July 16, 1963 D. A. WILLIAMS 3,097,498

APPARATUS FOR HANDLING LIQUEFIED CASES

Filed June 29, 1959 2 Sheets-Sheet 1

Fig. 1

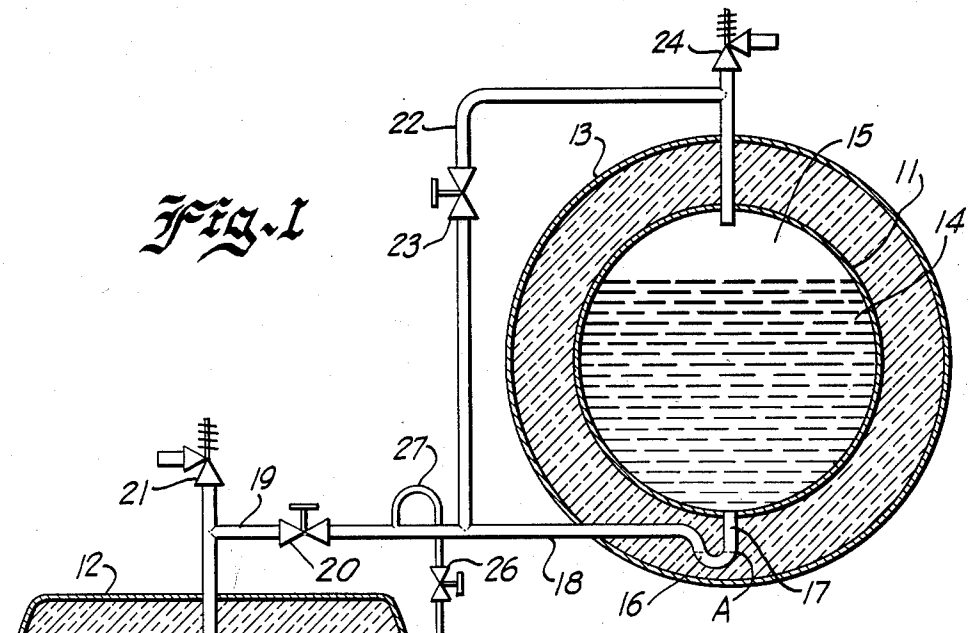
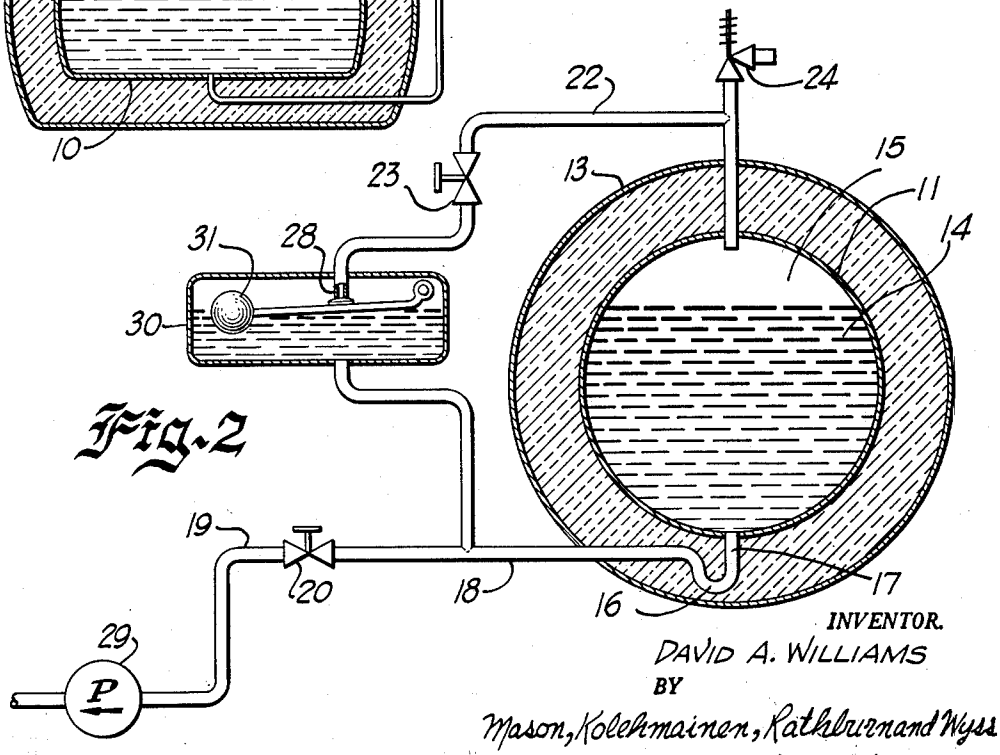


Fig. 2



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Fig. 3

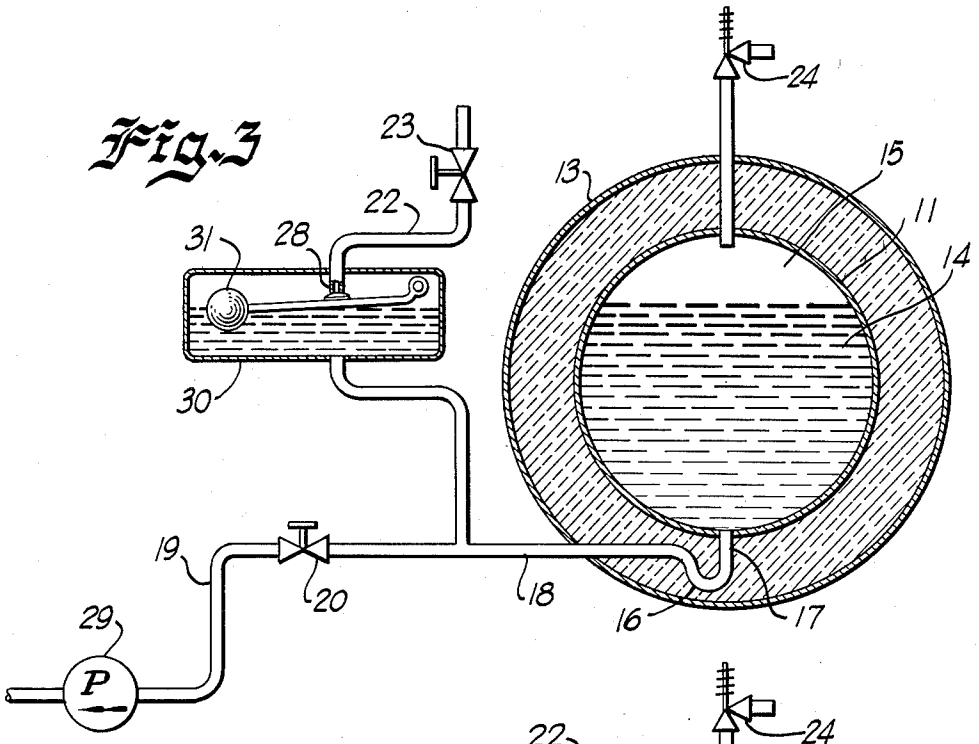
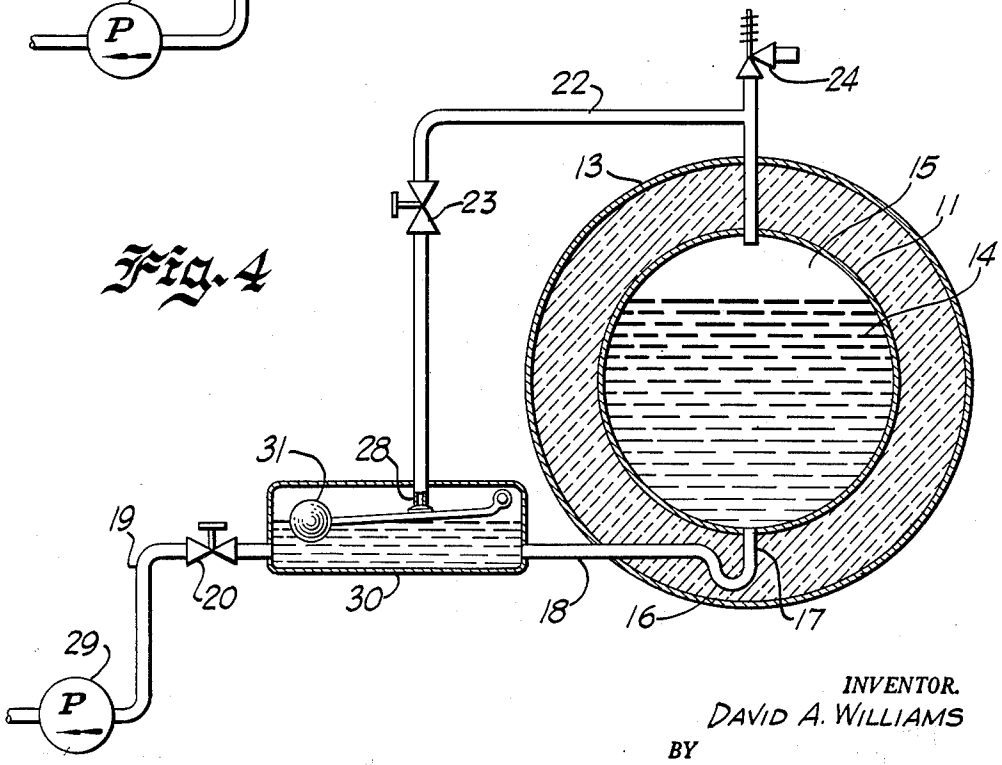


Fig. 4



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APPARATUS FOR HANDLING LIQUEFIED GASES

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6 Claims. (Cl. 62—55)

This invention relates to fluid handling systems for volatile liquid having a boiling temperature at atmospheric pressure materially below 273° K., and more particularly to a system for supplying a liquefied gas having a normal boiling point below 233° K., such as liquid oxygen, nitrogen and the like to a receiver from a main supply tank. Such a system is particularly useful in the apparatus described in copending United States Patent application Serial No. 823,400 of the present applicant and Lester C. Browning, entitled "Apparatus for Handling Liquefied Gases," filed of even date herewith and assigned to the same assignee as the present invention.

One of the unique properties of liquefied gas having a boiling point below 233° K. is that the critical temperatures of the majority of such liquefied gas is well below normal ambient temperatures. Thus, whenever liquefied gas is permitted to come in contact with pipes, containers, or machinery which is near to ambient temperatures, some of the liquid will be changed into a gas by its absorption of heat. When this liquid changes to gas a large increase in volume takes place, or if the volume is limited a large pressure increase will take place. Difficulty has heretofore been experienced in supplying a receiver with liquefied gas when the receiver is remote from the supply tank in that vaporization of the liquid may occur in the system. In the past it has been necessary to provide two lines from the supply tank to the receiver, one to carry off the vapor.

It is, therefore, an object of the invention to provide an improved handling system for liquefied gas having a boiling point below 233° K.

A more specific object of the invention is to provide a handling system for supplying liquefied gas to a receiver remote from the supply tank which system requires only one line from the supply tank to the receiver.

Further objects and advantages of the invention will become apparent as the following description proceeds and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

Briefly stated, in accordance with the invention, the fluid handling system includes a receiver such as a vessel or pump remote from a supply tank and connected to be filled from the supply tank with liquid gas having a boiling point below 233° K. A fluid trap below the liquid level of the supply tank has its inlet in communication with the tank below the liquid level thereof and has its outlet discharging through a supply line into the receiving vessel. The fluid level of the receiving vessel is below the discharge of the fluid trap. A vent conduit connects with the highest point of the supply line to remove gas formed in the system.

The nature of the invention will best be understood when described in connection with the accompanying drawings, in which:

FIG. 1 is a schematic elevational view, partly in section, of a liquefied gas handling system according to one embodiment of the instant invention;

FIG. 2 is a schematic elevational view, partly in section, of a liquefied gas handling system incorporating a second embodiment of the instant invention;

FIG. 3 is a schematic elevational view, partly in section, of a liquefied gas handling system incorporating another embodiment of the instant invention; and

FIG. 4 is a schematic elevational view, partly in section, of a liquefied gas handling system incorporating yet another embodiment of the instant invention.

Referring to the modification of FIG. 1, a receiver, shown as a receiving vessel **10**, is connected to be kept full of liquefied gas when located remote from a main supply tank **11**. Vessel **10** and tank **11** are each contained within a vacuum or insulation space defined by outer shells **12**, **13** respectively. The supply tank **11** is at least partially full of liquefied gas **14**; above the liquid is a gas **15** which may contain the vapor from the liquefied gas.

A fluid trap **16** has its inlet **17** communicating with the liquefied gas **14** in the supply tank and has its outlet or discharge **18** connected through a main supply line or conduit **19** to discharge into the top of the receiving vessel **10**. A shut-off valve **20** is in the main line **19** between the discharge **18** of the trap **16** and the receiving vessel **10**. It may be desirable to have a safety pressure relief valve **21** in communication with the receiving vessel **10**. A vent line or conduit **22** connects with the highest point on the supply line **19** between the discharge side **18** of the fluid trap **16** to vent the vapor or gas which may be evolved in the system. As shown, the vent line **22** returns the gas to the supply tank **11** above the liquid gas level **14**. It is to be understood, however, that where it is not desired to save the gas formed in the system, the vent line **22** may be returned to the atmosphere. Vent line **22** contains a shut-off valve **23** and may also contain a safety pressure relief valve **24** in communication with the supply tank **11**.

As is common cryogenic practice, the fluid trap **16** is contained within the insulation space defined by outer shell **13** around the supply tank **11**. When valves **20** and **23**, external to the tank, are closed, the liquefied gas within the supply line **19**, exterior to the insulation jacket enclosed by outer shell **13**, will, because of absorbed heat, be partially vaporized into the gaseous state. This gas evolved will then fill the portion of conduit **19** between the tank **11** and the two valves **20** and **23** and will thereby force the liquefied gas level in the fluid trap **16** to recede to point A which is protected against heat loss by the insulation within insulation space **13**. The heat absorption loss by the liquefied gas in the suply tank **11** will then be greatly reduced. When it is desired to maintain the receiving vessel **10** full of liquid, valve **20** is opened. This will permit liquefied gas to flow into the receiving vessel until sufficient gas has been evolved to raise the pressure of this external system to equal that at point A. If valve **23** is then opened, the gas which has been evolved in this system will be allowed to return by way of vent line **22** to the gas space **15** above the liquefied gas **14** level within the supply tank **11**.

Liquid will now flow to the receiving vessel **10** and the vessel will be maintained full because the gas evolved in the receiving vessel **10** and supply line **19** will be permitted to return to the gas space **15** of the supply tank **11** as rapidly as it is formed. In this manner a receiving vessel remote from the supply tank can be maintained full of liquefied gas with only one line connecting the vessel and the tank.

It may be desirable, but not necessary, to provide a fluid drain line for the receiving vessel. This line will come into use when it is desired for economical reasons to return the liquefied gas within the receiving vessel to the supply tank at the end of an operating cycle. Such an arrangement is illustrated by the drain line **25** having one end connecting with the bottom of the receiving vessel **10** and having its other end connecting with the discharge side **18** of the fluid trap **16** on the side of valves **20** and **23** nearest to the discharge **18**. The line **25** contains a shut-off valve **26**. When it is desired to drain the receiving vessel **10**, it is merely necessary to close valves **20**

and 23 and to open valve 26. The boiling of the liquefied gas in the receiving vessel 10 due to heat absorption will create a pressure build-up in the vessel 10. The gas evolved will rise to the top of the vessel and the pressure in the upper part of the vessel will be increased until the liquid remaining in the vessel is pushed back into the supply tank through drain line 25 and valve 26. This will result in a minimum loss of the liquefied gas. Valve 26 and conduit 25 may be quite small and may be routed to the main supply tank 11 close to the main supply line 19 so that lines 25 and 19 can be thoroughly insulated to reduce heat infiltration into the liquefied gas. It may be desirable, but not necessary, to provide the line 25 with a small portion 27 elevated above the main supply line 19 just after the point where the line 25 leaves the main supply line 19 in order to prevent line 25 from standing full of liquefied gas when valve 26 is closed.

Referring now to the modification of FIG. 2, the fluid handling system illustrated therein is similar to that of FIG. 1, except that a float valve 28 is inserted in the vent line 22, and the receiver is illustrated as a pump 29. The vent line 22 connects to the supply line 19 at the high point of the supply line 19. The float valve 28 results in automatic operation of the vent line 22. In order to supply liquefied gas to the pump 29, valve 20 in supply line 19 and valve 23 in vent line 22 are opened. The gas evolved in this system will pass through supply line 19 into float chamber 30 of valve 28 forcing the liquid level in the chamber to drop, thereby lowering the float 31 and opening the vent line 22. The gas evolved will now be vented back to the upper part of the supply tank 11. The level of liquid within the float chamber will rise to a point at which the float 31 will shut off the opening to the line 22 leading out to the top of the float chamber 30. In the event of further evolvement of gas in the system, this gas will enter the float chamber at the bottom and the liquid level in the float chamber will then drop. This will in turn allow the float 31 to drop which will open the chamber 30 to the gas venting line 22.

Such a modification results in automatic operation of the vent line. The system has the advantage that the amount of piping containing cryogenic liquid can be limited to the extent that the gas vent line 22 above the float chamber 30 does not stand full of liquid. The weight of the float must be such that the static head of liquid which would be developed between the point at which the vent line 22 is obstructed by a rising float and the uppermost level of liquid in the supply tank 11 would be insufficient to keep the float in the closed position. The float must also be light enough so that the rising liquid can make this float rise with the surface of the liquid due to the displacement of the liquid involved.

The embodiment illustrated in FIG. 3 is identical to that of FIG. 2 except that the vent line 22 vents to the atmosphere.

FIG. 4 illustartes a modification similar to FIG. 2 except that the float chamber 30 is part of the supply line 19 rather than in the vent line 22. The method of operation is essentially the same as that of FIG. 2. When the gas is vented from the float chamber 30, the liquid level within the float chamber will rise and close the float valve 28. When sufficient gas is evolved in this system to lower the level of the liquid in the float chamber 30, the float 31 will drop, thus opening the valve 28 and venting the gas.

While there has been described and illustrated preferred embodiments of the instant invention, it will be expected that various changes and modifications can be made therein without departing from the scope of the invention, which should be limited only by the claims annexed to and forming a part of this specification.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. Apparatus for handling liquefied gas having a boiling temperature below 233° K., comprising a supply tank within an insulation jacket adapted to be at least partially filled with fluid in the liquid state, a fluid trap below the liquid level of said tank having inlet means in communication with said tank below the liquid level thereof and having discharge means, a receiving vessel remote from and independent of said tank adapted to be supplied with said fluid, the fluid of said receiving vessel being below the discharge means of said fluid trap, first conduit means directly connecting said discharge means to said receiving vessel, and second conduit means connected to said first conduit means at the high point thereof and external of said jacket and connected to said tank above the liquid level thereof venting said first conduit means.

2. Apparatus for handling liquefied gas having a boiling temperature below 233° K., comprising a supply tank within an insulation jacket adapted to be at least partially filled with fluid in the liquid state, a fluid trap below the liquid level of said tank having inlet means in communication with said tank below the liquid level thereof and having discharge means, a receiving vessel remote from and independent of said tank adapted to be supplied with said fluid, the fluid of said receiving vessel being below the discharge means of said fluid trap, first conduit means directly connecting said discharge means to said receiving vessel, second conduit means connected to said first conduit means at the high point thereof and external of said jacket connected to said tank above the liquid level thereof for venting said first conduit means, a float operated valve within a float chamber which is opened by the evolution of gas in the system to vent said gas through said second conduit means, said float chamber being in said first conduit means and said second conduit means venting from the top of said chamber, and shut-off valve means in each of said conduit means.

3. Apparatus for handling liquefied gas having a boiling temperature below 233° K., comprising a supply tank within an insulation jacket adapted to be at least partially filled with fluid in the liquid state, a fluid trap below the liquid level of said tank having inlet means in communication with said tank below the liquid level thereof and having discharge means, a receiving vessel remote from and independent of said tank adapted to be filled with said fluid, the fluid of said vessel being below the discharge means of said fluid trap, first conduit means connecting said discharge means to said vessel, second conduit means connected to said first conduit means externally of said insulation jacket connecting said first conduit means and said tank above the liquid level thereof, a fluid drain line connected between the bottom of said vessel and said discharge means, and shut-off valve means in said fluid drain line.

4. Apparatus for handling liquefied gas comprising a supply tank within an insulation jacket and adapted to be at least partially filled with fluid in the liquid state, a fluid trap within said jacket and located below said tank having inlet means in communication with said tank and having discharge means, a pump located below and remote from said tank for receiving said fluid, first conduit means connecting the discharge of said trap with said pump, shut-off valve means in said first conduit means, second conduit means connecting the high point on said first conduit means with the top of said tank, a float chamber in said second conduit, a float valve in said chamber actuated by the level of liquid therein to open or close said second conduit means, and shut-off valve means in said second conduit means.

5. Apparatus for handling liquefied gas comprising a supply tank within an insulation jacket and adapted to be at least partially filled with fluid in the liquid state, a fluid trap within said jacket and located below said tank having inlet means in communication with said tank and having discharge means, a pump located below and remote from said tank for receiving said fluid, first conduit

means connecting the discharge of said trap with said pump, shut-off valve means in said first conduit means, a float chamber in the high point of said first conduit means, a second conduit means connecting said high point with the top of said tank, a float valve in said chamber actuated by the level of liquid therein to open or close said second conduit means, and shut-off valve means in said second conduit means.

6. In apparatus for handling liquefied gases having boiling points below 233° K., a supply tank within an insulation jacket adapted to be at least partially filled with liquefied gas in the liquid state, a fluid trap below the liquid level of said tank having inlet means in communication with said tank below the liquid level thereof and having discharge means, a receiving vessel remote from and independent of said tank adapted to be supplied with said liquefied gas, the liquefied gas of said receiving vessel being wholly below said discharge means, and gravity transferring means for transferring liquefied gas from said supply tank to said receiving vessel solely by gravity flow with only a single conduit connecting

said supply tank to said receiving vessel, said transferring means including a first conduit connecting said supply tank discharge means to said receiving means, a second conduit connecting the high point of said first conduit to the tank above its liquid level, and shut-off valves in said first and said second conduits external of said insulation jacket, whereby on opening of said valves liquefied gas will transfer from said supply tank through said first conduit to said receiving vessel while gas evolved during the transfer will return to said supply tank through said second conduit.

References Cited in the file of this patent

UNITED STATES PATENTS

2,021,271	Thomas	Nov. 19, 1935
2,435,332	Van Vleet et al.	Feb. 3, 1948
2,487,863	Garretson	Nov. 15, 1949
2,576,985	Wildhack	Dec. 4, 1951
2,705,873	Bonnaud	Apr. 12, 1955
2,848,879	Hesson	Aug. 26, 1958