

A MANIFOLD ASSEMBLY

TECHNICAL FIELD

5 This invention relates generally to a manifold assembly for conveying natural gas from a storage system to a downstream system.

Background

Natural gas is a naturally occurring hydrocarbon gas mixture consisting primarily of methane, but commonly including varying amounts of other higher alkanes, and sometimes a small
10 percentage of carbon dioxide, nitrogen, hydrogen sulfide, or helium. Natural gas is a fossil fuel used as a source of energy for heating, cooking, and electricity generation. It is also used as a fuel for vehicles and as a chemical feedstock in the manufacture of plastics and other commercially important organic chemicals. Natural gas is often informally referred to simply as "gas", especially when compared to other energy sources such as oil or coal.
15 However, it is not to be confused with gasoline, especially in North America, where the term gasoline is often shortened in colloquial usage to gas.

Liquefied natural gas (LNG) is a composition of methane and some mixture of ethane used to convert natural gas to liquid form for ease and safety of storage transport. It is cooled to
20 approximately -256 degrees Fahrenheit so that it can be transported from countries with a large supply of natural gas to countries that demand more natural gas than they produce. In its liquid state, natural gas takes up 1/600th of the space, making it much easier to ship and store when pipeline transport is not feasible. Liquefied natural gas is primarily used to transport natural gas from one source to another. The main method of transportation
25 is storage tanks ashore to vessel tanks. Once the cargo is delivered, the natural gas is allowed to expand and convert back to its gaseous form. Regasification terminals are used to help convert temperatures back to a natural gas state.

One approach to the storage of LNG is through the use of cryogenic storage dewars, a
30 specialised type of vacuum flask used for storing cryogenics (such as liquid nitrogen or liquid

helium), whose boiling points are much lower than room temperature. Cryogenic storage dewars may take several different forms including open buckets, flasks with loose-fitting stoppers and self-pressurising tanks. All dewars have walls constructed from two or more layers, with a high vacuum maintained between the layers. This provides very good thermal insulation between the interior and exterior of the dewar, which reduces the rate at which the contents boil away. Precautions are taken in the design of dewars to safely manage the gas which is released as the liquid slowly boils. The simplest dewars allow the gas to escape either through an open top or past a loose-fitting stopper to prevent the risk of explosion. More sophisticated dewars trap the gas above the liquid, and hold it at high pressure. This increases the boiling point of the liquid, allowing it to be stored for extended periods. Excessive vapour pressure is released automatically through safety valves.

Nonetheless, cryogenics still present several safety hazards and storage vessels are designed to reduce the associated risk. Firstly, no dewar can provide perfect thermal insulation and the cryogenic liquid slowly boils away, which yields an enormous quantity of gas. For example, the expansion ratio of cryogenic argon from the boiling point to ambient is 1 to 847, liquid hydrogen 1 to 851, liquid helium 1 to 757, liquid nitrogen 1 to 696, and liquid oxygen 1 to 860. In dewars with an open top, the gas simply escapes into the surrounding area. However, very high pressures can build up inside sealed dewars, and precautions are taken to minimise the risk of explosion. One or more pressure-relief valves allow gas to vent away from the dewar whenever the pressure becomes excessive. If a dewar is left open to the air for extended periods, atmospheric chemicals can condense or freeze on contact with the cryogenic material. This can introduce contaminants. If these materials freeze, for example, water vapor becoming ice, they can block the openings, leading to pressure buildup and the risk of an explosion. Further, the gas escaping from a dewar can gradually displace the oxygen from the air in the surrounding area, which presents an asphyxiation hazard. Users are trained to only store dewars in a well-ventilated area and before transporting dewars in an elevator, the excess gas pressure is vented away and the dewars are sent unaccompanied to their destination. Therefore, there exists a need for a system for addressing the foregoing problems.

Summary

In accordance with a first aspect of the invention, there is disclosed a manifold assembly comprising a first segment for receiving vapourised natural gas from at least one storage system, a second segment coupled to the first segment at an interface point for fluid communication therewith, the second segment for conveying the vapourised natural gas from the first segment to a downstream system, and a first pressure relief valve configured parallel the interface point for intercoupling the first segment and the second segment, the first pressure relief valve having a first pressure limit. The vapourised natural gas in the first segment is vented to the second segment when the pressure thereof is at least at the first pressure limit, fluid communication between the first segment and the segment via the first pressure relief valve is impeded when pressure of the vapourised natural gas in the first segment is below the first pressure limit.

In accordance with a second aspect of the invention, there is disclosed a manifold assembly comprising a first segment for receiving vapourised natural gas from at least one storage system, a second segment coupled to the first segment at an interface point for fluid communication therewith, the second segment for conveying the vapourised natural gas from the first segment to a downstream system, and a first pressure relief valve configured parallel the interface point for intercoupling the first segment and the second segment, the first pressure relief valve having a first pressure limit. The manifold assembly further comprises a first pressure step down regulator configured at the interface point for interposing the first segment and the second segment, the first pressure step down regulator for lowering the pressure of the vapourised natural gas communicated to the second segment from the first segment, and a second pressure step down regulator configured to interpose the first pressure relief valve and the second segment, the second pressure step down regulator for lowering the pressure of the vapourised natural gas vented to the second segment from the first pressure relief valve. The vapourised natural gas in the first segment is vented to the second segment when the pressure thereof is at least at the first pressure limit, fluid communication between

the first segment and the segment via the first pressure relief valve is impeded when pressure of the vapourised natural gas in the first segment is below the first pressure limit.

5 In accordance with a third aspect of the invention, there is disclosed a manifold assembly comprising a first segment for receiving vapourised natural gas from at least one storage system, each of the at least one storage system comprising at least one at least one storage system comprising a plurality of insulative vessels, each of the plurality of insulative vessels having less than 1000 litres in storage capacity, a second segment coupled to the first segment at an interface point for fluid communication therewith, the second segment for
10 conveying the vapourised natural gas from the first segment to a downstream system, and a first pressure relief valve configured parallel the interface point for intercoupling the first segment and the second segment, the first pressure relief valve having a first pressure limit. The vapourised natural gas in the first segment is vented to the second segment when the pressure thereof is at least at the first pressure limit, fluid communication between the first
15 segment and the segment via the first pressure relief valve is impeded when pressure of the vapourised natural gas in the first segment is below the first pressure limit.

Brief Description of the Drawings

FIG. 1 shows an exemplary partial system diagram of a manifold assembly in accordance
20 with an aspect of the invention.

Detailed Description

An exemplary embodiment of the present invention, a manifold assembly 20, is described hereinafter with reference to FIG. 1. The manifold assembly 20 comprises a first segment 22 for receiving vapourised natural gas from at least one storage system 24, and a second segment 25 coupled to the first segment 22 at an interface point 26 for fluid communication therewith. The second segment 25 is for conveying the vapourised natural gas from the first segment 22 to a downstream system 28. The manifold assembly 20 further comprises a first pressure relief valve 30 configured parallel the interface point 26 for intercoupling the first segment 22 and the second segment 25. The first pressure relief valve 30 has a pre-set or pre-defined first pressure limit. For the avoidance of doubt, the interface point 26 and the first pressure relief valve 30 are on separate flow pathways in a parallel gas flow circuit arrangement between the at least one storage system 24 and the downstream system 28.

When in use, the vapourised natural gas in the first segment 22 is vented into the second segment 25 when the pressure of the vapourised natural gas in the first segment 22 is at least at the first pressure limit. Fluid communication between the first segment 22 and the segment 25 via the first pressure relief valve 30 is impeded when pressure of the vapourised natural gas in the first segment 22 is below the first pressure limit. This enables the vapourised natural gas in and upstream of the first segment 22 to be vented into the second segment 25 during pressure build-up in the first segment 22 which would have otherwise been vented into the atmosphere for safety reasons, thereby conserving the vapourised natural gas within the manifold assembly 20.

Preferably, the manifold assembly 20 further comprises a first pressure step down regulator 32 configured at the interface point 26 for interposing the first segment 22 and the second segment 25. The first pressure step down regulator 32 for lowering the pressure of the vapourised natural gas communicated to the second segment 25 from the first segment 22. Additionally, the manifold assembly 32 further comprises a second pressure step down regulator 34 configured to interpose the first pressure relief valve 30 and the second segment

25. The second pressure step down regulator 34 is for lowering the pressure of the vapourised natural gas vented to the second segment 25 from the first pressure relief valve 30.

The manifold assembly 20 further comprises a second pressure relief valve 36 configured
 5 along the first segment 22 for interposing the interface point 26 and the at least one storage system 24. The second pressure relief valve 36 has a pre-set or pre-defined second pressure limit. The second pressure limit is higher than the first pressure limit. When in use, the vapourised natural gas in the first segment 36 is vented to the atmosphere by the second pressure relief valve 36 when the pressure thereof is at least at the second pressure limit.

10 Venting of the vapourised natural gas from the first segment 22 to the atmosphere by the second pressure relief valve 36 is impeded when pressure of the vapourised natural gas in the first segment 22 is below the second pressure limit. The second pressure relief valve 36 functions as a second line of defense to build-up of pressure in the manifold assembly 20 beyond safety limits and beyond what the second segment 25 can accommodate from
 15 vapourised natural gas being vented therein by the first pressure relief valve 30. Hence, should the pressure of the vapourised natural gas in the first segment 22 still continue to climb past the first pressure limit subsequent to venting thereof into the second segment 25 by the first pressure relief valve 30, conservation of the vapourised natural gas is no longer a concern with the second pressure relief valve 36 venting the vapourised natural gas into the
 20 atmosphere until the pressure in the first segment reduces to below the second pressure limit.

Preferably, each of the first segment 22 and the second segment 25 are formed from at least one pipe structure with the downstream system 28 comprising at least one of a downstream manifold, a natural gas operated system and a natural gas processing system, and a natural
 25 gas consuming system. The downstream system 28 can be adapted for various uses including by not limiting to heating, gas for cooking, power production, cooling and other industrial processes.

Preferably, each of the at least one storage system 24 comprises a plurality of insulative vessels 40. It is preferred that each of the plurality of insulative vessels 40 has an internal vapouriser and a gas outlet 44 which precludes the need for and use of an external vapouriser. The at least one storage system 24 further comprises a gas withdrawal valve 46 and a pipe assembly 48 for removably intercoupling and fluid communicating the plurality of insulative vessels 40 with the gas withdrawal valve 46. For the avoidance of doubt, the second pressure relief valve 36 may, alternatively or additionally, also be configured along the pipe assembly 48. Each of the plurality of insulative vessels 40 is for storing liquefied natural gases and the internal vapouriser is for vapourizing the liquefied natural gas into vapourised natural gas at the gas outlet 44 thereof for provision to the pipe assembly 48. The pipe assembly 48 is for providing the vapourised natural gas for dispensing from the gas withdrawal valve 46 to the first segment 22 of the manifold assembly 20. It is preferred that each of the plurality of insulative vessels 40 has less than 1000 litres in storage capacity. As liquefied natural gas is flammable and explosive when vapourised, storing the liquefied natural gas in smaller vessel, for example vessels with a storage capacity of 1000 litres or lower, and across multiple vessels reduces the effects of such risks and allows pre-emptive safety-measures to be employed and designed into the system for use.

Aspects of particular embodiments of the present disclosure address at least one aspect, problem, limitation, and/or disadvantage associated with existing manifold assemblies. While features, aspects, and/or advantages associated with certain embodiments have been described in the disclosure, other embodiments may also exhibit such features, aspects, and/or advantages, and not all embodiments need necessarily exhibit such features, aspects, and/or advantages to fall within the scope of the disclosure. It will be appreciated by a person of ordinary skill in the art that several of the above-disclosed structures, components, or alternatives thereof, can be desirably combined into alternative structures, components, and/or applications. In addition, various modifications, alterations, and/or improvements may be made to various embodiments that are disclosed by a person of ordinary skill in the art within the scope of the present disclosure, which is limited only by the following claims.

Claims

1. A manifold assembly comprising:

a first segment for receiving natural gas from at least one storage system;

a second segment coupled to the first segment at an interface point for fluid communication therewith, the second segment for conveying the natural gas from the first segment to a downstream system;

a first pressure relief valve configured parallel the interface point for intercoupling the first segment and the second segment, the first pressure relief valve having a first pressure limit; and

a second pressure relief valve configured along the first segment for interposing the interface point and the at least one storage system, the second pressure relief valve having a second pressure limit, the second pressure limit being higher than the first pressure limit,

wherein the natural gas in the first segment is vented to the second segment when the pressure thereof is at least at the first pressure limit, fluid communication between the first segment and the second segment via the first pressure relief valve is impeded when pressure of the natural gas in the first segment is below the first pressure limit, and

wherein the natural gas in the first segment is vented to the atmosphere by the second pressure relief valve when the pressure thereof is at least at the second pressure limit, venting of the natural gas from the first segment to the atmosphere by the second pressure relief valve is impeded when pressure of the natural gas in the first segment is below the second pressure limit.

2. The manifold assembly as in claim 1, further comprising:

a first pressure step down regulator configured at the interface point for interposing the first segment and the second segment, the first pressure step down regulator for lowering the pressure of the natural gas communicated to the second segment from the first segment.

3. The manifold assembly as in claim 2, further comprising:

5 a second pressure step down regulator configured to interpose the first pressure relief valve and the second segment, the second pressure step down regulator for lowering the pressure of the natural gas vented to the second segment from the first pressure relief valve.

4. The manifold assembly as in claim 1, each of the first segment and the second segment being formed from at least one pipe structure.

- 10 5. The manifold assembly as in claim 1, further comprising the downstream system, the downstream system comprising at least one of a downstream manifold, a natural gas operated system and a natural gas processing system, and a natural gas consuming system.

- 15 6. The manifold assembly as in claim 1, further comprising the at least one storage system, each of the at least one storage system comprising a plurality of insulative vessels.

- 20 7. The manifold assembly as in claim 6, each of the plurality of insulative vessels having an internal vapouriser and a gas outlet, the at least one storage system further comprising:

a gas withdrawal valve; and

25 a pipe assembly for removably intercoupling and fluid communicating the plurality of insulative vessels and the gas withdrawal valve,

wherein each of the plurality of insulative vessels is for storing liquefied natural gases and the internal vapouriser is for vapourizing the liquefied natural gas into natural gas at the gas outlet thereof for provision to the pipe assembly, the pipe assembly for providing the natural gas for dispensing from the gas withdrawal valve
30 to the first segment of the manifold assembly.

8. The manifold assembly as in claim 6, each of the plurality of insulative vessels having less than 1000 litres in storage capacity.

- 5 9. A manifold assembly comprising:

a first segment for receiving natural gas from at least one storage system;

a second segment coupled to the first segment at an interface point for fluid communication therewith, the second segment for conveying the natural gas from the first segment to a downstream system;

- 10 a first pressure relief valve configured parallel the interface point for intercoupling the first segment and the second segment, the first pressure relief valve having a first pressure limit;

- 15 a first pressure step down regulator configured at the interface point for interposing the first segment and the second segment, the first pressure step down regulator for lowering the pressure of the natural gas communicated to the second segment from the first segment;

- 20 a second pressure step down regulator configured to interpose the first pressure relief valve and the second segment, the second pressure step down regulator for lowering the pressure of the natural gas vented to the second segment from the first pressure relief valve; and

- a second pressure relief valve configured along the first segment for interposing the interface point and the at least one storage system, the second pressure relief valve having a second pressure limit, the second pressure limit being higher than the first pressure limit,

- 25 wherein the natural gas in the first segment is vented to the second segment when the pressure thereof is at least at the first pressure limit, fluid communication between the first segment and the second segment via the first pressure relief valve is impeded when pressure of the natural gas in the first segment is below the first pressure limit, and

wherein the natural gas in the first segment is vented to the atmosphere by the second pressure relief valve when the pressure thereof is at least at the second pressure limit, venting of the natural gas from the first segment to the atmosphere by the second pressure relief valve is impeded when pressure of the natural gas in the first segment is below the second pressure limit.

10. The manifold assembly as in claim 9, each of the first segment and the second segment being formed from at least one pipe structure.

11. A manifold assembly comprising:

a first segment for receiving natural gas from a plurality of insulative vessels, each of the plurality of insulative vessels having less than 1000 litres in storage capacity;

a second segment coupled to the first segment at an interface point for fluid communication therewith, the second segment for conveying the natural gas from the first segment to a downstream system;

a first pressure relief valve configured parallel the interface point for intercoupling the first segment and the second segment, the first pressure relief valve having a first pressure limit; and

a second pressure relief valve configured along the first segment for interposing the interface point and the plurality of insulative vessels, the second pressure relief valve having a second pressure limit, the second pressure limit being higher than the first pressure limit,

wherein the natural gas in the first segment is vented to the second segment when the pressure thereof is at least at the first pressure limit, fluid communication between the first segment and the second segment via the first pressure relief valve is impeded when pressure of the natural gas in the first segment is below the first pressure limit, and

wherein the natural gas in the first segment is vented to the atmosphere by the second pressure relief valve when the pressure thereof is at least at the second

pressure limit, venting of the natural gas from the first segment to the atmosphere by the second pressure relief valve is impeded when pressure of the natural gas in the first segment is below the second pressure limit.

- 5 12. The manifold assembly as in claim 11, each of the first segment and the second segment being formed from at least one pipe structure.

10

15