (50). The intermodal containers have a tank (15) for the storage of the fluid, which tanks are connected to a transfer manifold (50). The transfer manifold (50) has a plurality of manifold inlets (55) and a manifold outlet (60). The manifold outlet (60) is in fluid communication with at least two tanks of the plurality of intermodal containers (10) via the transfer manifold (50).

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Description

[0001] The present invention relates to a fluid supply assemblage for the storage and supply of a fluid and a floating transportation vessel, such as an off-shore supply vessel, comprising such a fluid supply assemblage. The present invention further relates to a method for assembling such a fluid supply assemblage, and a method of transferring a fluid between a first floating moveable structure and a second floating structure using such a fluid supply assemblage.

[0002] The storage and transfer of fluids in general, but particularly in the case of cryogenic hydrocarbon fluids being stored on and transferred between off-shore structures, present a variety of logistical problems associated with one or more of the storage, the transport and the transfer of the fluid. For instance, the fluid itself may require special considerations, for example because it may be hazardous, due to its chemical nature, such as flammability, and/or it may be have particular handling requirements, for example if it is a cryogenic fluid. The off-shore structures may be those used in the production of hydrocarbons from sources such as oil and natural gas.

[0003] One important fluid to be stored and supplied, particularly to a floating structure, is a refrigerant substance, which can be used in a variety of cooling processes. Such a refrigerant substance may be both a hydrocarbon fluid and a cryogenic fluid. Cryogenic hydrocarbon refrigerant substances such as ethane and propane are particularly useful in the liquefaction of natural gas.

[0004] Natural gas is a useful fuel source, as well as being a source of various hydrocarbon compounds. It is not unusual to liquefy natural gas in a liquefied natural gas (LNG) plant at or near the source of a natural gas stream to form a liquefied natural gas stream. Liquefied natural gas can be stored in cryogenic tanks, and/or transported in carrier vessels, at atmospheric pressure and a temperature of about -162 °C.

[0005] Usually, natural gas, comprising predominantly methane, enters an LNG plant at elevated pressures and is pre-treated to produce a purified feed stream suitable for liquefaction at cryogenic temperatures. The purified gas is processed through a plurality of cooling stages where it is cooled against refrigerant in heat exchangers to progressively reduce its temperature until liquefaction is achieved. The liquid natural gas is then further cooled and expanded to final atmospheric pressure suitable for storage and transportation.

[0006] Typically, the liquefaction of natural gas, together with any necessary pre-treatment, is carried out in an on-shore facility. The natural gas must be transported from the natural hydrocarbon reservoir where it extracted to the liquefaction and optionally pre-treatment facility. Hydrocarbon reservoirs producing natural gas may be found off-shore. An off-shore structure, preferably a floating structure, for the processing of natural gas is advantageous because it provides an off-shore alternative to on-shore liquefaction plants. A floating structure for the liquefaction of natural gas can be moored off the coast, or close to or at a gas field, in waters deep enough to allow off-loading of the LNG product onto a carrier vessel. It also represents a movable asset, which can be relocated to a new site when the gas field is nearing the end of its productive life, or when required by economic, environmental or political conditions.

[0007] Examples of such floating structures include a Floating Liquefaction Storage Off-shore (FLSO) facility which combines the natural gas liquefaction process, storage tanks, loading systems and other infrastructure into a single floating structure. A Floating Liquefaction of Natural Gas (FLNG) facility or a Floating Production, Liquefaction, Storage and Off-loading (FPLSO) facility further contains other processing capabilities necessary to prepare the natural gas being produced from the natural hydrocarbon reservoir for the liquefaction process.

[0008] The natural gas liquefaction process, including processes operated on-shore or off-shore (e.g. aboard a floating structure), may utilise a refrigerant to reduce the temperature of the natural gas to cryogenic temperatures. The refrigerant is typically a multicomponent composition comprising a plurality of refrigerant components. The refrigerant components may comprise one or more hydrocarbon refrigerant substances, each mainly consisting of one refrigerant component such as ethane and propane. The natural gas itself may provide a source of such hydrocarbon refrigerant substances, such that they can be produced as part of the liquefaction process. However, not all hydrocarbon reservoirs contain natural gas with sufficient concentrations of heavier hydrocarbons such as ethane and propane to provide them in sufficient quantities for use as refrigerant components. Even if the natural gas does contain the necessary amounts of heavier hydrocarbons, it would require installation and operation of process equipment to extract the refrigerant substances from the natural gas and to prepare them for use as refrigerant. Available space on a floating structure is limited. In either case, the installation and operation of process equipment to extract and process the refrigerant substances can be avoided by supplying the refrigerant substances from a different location, thereby freeing space which can be put to other uses.

[0009] Consequently, a need exits for means to provide one or more hydrocarbons suitable for use as refrigerant substances in the refrigeration cycle of a liquefaction facility. The liquefaction facility may be located in an off-shore location, for example on a floating off-shore facility, such as a FLSO facility.

[0010] US Patent Application Publication No. 2011/0132033 discloses a process for conditioning an ethane-rich stream for storage and transportation. This document discloses that the conditioned ethane-rich stream may be transported using a pipeline, a truck, a rail car, or tanker ship. In embodiments, the pipeline, truck, rail car, or tanker ship may be one which is normally configured to transport LNG, CNG, NGLs, or any other type of hydrocarbons. It is disclosed that the vessels that contain the conditioned ethane on the transport vehicles may be insulated to minimize heat ingress and ethane boil-off. It is disclosed that in some cases, the transport vehicles may be equipped with recycle systems and cooling systems to re-liquefy the boiled-off ethane vapour.

[0011] For off-shore locations, truck and rail cars are inappropriate means of transportation, while laying an insulated pipeline for the purpose of supplying cryogenic fluids would be prohibitively expensive. Maritime Economics, by Martin Stopford (Taylor & Francis 2009, 3rd Edition), discusses in Chapter 12, section 4, liquefied gas commodities such as liquefied petroleum gas, typically propane, ethane or butane and olefins such as ethylene and propylene and the transportation of such commodities in gas tankers. These will be referred to as hydrocarbon carrier vessels herein. Chapter 14, section 6 of Maritime Economics discloses that such hydrocarbon carrier vessels can carry their hydrocarbon cargo in refrigerated and/or pressurised tanks. Both refrigerated and pressurised tanks are known to have disadvantages. Refrigerated tanks require refrigeration systems to maintain the full cargo in the liquid state adding to their operational costs. Pressurised tanks are heavy in order to contain the pressurised cargo. They therefore have a low cargo to tank weight ratio and have risks associated with the handling of pressurised cargo. It will be appreciated that liquefied hydrocarbon gas and hydrocarbon vapours can be flammable.

[0012] Such vessels may be efficient for the transportation of large quantities of hydrocarbons, but are uneconomic for the transportation of smaller quantities of hydrocarbons. According to "Maritime Economics", Chapter 14, section 6, hydrocarbon carrier vessels, such as ethylene carriers, which can be repurposed to carry ethane, typically have a minimum cargo size of approximately 2000 m^3. In contrast, the monthly average requirements of a hydrocarbon refrigerant substance for a liquefaction facility may be considerably less than the cargo carrying capacity of such a hydrocarbon carrier vessel, for instance 10% to 15% or possibly less by volume, while being greater than that of a standard vessel (container) for transporting cryogenic fluid. Thus, the use of hydrocarbon carrier vessels as the transporter may thus not be practical if quantities of hydrocarbon less than that of a carrier vessel are to be supplied to a floating structure, for instance on a monthly basis.

[0013] Furthermore, the transfer of a fluid between off-shore structures, particularly floating structures also presents further problems. Transfer of a fluid from a hydrocarbon carrier vessel requires many connections and disconnections to be made between the pipework in fluid communication with the storage tanks on both structures. The transfer of the fluid therefore also poses certain risks, particularly when the fluid is hazardous, such as a cryogenic or flammable fluid.

[0014] A need exists to provide an alternative means to store and supply fluid, particularly a hydrocarbon refrigerant fluid, more particularly a cryogenic hydrocarbon fluid, in quantities less than the cargo carrying capacity of a carrier vessel.

[0015] In a first aspect, the present invention provides a fluid supply assemblage for the storage and supply of a fluid, said fluid supply assemblage comprising at least:

- a plurality of intermodal containers, each of said intermodal containers comprising a tank for the storage of a fluid, said tank having at least a tank inlet and a tank outlet;
- a transfer manifold, said transfer manifold comprising a plurality of manifold inlets and a manifold outlet, which manifold outlet is in fluid communication with each of said manifold inlets, and wherein at least two tanks of the plurality of intermodal containers are in fluid communication with the manifold outlet via the transfer manifold whereby a first tank outlet of said at least two tanks is fluidly connected to the transfer manifold via at least one of the plurality of manifold inlets and a second tank outlet of said at least two tanks is fluidly connected to the transfer manifold via at least another one of the plurality of manifold inlets; and
- a fluid transfer connector in fluid communication with said manifold outlet.

[0016] The invention further provides a floating transportation vessel, such as an off-shore supply vessel, comprising a fluid supply assemblage for the storage and supply of a fluid, said fluid supply assemblage comprising at least:

- a plurality of intermodal containers, each of said intermodal containers comprising a tank for the storage of a fluid, said tank having at least a tank inlet and a tank outlet;
- a transfer manifold, said transfer manifold comprising a plurality of manifold inlets and a manifold outlet, which manifold outlet is in fluid communication with each of said manifold inlets, and wherein at least two tanks of the plurality of intermodal containers are in fluid communication with the manifold outlet via the transfer manifold whereby a first tank outlet of said at least two tanks is fluidly connected to the transfer manifold via at least one of the plurality of manifold inlets and a second tank outlet of said at least two tanks is fluidly connected to the transfer manifold via at least another one of the plurality of manifold inlets; and
- a fluid transfer connector in fluid communication with said manifold outlet.

[0017] In a second aspect, the present invention provides a method for assembling the fluid supply assemblage according to the first aspect, comprising at least the steps of:

- providing a plurality of intermodal containers, each of said intermodal containers comprising a tank for the storage of a fluid, said tank having at least a tank inlet and a tank outlet;
- providing a transfer manifold comprising a plurality of manifold inlets and a manifold outlet, which manifold outlet is in fluid communication with each of said manifold inlets, said manifold outlet in fluid communication with a fluid transfer connector;
- connecting a first tank outlet of one tank of at least two tanks of the plurality of intermodal containers to the transfer manifold via at least one of the plurality of manifold inlets;
- connecting a second tank outlet of another tank of the at least two tanks to the transfer manifold via at least another one of the plurality of manifold inlets; and
- establishing fluid communication between the at least two tanks and the manifold outlet via the transfer manifold.

[0018] In a third aspect, there is provided a method of transferring a fluid between a first moveable floating structure, and a second floating structure comprising a liquefaction facility, comprising at least the steps of:

- providing a first moveable floating structure comprising a fluid supply assemblage in accordance with the first aspect, whereby one or more of the tanks of said fluid supply assemblage contain a fluid;
- providing a second floating structure comprising a second structure manifold;
- aligning the fluid transfer connector of the first moveable structure with the second structure manifold;
- connecting a flexible hose between the fluid transfer connector of the first floating structure and the second structure manifold;
- purging the flexible hose;
- passing fluid through the flexible hose from at least two of the plurality of storage tanks to the second structure manifold, wherein the fluid passes through the transfer manifold on the first moveable floating structure via a first tank outlet of one tank of at least two tanks of the plurality of intermodal containers to the transfer manifold via at least one of a plurality of manifold inlets and via a second tank outlet of another tank of the at least two tanks to the transfer manifold via at least one of a plurality of manifold inlets, and wherein the fluid passes from the transfer manifold to the flexible hose via the fluid transfer connector;
- purging the flexible hose; and
- disconnecting the flexible hose from the fluid transfer connector.

[0019] Embodiments of the present invention will now be described by way of example only and with reference to the accompanying non-limited drawings in which:

Figure 1 is a diagrammatic scheme of one embodiment of a fluid supply assemblage described herein;
Figure 2 is a diagrammatic scheme of a method of transferring a cryogenic fluid between a first moveable floating structure and a second floating structure.

[0020] A fluid supply assemblage is proposed involving a plurality of intermodal containers and a transfer manifold, for transferring a fluid, for instance from one floating structure to another. The intermodal containers each have a tank for the storage of the fluid, which tanks are connected to a transfer manifold. The transfer manifold has a plurality of manifold inlets and a manifold outlet. The manifold outlet is in fluid communication with at least two tanks of the plurality of intermodal containers via the transfer manifold.

[0021] As used herein, the term "assemblage" is an apparatus of assembled components such as an arrangement of interlinked components. Typically the fluid supply assemblage comprises a plurality of intermodal containers and a transfer manifold, in which at least one of the one or more, preferably all, of the plurality of intermodal containers are removable from the fluid supply assemblage and are replaceable.

[0022] As used herein, the term "tank" is a storage container for a fluid, the fluid preferably being in liquid state under its own vapour pressure. The tank forms part of the intermodal container, such that the intermodal container comprises the tank.

[0023] The term "intermodal container" as used herein means a movable container which can be transported from one location to another, and from one transporter to another, without off-loading and reloading of the contents of the tank from and to the container (in this case the fluid). An intermodal container is advantageous because it can be used in a global containerised intermodal freight transport system and used with and transferred between any mode of transport such as ship, rail or truck. Thus, the plurality of intermodal containers comprising the fluid can be transported from any location, such as that of the manufacture of the fluid, to a location at which the intermodal containers are incorporated into the fluid supply assemblage.

[0024] The use of intermodal containers allows a modular construction of the fluid supply assemblage, providing flexibility in the number of containers to be attached to the transfer manifold, and therefore the quantity of fluid to be supplied. This is achieved by fluidly connecting at least two of a plurality of intermodal containers via a single transfer manifold. The manifold inlets of the plurality of manifold inlets are typically in fluid communication with a single manifold outlet. The transfer manifold is in fluid communication with a fluid transfer connector via the manifold outlet, so that fluid may be discharged, preferably simultaneously discharged, from at least two of the intermodal containers to the fluid transfer connector.

[0025] The assembling of the fluid supply assemblage can be done at ease before transferring the fluid. The assembling can for instance be done in a safe area, such as in a relatively protected area of a port or harbour, such that the transferring of the fluid from the tanks can be done relatively quickly and safely, without the need to connect and/or disconnect hoses to the tanks during the transferring of the fluid.

[0026] In one embodiment, the plurality of intermodal containers can be interlinked, for instance by mechanically attaching an intermodal container to at least one, typically one or two other intermodal containers. The fluid supply assemblage may comprise from 2 to 20, more preferably from 5 to 10 intermodal containers, typically of 20 or 40 kliter (20 m^3) capacity each.

[0027] The fluid supply assemblage is particularly suitable when the fluid is a hydrocarbon fluid, preferably for at least 95 mol% consisting of hydrocarbons. The hydrocarbon fluid preferably comprises one or more hydrocarbon components, more preferably one or more hydrocarbon refrigerant components. The one or more hydrocarbon components or hydrocarbon refrigerant components may be selected from the group comprising ethane, ethylene, propane, butane, and isobutene. The hydrocarbon fluid may comprise at least two of said hydrocarbon refrigerant components.

[0028] The fluid may be a cryogenic fluid, preferably a cryogenic hydrocarbon fluid. As used herein, the term "cryogenic" is intended to mean a fluid at a temperature of lower than -30 °C, more preferably at a temperature of lower than -80 °C.

[0029] For instance, if at least 95 mol%, preferably at least 98 mol%, of the fluid consists of ethane, the temperature may be selected ≤ -88 °C, typically in a range of from -100 °C to -88°C. In another embodiment, in which at least 95 mol%, preferably at least 98 mol%, of the fluid consists of propane, the temperature may be selected ≤ -42 °C, typically in a range of from -100 °C to -42°C. In either of these embodiments, the fluid may be at a pressure in the range of from about 1 to 2 bar. The balance of the hydrocarbon fluid may be provided by one or more further components as defined elsewhere herein.

[0030] Providing the fluid, particularly a cryogenic fluid such as a cryogenic hydrocarbon refrigerant substance, stored in and supplied from in an intermodal container, allows the transportation of the hydrocarbon in much smaller and variable quantities than that required by a hydrocarbon carrier vessel. Furthermore, it is intended to supply the fluid in a form best suited for storage and use as a refrigerant substance, namely in the liquid state and at a pressure in the range of from about 1 to 2 bar.

[0031] Hence, the fluid is preferably in a conditioned state, forming a conditioned fluid. In preferred embodiments the fluid is a conditioned hydrocarbon fluid. The conditioned fluid, particularly the conditioned hydrocarbon fluid, is preferably conditioned such that it is in the liquid state and at a pressure in the range of about 1 to 2 bar. It will be apparent that conditioned hydrocarbons such as ethane or propane i.e. which are in the liquid state and at a pressure of about 1 to 2 bar are cryogenic fluids.

[0032] The fluid, particularly a hydrocarbon fluid or conditioned hydrocarbon fluid may consist for at least 95 mol%, preferably for at least 98 mol%, of a main hydrocarbon component. Examples of a main hydrocarbon component are ethane, ethylene, propane, propylene, butane or isobutene, and may be suitable for use as a refrigerant substance without further fractionation. As used herein, the main hydrocarbon component is the one which constitutes the highest proportion, by mol%, of the fluid. The use of the fluid supply assemblage may thus dispense with the requirement for fractionation equipment at the destination, providing a fluid comprising the desired composition for operation as a refrigerant.

[0033] Further components, in addition to the main hydrocarbon components may be present in the fluid, such as further hydrocarbons, mercury and/or water. Preferably the further components do not preclude the operation of the conditioned ethane as a refrigerant substance at the temperature and pressure under which the refrigerant is intended to be used. In this respect, particularly when used in aluminium-based heat exchangers, it is preferred that the conditioned ethane comprises less than 50 ng/m^3, preferably less than 10 ng/m^3, and more preferably less than 5 ng/m^3 mercury.

[0034] The fluid supply assemblage provided is intended to be moveable, such that it may be incorporated onto or into a transportation means (e.g. a transporter). The transportation means is preferably a floating transportation vessel, such as a floating supply vessel, for instance in the form of a supply ship for an off-shore installation. The fluid supply assemblage may advantageously be located the deck of such a vessel outside the hull.

[0035] Figure 1 shows a horizontal cross-section of a fluid supply assemblage 1 disclosed herein as viewed from above a base 140. The fluid supply assemblage 1 comprises a plurality of intermodal containers 10a, 10b, 10c. The cross-section is taken mid-way through the intermodal containers 10. Although three intermodal containers 10a, 10b, 10c are shown in the embodiment of Figure 1, the assemblage may comprise more or less containers, such as 2, 4, 5, 6, 7, 8, 9, 10 or more than 10. The intermodal containers may be of any size, but are typically 20 feet (6.10 m) or 40 feet (12.19 m) in length for use in a global containerised intermodal freight transport system.

[0036] Each intermodal container 10a, 10b, 10c comprises a tank 15a, 15b, 15c for a fluid. Preferably the tank 15 is thermally insulated, more preferably multi-layer thermally insulated, when it is to hold cryogenic fluid. The thermal insulation may include a vacuum jacket (not shown). Preferably the tank 15 is vapour tight.

[0037] The use of intermodal containers comprising a tanks that are thermally insulated and/or vapour-tight, provides the advantage that the fluid may be transported and supplied in the form in which it can be most readily transferred, stored and used at its destination such as a floating structure. The fluid may be a cryogenic liquid.

[0038] The tank 15 may comprise one or more pressure relief valves, comprising at least a lowest pressure relief valve (not shown). Such a tank will have an associated hold time for a particular fluid. The hold time is the time elapsed from loading until the pressure under equilibrium conditions in the tank reaches the level of the lowest pressure relief valve setting. After the lowest pressure relief valve is opened, the loss of fluid to evaporation can be quantified by a net evaporation rate. In order to prevent escape of fluid vapour from the tank, the residence time of fluid in the tank 15 should not exceed the hold time.

[0039] The tank 15 may have any shape of horizontal cross-section, such as quadrilateral, circular or elliptical. Figure 1 shows three tanks, a first tank 15a, a second tank 15b, and a third tank 15c, each with elliptical horizontal cross-sections. Each tank 15a, 15b, 15c comprises a tank inlet (not shown) and a tank outlet 25, particularly a first tank outlet 25a on the first tank 15a, a second tank outlet 25b on the second tank 15b, and a third tank outlet 25c on the third tank 15c. The tank inlet and tank outlet 25 provide fluid communication between the inside and outside of the tank 15. The tank inlet and tank outlet 25 may have associated tank inlet and tank outlet valves (not shown) in order to isolate the inside of the tank 15 from the external environment.

[0040] Preferably the tank inlet is located gravitationally higher than the tank outlet. More preferably, the tank inlet is located at or near the top of the tank while the tank outlet is located at or near the bottom of the tank (with respect to gravity). The tank outlet 25 in Figure 1 is shown located at the gravitationally lowest part of the tank 15.

[0041] The fluid supply assemblage 1 further comprises a transfer manifold 50. The transfer manifold 50 comprises a plurality of manifold inlets 55. The transfer manifold 50 of the embodiment of Figure 1 comprises three manifold inlets in the form of a first manifold inlet 55a, a second manifold inlet 55b, and a third manifold inlet 55c. Each of the manifold inlets 55a, 55b, 55c is in fluid communication with a manifold outlet 60, in this case the same manifold outlet. Inlet fluid flow control valves 57a, 57b, 57c are provided downstream of each manifold inlet 55 so that each inlet can be independently isolated. Similarly, outlet fluid control valve 59 is provided upstream of the manifold outlet 60 so that it can be isolated.

[0042] The transfer manifold 50 allows the interlinking of the tanks 15a, 15b, 15c. In the embodiment shown in Figure 1, all of the intermodal containers 10 present in the fluid supply assemblage are interlinked via the transfer manifold 50. This is achieved by connecting the tank outlet 25 with a manifold inlet 55. Each tank outlet 25 is connected to a different manifold inlet 55. Figure 1 shows three pairs of such connections, namely tank outlets 25a, 25b, 25c connected to manifold inlets 55a, 55b, 55c respectively. In this way, the fluid held in tanks 15a, 15b, 15c can be passed via the transfer manifold 50 to a single manifold outlet 60.

[0043] In an embodiment not shown in Figure 1, the three intermodal containers 10a, 10b, 10c may be releasably and mechanically interlinked. For instance, the intermodal container 10 may further comprise a frame to support the tank 15. When the intermodal containers 10 are positioned adjacent to one another, the frames may be mechanically interlinked, for instance by bolting them together.

[0044] The fluid supply assemblage 1 further comprises a fluid transfer connector 80 in fluid communication with the manifold outlet 60. The fluid transfer connector is adapted to be attached to a fluid transfer line, such as a that of flexible hose, typically an aerial, floating or crane boom hose. It is preferred that the fluid transfer connector 80 further comprises a restriction collar 90. The restriction collar 90 operates to prevent any flexible hose which is connected to the fluid transfer connector 80 from adopting a configuration with a bending radius less than that of the minimum bending radius of the flexible hose. In this way, damage, particularly rupture of any flexible hose is mitigated by ensuring that the minimum bending radius is not passed. The restriction collar 90 may be configured as an open cone as shown in Figure 1.

[0045] The fluid supply assemblage 1 may be used for the supply and transfer of hazardous fluids, such as cryogenic and/or flammable fluids. It is therefore preferred that the fluid transfer connector 80 further comprises an emergency release coupling 85. The emergency release coupling 85 may be situated upstream of the manifold outlet 60 and downstream of any flexible hose to which the fluid transfer connector 80 is connected. The emergency release coupling 85 is configured to quickly separate the manifold outlet 60 from any flexible hose to which it is connected via the fluid transfer connector 80. It can do this by separating the end of the fluid transfer connector 80 having the restriction collar 90 from the manifold outlet 60. The emergency release coupling may comprise an emergency fluid control valve 86, operable to stop fluid flow between the manifold outlet 60 and any flexible hose to which the fluid transfer connector is attached. The emergency release coupling 85 is configured to activate when the safe operating envelope of a flexible hose connected to fluid transfer connector 80 is exceeded during the transfer of fluid from tanks 15a, 15b, 15c. The safe operating envelope can be monitored by a variety of means known in the art, for instance by a satellite positioning or a guide wire and gimbal attached to the end of the flexible hose, which may be housed on a crane boom, which is connected to the fluid connector.

[0046] The fluid supply assemblage 1 may further comprise a base 140, having a surface 140a. The transfer manifold 50 may be attached to the base 140, preferably the surface 140a thereof. The transfer manifold may be permanently attached to such a base, for instance by welds, rivets or the like. The intermodal containers may be releasably secured to the base 140, for instance by releasable bolts or other suitable releasable attachment means.

[0047] In an embodiment not shown in Figure 1, the fluid supply assemblage 1 may further comprise additional intermodal containers which are not connected to the transfer manifold 50 i.e. containers whose tanks are not in fluid communication with the transfer manifold 50 via connection of their tank outlet to a manifold inlet.
This may occur, for instance when different fluids are held in the tanks of different intermodal containers. For example, first tanks of first intermodal containers containing a first fluid may be connected to the transfer manifold for fluid transfer, while second tanks of second intermodal containers containing a second fluid different from the first fluid are not connected to the transfer manifold, but are still present as part of the fluid supply assemblage 1. After transfer of the first fluid from the first tanks of the first intermodal containers, the tank outlets of the first tanks can be disconnected from the transfer manifold. The tank outlets of the second tanks containing the second fluid can then be connected to the manifold inlets of the transfer manifold in order to facilitate the transfer of the second fluid.

[0048] In a further embodiment not shown in Figure 1, the tank 15 of the intermodal container 10 may further comprise a tank conditioning means. Herewith the fluid contained inside of tank 15 may be cooled. Preferably the tank conditioning means can cool the fluid contained inside the tank, to maintain it in the liquid state and at a pressure in the range of from about 1 to 2 bar and/or to condense vapour in the tank into fluid in a liquid state and at a pressure in the range of from about 1 to 2 bar.

[0049] The tank conditioning means may comprise a tank conditioning heat exchanger, such as one or more conditioning refrigerant coils. When a conditioning refrigerant is passed through the tank conditioning means, it is heat exchanged against the fluid in the tank to cool it. The one or more conditioning refrigerant coils allow the tank to operate as a shell and tube heat exchanger with the fluid on the shell side and the conditioning refrigerant on the tube side.

[0050] The conditioning refrigerant preferably has an atmospheric bubble point lower than the atmospheric bubble point of the fluid to be cooled. Preferably the bubble point of the conditioning refrigerant is lower than the atmospheric bubble point of the hydrocarbon fluid. The conditioning refrigerant may be selected from one or more of the group comprising nitrogen, methane, ethane, propane and butane. When the hydrocarbon fluid comprises ethane as the main component, the conditioning refrigerant may be nitrogen, methane or ethane. In a preferred embodiment, the conditioning refrigerant is nitrogen, more preferably liquid nitrogen.

[0051] The tank conditioning means comprising the tank conditioning heat exchanger may be a closed or open refrigerant system. A closed refrigerant system is one in which after heat exchange, all the conditioning refrigerant is treated and recirculated so that it may carry out further conditioning.

[0052] In an open refrigerant system, only a part, or none of the refrigerant may be treated and recirculated so that it may carry out further conditioning. For example, an open refrigerant system may comprise a conditioning refrigerant storage tank, which is preferably vapour tight and thermally insulated, and the tank conditioning heat exchanger. A conditioning refrigerant stream, such as a liquid nitrogen stream, can be passed from the conditioning refrigerant storage tank to the tank conditioning heat exchanger, where it is heat exchanged against the hydrocarbon to cool the hydrocarbon and provide a warmed conditioning refrigerant stream.

[0053] After heat exchange, the warmed conditioning refrigerant stream may be a single phase stream comprising gaseous conditioning refrigerant or a multi-phase stream comprising liquid and gaseous conditioning refrigerant. In an open refrigerant system, when the conditioning refrigerant is nitrogen, any gaseous nitrogen produced by the heat exchange can be vented to the atmosphere. Thus, when the warmed conditioning refrigerant stream is a single phase stream comprising gaseous nitrogen, it can be vented. In an alternative embodiment, when the warmed conditioning refrigerant stream is a multi-phase stream comprising liquid and gaseous conditioning refrigerant, it can be passed to a conditioning refrigerant gas/liquid separation device in which the phases are separated to provide a conditioning refrigerant return stream comprising liquid conditioning refrigerant and a conditioning refrigerant continuing stream comprising gaseous conditioning refrigerant. The conditioning refrigerant return stream can be passed to the conditioning refrigerant storage tank. When the conditioning refrigerant is nitrogen, the conditioning refrigerant continuing stream, which comprises gaseous nitrogen, can be vented to the atmosphere.

[0054] In an alternative embodiment, in a closed refrigerant system, either the warmed conditioning refrigerant stream, particularly if it is a single phase gaseous stream, or the conditioning refrigerant continuing stream, can be passed to a conditioning refrigerant compressor in which either stream is compressed to provide a compressed conditioning refrigerant stream. The compressed conditioning refrigerant stream can then be cooled in a conditioning refrigerant cooler, for instance against ambient air, or a further refrigerant in a further refrigerant system, to provide a cooled conditioning refrigerant stream. The cooled conditioning refrigerant stream may then be optionally expanded in a conditioning refrigerant pressure reducing device, such as a Joule-Thomson valve, to provide a cooled, optionally expanded conditioning refrigerant stream, which can be passed back to the conditioning refrigerant storage tank for reuse or directly to the tank conditioning heat exchanger.

[0055] In a further embodiment, the intermodal container may further comprise a conditioning refrigerant system comprising a tank conditioning heat exchanger, conditioning refrigerant compressor, conditioning refrigerant cooler, and optionally a conditioning refrigerant pressure reduction device and conditioning refrigerant storage tank and further optionally the conditioning refrigerant itself. The conditioning refrigerant system operates as discussed in the previous paragraphs. The conditioning refrigerant system may be an open or closed conditioning refrigerant system.

[0056] The fluid supply assemblage 1 is preferably present on a supply vessel, more preferably a dynamically positionable supply vessel, such as that suitable to supply an off-shore facility such as a FLSO. The fluid supply assemblage 1 can be located on the deck of such a vessel. For instance the base 140 may be a prepared location on the deck.

[0057] The fluid supply assemblage 1 can be assembled by providing the intermodal containers 10a, 10b, 10c each comprising a tank 15a, 15b, 15c, each tank 15 having at least a tank inlet (not shown) and a tank outlet 25a, 25b, 25c as discussed above. The intermodal containers 10 can be provided with their tanks 15 containing fluid, such as a hydrocarbon load, particularly a hydrocarbon refrigerant substance. The hydrocarbon load preferably comprises a conditioned hydrocarbon.

[0058] The fluid may be manufactured at a location other than the location wherein the fluid supply assemblage 1 is being assembled. For instance, the fluid may be manufactured at a starting location at which it may or may not have been transferred to the tank of the intermodal container. If it is not transferred to the tank of the intermodal container at the starting location, it can be transferred to the tank at a further or intermediate location.

[0059] Preferably, the fluid comprises ethane. The ethane may be provided as part of the manufacture of ethylene by thermal cracking of hydrocarbons comprising two or more carbon atoms. The ethane need not be produced from another hydrocarbon but may instead be isolated during the manufacturing process, for instance as an unreacted reactant in the thermal cracking process.

[0060] In one embodiment, when the fluid is a hydrocarbon refrigerant substance and comprises ethane or propane as the main hydrocarbon component, it can be provided as part of a process for the manufacture of ethylene from the cracking of a feedstock comprising hydrocarbon having two or more carbon atoms. Such a process can provide conditioned ethane or propane hydrocarbon i.e. in ethane or propane in the liquid state and at a pressure of about 1 to 2 bar.

[0061] If the hydrocarbon refrigerant substance is provided as conditioned hydrocarbon, conditioning the hydrocarbon to the liquid state at a pressure in the range of from about 1 to 2 bar can be carried out as part of the hydrocarbon refrigerant substance manufacturing process or in a separate step at the starting location or elsewhere at an intermediate location. When the hydrocarbon refrigerant substance is conditioned hydrocarbon it is preferred that it is provided in the tank of the intermodal container.

[0062] If the hydrocarbon refrigerant substance is conditioned to provide conditioned hydrocarbon at an intermediate location, the conditioning may comprise heat exchanging the hydrocarbon refrigerant substance against a conditioning refrigerant to cool it and provide conditioned hydrocarbon in the liquid state and at a pressure of about 1 to 2 bar. The intermodal container can then be transported to the location of the assembling of the fluid supply assemblage 1. It will be apparent that the plurality of intermodal containers 10 may be transported from separate locations to the location of assembly. This transportation may be over significant distances, such as at least 500km, or even at least 1000 km.

[0063] When the fluid supply assemblage 1 is provided aboard a supply vessel, the location of assembly may be in a port. For instance, the intermodal containers 10 may be transported to the port, for instance over sea or land, and then lifted aboard the supply vessel, for instance by crane. Each intermodal container may be loaded onto the surface 140a of the base 140, whereby preferably each tank outlet 25 of the plurality of intermodal containers is aligned with a manifold inlet 55 of the transfer manifold 50.

[0064] The intermodal containers 10 can for instance be positioned on the surface 140a of the base 140 of the fluid supply assemblage 1 facing outside the hull of the floating vessel, for instance in a position such that the tank outlets 25 are aligned with the manifold inlets 55 of the transfer manifold 50. The intermodal containers 10 may then be releasably attached to the base 140 and/or one another for instance by releasably attaching one of said intermodal containers to one or more other adjacent intermodal containers of said plurality of intermodal containers. The tank outlets 25 of some, but not necessary all, of the intermodal containers can then be attached to the manifold inlets 55 of the transfer manifold 50.

[0065] As illustrated in Figure 2, the assemblage disclosed herein may be provided a floating supply vessel, such as an off-shore supply vessel. Figure 2 shows a schematic diagram of a cross-section of the side view of a method of transferring fluid between a first moveable floating structure 200, such as the floating supply vessel, comprising a fluid supply assemblage 1, and a second floating structure 300 comprising a liquefaction facility 350, such as a FLSO, FLNG or FPLSO or other similar structure requiring external supply of a refrigerant fluid.

[0066] The second floating structure 300 may be located less than or equal to 500 km, preferably less than or equal to 300 km, and/or more than or equal to 50 km, preferably more than or equal to 100 km, from the location in which the fluid supply assemblage is assembled (particularly, the location in which the plurality of intermodal containers 10 are connected to the transfer manifold 50). The distance between the second floating structure 300 and the location in which the fluid supply assemblage is assembled may for instance be in the range of from 10 km to 500 km, and preferably in the range of from 50 to 300 km.

[0067] The distance between the location in which the fluid supply assemblage is being assembled and the second floating structure, may be less than the distance between the location in which the fluid supply assemblage is being assembled and the location in which the tank of the intermodal container is first filled with the cryogenic fluid. Preferably, the duration for the journey from the location at which the fluid supply assemblage is assembled and the second floating structure is shorter than the duration of the journey from the location at which the intermodal container comprising the cryogenic fluid is first placed in the tank of the intermodal container to the location at which the fluid supply assemblage is assembled.

[0068] The base 140 of the fluid supply assemblage may be an area of the deck of the supply vessel 200, with intermodal containers 10 each comprising tanks 15 attached to a surface 140a facing outside the hull 205. Only a single tank 15 is visible in the cross-section of Figure 2, but the fluid supply assemblage 1 comprises at least one further intermodal container and tank. The tanks 15 comprise a fluid, such as a cryogenic fluid. The fluid is preferably a hydrocarbon refrigerant substance, which is more preferably in the liquid state and at a pressure of from about 1 to 2 bar. The transfer manifold may also be attached to the base 140, preferably to the surface 140a thereof. As the intermodal containers 10 with the tanks 15 are outside of the confined area in the hull 205 underneath the deck, the safety measures may be less stringent compared with when the fluid in the tanks of the intermodal containers would have to be stored in a fluid cargo tank inside the hull.

[0069] A flexible hose 320 is shown attached at a first end to the fluid transfer connector 80 of the transfer manifold and at a second end to a second structure manifold 310. The second structure manifold 310 is on the second floating structure 300 and is in fluid connection with a second structure fluid storage tank 330. The second structure fluid storage tank 330 may be in the form of a cryogenic storage tank. Flexible hoses for the transfer of fluids, such as hydrocarbons and/or cryogenic fluids between floating structures are known in the art. When the fluid is a cryogenic fluid, the flexible hose may be thermally insulated.

[0070] After the fluid has passed between the fluid supply assemblage 1 and the second floating structure 300, it can then be stored in one or more of the second structure fluid storage tanks 330, in which the fluid is held the liquid state at or near atmospheric pressure. No further processing of the fluid, particularly a hydrocarbon refrigerant substance, such as one or more of fractionation, temperature adjustment and pressure adjustment may be required as it may already be provided in the required state from the fluid supply assemblage 1.

[0071] Figure 2 shows second structure fluid storage tank 330 located underneath a deck 340 within a hull 305 of the second floating structure 300. In an alternative embodiment, the second structure fluid storage tank 330 may be located on deck 340, preferably facing outside the hull 305 of the second floating structure 300. The second structure fluid storage tank 330 is preferably one or both of thermally insulated and refrigerated, for instance so that it can store a cryogenic fluid, such as a hydrocarbon refrigerant substance in the liquid state and at a pressure of from about 1 to 2 bar.

[0072] The fluid held in the tank 15 of the intermodal container 10 may be transferred from the first moveable floating structure 200 to the second floating structure 300 as follows. The fluid supply assemblage 1 can be assembled as discussed above on the deck 140 of the first moveable floating structure 200 at port. The first moveable floating structure 200 can then be transported to the location of the second floating structure 300, preferably under its own power, for instance when the first moveable floating structure 200 is a supply vessel, in contrast to, for instance, a moveably floating structure like a barge which does not comprise an engine and could be towed to the location by a supply vessel. The first moveable floating structure 200 can be dynamically positioned next to the second floating structure 300, for instance using a positioning system, such as satellite, radar or other electromagnetic positioning systems. It is preferred that the two floating structures are positioned side-by-side i.e. with their shortest horizontal axis next to one another such as starboard to port or port to port or port to starboard of the two floating structures.

[0073] The fluid transfer connector 80 of the fluid supply assemblage 1 can then be aligned with the second structure manifold 310, for instance by manoeuvring the first moveable floating structure 200, typically using thrusters if it is a supply vessel.

[0074] Once alignment is achieved, a flexible hose 320 can be connected between the fluid transfer connector 80 and the second structure manifold 310. In a preferred embodiment the flexible hose 320 is first attached to the second structure manifold 310 or may be already attached to the second structure manifold 310 and resides on the second floating structure 300. The flexible hose 320 may be a floating hose or attached to a crane boom. If the flexible hose 320 is present as part of a crane boom, the boom can be moved from its storage position into its operating position. The configuration of the operating position will depend on the height of the second structure manifold 310 versus that of the fluid transfer connector 80 of the fluid supply assemblage 1. Once the flexible hose 320 is connected between the fluid transfer connector 80 and the second structure manifold 310, the relative positions of the first and second floating structures 200, 300 should be maintained until disconnection of the flexible hose 320.

[0075] The flexible hose 320 can then be purged. For instance, when the fluid to be transferred is a hydrocarbon refrigerant substance, the purge fluid may be nitrogen gas.

[0076] The fluid, such as a hydrocarbon refrigerant substance, can then be transferred from the tanks 15 of the fluid supply assemblage 1 of the first floating structure 200, through the flexible hose 320 to the second structure manifold 310 of second floating structure 300 and into the second structure fluid storage tank 330. It is preferred that the fluid is transferred without pressuring the system by more than a few bar, for instance by more than 4 bar.

[0077] The fluid may be transferred via a fluid transfer means. An example of such fluid transfer means is pump 100, arranged to displace the liquid fluid from a pump inlet 105 to a pump outlet 110 by directly interacting with the liquid fluid. An inert gas such as nitrogen may be passed into the tank 15 of the intermodal container 10, for instance via a tank inlet, to replace the fluid being supplied to the second floating structure 300.

[0078] Alternatively, the fluid transfer device may be a compressor (not shown), or other suitable device which indirectly acts upon the liquid fluid. If the fluid transfer device is a compressor, a drive gas, such as an inert gas like nitrogen or a portion of any fluid vapour present in the tank or provided by the vaporisation of a portion of the liquid fluid in the tank, may be compressed in the compressor and injected into the tank, for instance via the tank inlet, thereby pressuring the tank and causing the fluid liquid to be transferred from the tank via the tank outlet to the manifold inlet.

[0079] The fluid transfer device may be connected between the tank outlet 25 and manifold inlet 55, for instance if it is a pump. In this case a plurality of pumps is required, one for each manifold inlet (55a, 55b, 55c). Alternatively, the fluid transfer device may be connected between the manifold outlet 60 and the fluid transfer connector 80, for instance such that one single pump 100 may be used to off-load fluid from a plurality of tanks, by drawing from all the tanks which are in fluid communication with the manifold outlet 60. As a further alternative, a gas injector system comprising a compressor as the fluid transfer means and optionally a source of transfer gas may be provided. The gas injector system can be connected to the tank inlets of the tanks to be off-loaded.

[0080] Once the fluid transfer has been completed, the flexible hose 320 can then be purged with purge fluid, such as nitrogen. The flexible hose 320 may then be disconnected from the fluid transfer connector 80. The flexible hose 320 may then be returned to the second floating structure, for instance by returning any crane boom supporting the flexible hose 320 to its storage position. The first moveable floating structure 200 may then be moved away from the second floating structure 300 and return to port.

[0081] Once aboard the second floating structure 300, the fluid, such as a hydrocarbon refrigerant substance, may be used in a liquefaction facility 350, such as in the cooling and liquefaction of natural gas.

[0082] The first moveable floating structure 200 may then return to port. Those intermodal containers 10 comprising tanks 15 empty of or depleted of fluid which are connected to the transfer manifold 50 can have their tank outlets disconnected from the manifold inlets. The intermodal containers 10 comprising tanks 15 empty of or depleted of fluid may be released from the base 140 of the fluid supply assemblage 1. The intermodal containers 10 comprising tanks 15 empty of or depleted of fluid may then be off-loaded from the first moveable floating structure 200, for instance by crane. Once off-loaded, the intermodal containers comprising empty tanks may be purged with inert gas such as nitrogen, and then transported to another location to be refilled with fluid. Once refilled with fluid, the intermodal containers can be returned to the port to be re-assembled into assemblage 1.

[0083] As used herein, the term "vapour-tight" means that, when the associated valves, such as the tank inlet and tank outlet valves are closed, the container comprising the fluid does not leak vapour from the evaporation of fluid in the liquid state e.g. it does not leak hydrocarbon vapour such as ethane vapour or propane vapour. In one embodiment, the term "vapour-tight" is intended to mean that the tank has a pressure loss of less than 0.0075 bar over 5 minutes after having pressurised to the maximum allowable working pressure of the tank of the intermodal container.

[0084] It will be apparent that a floating supply vessel is not the only mode of transportation with which the fluid transfer assemblage may be used. For instance, the fluid supply assemblage could be incorporated into other means of transportation, such as a railcar, railway wagon, truck or lorry.

[0085] As used herein, the term "thermally insulated" means that steps are taken to minimise heat exchange between the fluid in the tank of the intermodal container and the external environment. In one embodiment, the tank has a heat influx of less than 75 W/m^2 at the bubble point temperature of the contents of the tank over at least 90% of the outer surface area of the tank at a 50% filling ratio and +15 °C ambient temperature such as defined in engineering standard EN 12213. The tank may be multi-layer thermally insulated. In one embodiment, the tank may be provided with a vacuum jacket in the intermodal container.

[0086] Suitable intermodal containers, for instance 20 feet (6.1 m) in length with a tank capacity of 20000 litres, or 40 feet (12.2 m) in length with a tank capacity of 43500 litres, are available from Chart Industries Group D&S (Chart Ferox as, DĕČ in, the Czech Republic).

[0087] An example of a flexible hose capable of transferring cryogenic hydrocarbon liquids, including LPG (propane, butane), ethane, and LNG (predominantly methane), is available from Trelleborg Oil & Marine Hoses of Trelleborg Industrie SAS, under the name of Cryoline (TM).

[0088] The pressure unit "bar" as used herein is identical to "bar absolute" or "bara". As used herein, the term "liquid state" is intended to represent a fluid at or below its bubble point at the governing pressure.

[0089] The person skilled in the art will understand that the present invention can be carried out in many various ways without departing from the scope of the appended claims.

Claims

1. A fluid supply assemblage for the storage and supply of a fluid, said assemblage comprising at least:

   - a plurality of intermodal containers (10), each of said intermodal containers comprising a tank (15) for the storage of a fluid, said tank having at least a tank inlet and a tank outlet (25);
   - a transfer manifold (50), said transfer manifold comprising a plurality of manifold inlets (55) and a manifold outlet (60), which manifold outlet (60) is in fluid communication with each of said manifold inlets (55), and wherein at least two tanks (15) of the plurality of intermodal containers (10) are in fluid communication with the manifold outlet (60) via the transfer manifold (50) whereby a first tank outlet (25a) of said at least two tanks (15) is fluidly connected to the transfer manifold (50) via at least one (55a) of the plurality of manifold inlets (55) and a second tank outlet (25b) of said at least two tanks (15) is fluidly connected to the transfer manifold (50) via at least another one (55b) of the plurality of manifold inlets (55); and
   - a fluid transfer connector (80) in fluid communication with said manifold outlet (60).

2. The fluid supply assemblage of claim 1, wherein each tank (15) is thermally insulated and vapour-tight.

3. The fluid supply assemblage of claim 1 or claim 2, wherein the fluid is a cryogenic fluid, preferably for at least 95 mol% consisting of hydrocarbons.

4. The fluid supply assemblage of any of the preceding claims, further comprising:

   - a fluid transfer means (100) to facilitate the flow of fluid from the at least two tanks (15) in fluid communication with the manifold outlet (60) to the fluid transfer connector (80).

5. The fluid supply assemblage of any of the preceding claims, further comprising:

   - a base (140) onto which said plurality of intermodal containers (10) are releasably secured and onto which the transfer manifold (50) is attached.

6. The fluid supply assemblage of any of the preceding claims, wherein the fluid transfer connector (80) further comprises one or both of:

   - an emergency release coupling (85), and
   - a restriction collar (90).

7. The fluid supply assemblage of any of the preceding claims, wherein one or more of said tanks (15) contain a hydrocarbon fluid, said hydrocarbon fluid for at least 95 mol% consisting of a main hydrocarbon component selected from ethane, ethylene, propane, butane or isobutene, said hydrocarbon fluid in a liquid state and at a pressure in the range of about 1 to 2 bar.

8. A floating transportation vessel, such as an off-shore supply vessel, comprising the fluid supply assemblage of any one of the preceding claims.

9. The floating transportation vessel of claim 8, wherein the fluid supply assemblage further comprises a base (140) comprising a surface (140a) onto which said plurality of intermodal containers (10) are releasably secured and onto which the transfer manifold (50) is attached, said surface (140a) facing outside the hull of the floating transportation vessel.

10. A method for assembling the fluid supply assemblage of any one of claims 1 to 7, comprising at least the steps of:

    - providing a plurality of intermodal containers (10), each of said intermodal containers comprising a tank (15) for the storage of a fluid, said tank having at least a tank inlet and a tank outlet (25);
    - providing a transfer manifold (50) comprising a plurality of manifold inlets (55) and a manifold outlet (60), which manifold outlet (60) is in fluid communication with each of said manifold inlets (55), said manifold outlet (60) in fluid communication with a fluid transfer connector (80);
    - connecting a first tank outlet (25a) of one tank of at least two tanks (15) of the plurality of intermodal containers (10) to the transfer manifold (50) via at least one (55a) of the plurality of manifold inlets (55);
    - connecting a second tank outlet (25b) of another tank of the at least two tanks (15) to the transfer manifold (50) via at least another one (55b) of the plurality of manifold inlets (55); and
    - establishing fluid communication between the at least two tanks (15) and the manifold outlet (60) via the transfer manifold (50).

11. The method of claim 10, wherein one or more of said tanks (15) contain a cryogenic fluid, preferably for at least 95 mol% consisting of hydrocarbons.

12. The method of claim 10 or claim 11, wherein the fluid supply assemblage further comprises a base (140) having a surface (140a) and wherein the plurality of intermodal containers (10) are provided by the step of:

- loading each said intermodal containers (10) onto the surface (140a) of the base (140);
- aligning each tank outlet (25) the plurality of intermodal containers (10) with one of the plurality of manifold inlets (55) each.

13. The method of any one of claim 10 to claim 12, wherein the step of providing said plurality of intermodal containers (10) further comprises:

- releasably attaching each said intermodal container (10) to the base (140).

14. The method of claim 12 or claim 13, wherein one or both of the steps of loading and attaching are carried out in a port.

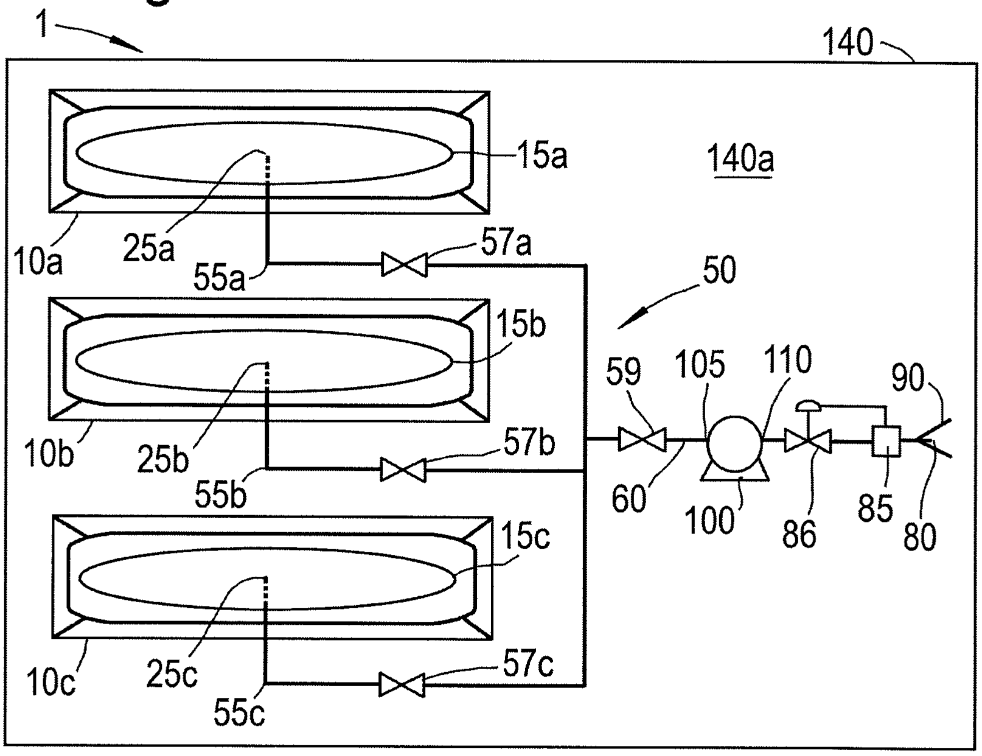
15. A method of transferring a fluid between a first moveable floating structure (200), and a second floating structure (300) comprising a liquefaction facility (350), comprising at least the steps of:

- providing a first moveable floating structure (200) comprising a fluid supply assemblage of any one of claims 1 to 7, whereby one or more of the tanks (15) of said assemblage contain a fluid;
- providing a second floating structure (300) comprising a second structure manifold (310);
- aligning the fluid transfer connector (80) of the first moveable structure (200) with the second structure manifold (310);
- connecting a flexible hose (320) between the fluid transfer connector (80) of the first floating structure (200) and the second structure manifold (310);
- purging the flexible hose (320);
- passing fluid through the flexible hose (320) from at least two of the plurality of storage tanks (15) to the second structure manifold (310), wherein the fluid passes through the transfer manifold (50) on the first moveable floating structure (200) via a first tank outlet (25a) of one tank of at least two tanks (15) of the plurality of intermodal containers (10) to the transfer manifold (50) via at least one (55a) of a plurality of manifold inlets (55) and via a second tank outlet (25b) of another tank of the at least two tanks (15) to the transfer manifold (50) via at least one (55a) of a plurality of manifold inlets (55), and wherein the fluid passes from the transfer manifold (50) to the flexible hose (320) via the fluid transfer connector (80);
- purging the flexible hose (320); and
- disconnecting the flexible hose (320) from the fluid transfer connector (80).

16. The method of claim 15, wherein the second structure manifold (310) is in fluid connection with one or more second structure fluid storage tanks (330) on said second structure (300).

17. The method of claim 15 or claim 16, wherein the second structure (300) is a moveable floating structure.

Fig.1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15a
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105
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60
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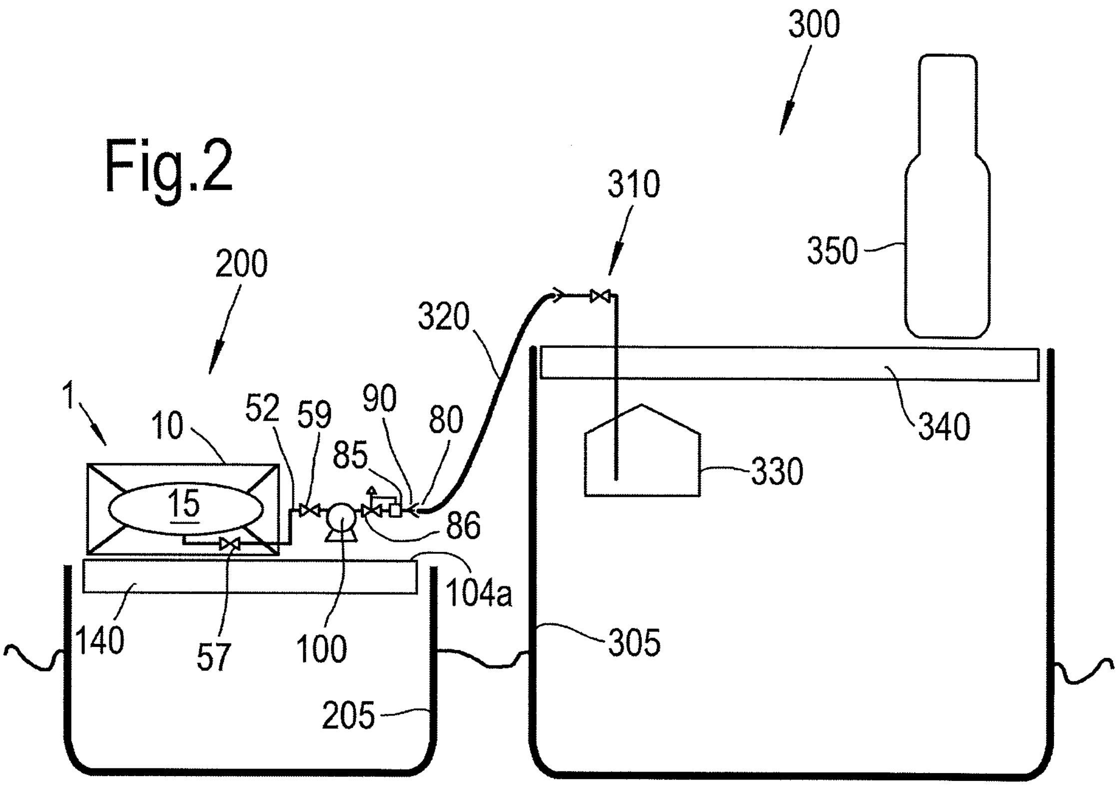
25c
55c
57c

Fig.2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310
350
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320
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52
59
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80
340
85
330
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86
104a
140
57
100
305
205

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EUROPEAN SEARCH REPORT

Application Number
EP 12 19 9552

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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	16 July 2013	Stängl, Gerhard

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EUROPEAN SEARCH REPORT

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