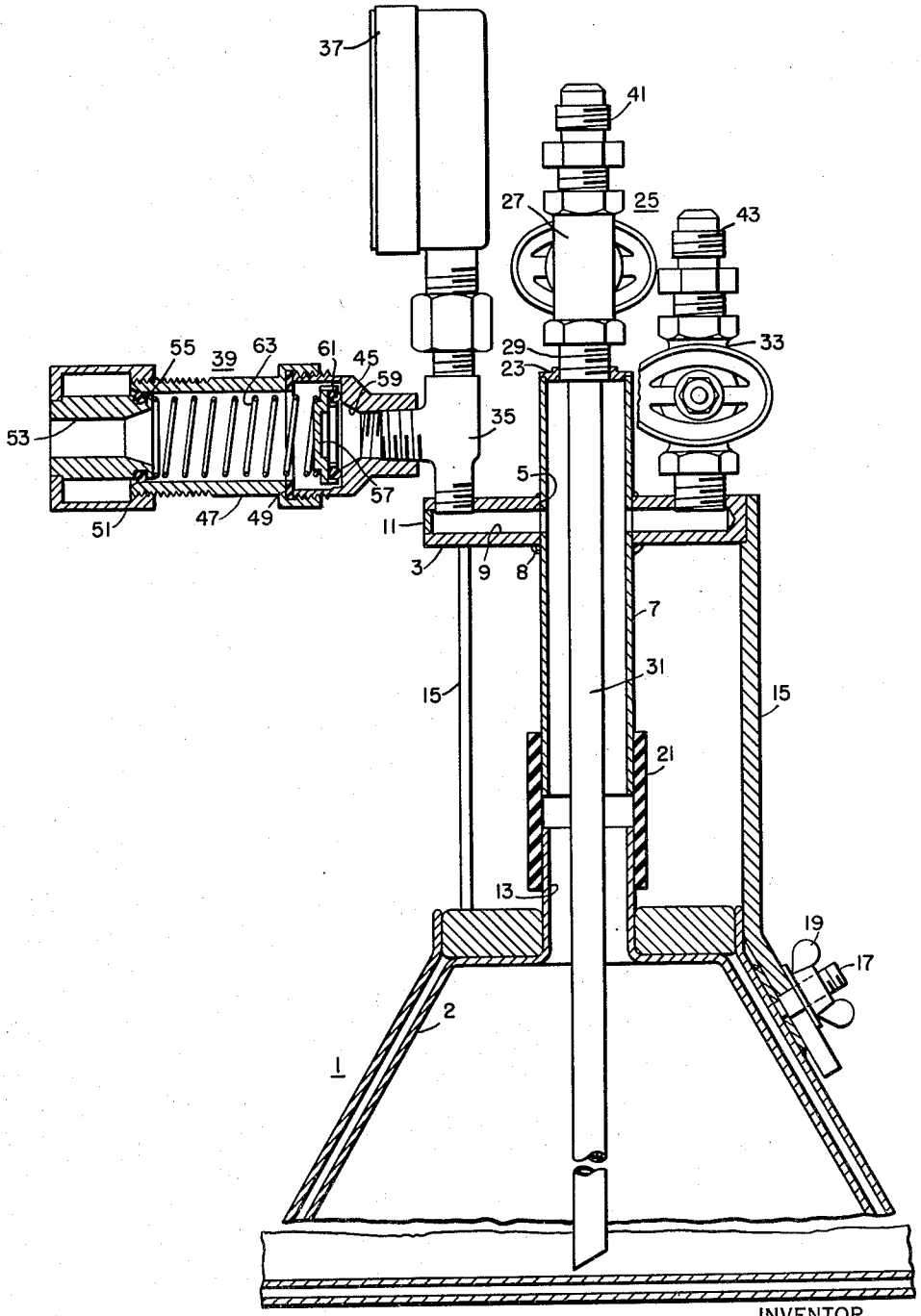
Aug. 21, 1951 A. WEXLER 2,565,156

VALVE APPARATUS

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WITNESSES:

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VALVE APPARATUS

2,565,156

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This invention relates, generally, to valve apparatus and more in particular to such an apparatus which is applicable in the transfer of low boiling point liquids to and from the container therefor.

Apparatus of the type generally referred to in the past included a short length of tubing through the end of which was fitted a U tube in gas tight relation therewith. The short length of tubing was connected to the container of the liquefied gas by means of a tubular section of material of low thermal conductivity. When so connected, the bottom end of the U tube projected to within a very small distance of the bottom of the container of the liquefied gas. The short length of tubing was provided with a port to which could be connected a supply of gas under pressure. Usually this gas is the same as the liquefied gas to avoid contamination of the material. In order to load the container with liquefied gas, the transfer device was disconnected therefrom and the container loaded according to conventional practice. Thereafter the transfer device was attached to the container in the manner hereinabove described. In order to remove liquefied gas from the container, the mentioned source of pressurized gas was connected to the port in the short length of tubing. The pressurized gas produced a pressure inside the container above atmospheric pressure and consequently forced liquid into the U tube and out of the container.

A system of this type is objectionable for a number of reasons. In this operation it is necessary to have a source of pressurizing gas available. It is highly desirable that the same gas be used. However, this leads to condensation at each transfer and subsequent "flash-off" during depressurization. The loss due to this flash-off can amount to about 4% of the contents at each transfer. If the pressurizing gas is not pure, contamination of the liquid results. For many research applications, such contamination is intolerable. Additionally, there is no provision for the relief of excess pressure since a permanent opening into the container may frequently result in contamination of the contents. As a consequence, the transfer device is often blown from the container. Further, it is not easy to control the rate of liquid transfer. The only way in which liquid transfer can be controlled is by controlling the rate of entry of the pressurized gas. Due to the compressibility of this gas, the operator must anticipate the amount of liquid transfer which will occur after the gas pressure

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is shut off. This may result in obtaining less or more than the desired amount of liquefied gas from the container. Moreover, such a system does not lend itself to a process for gasifying the liquid.

Accordingly, it is one object of this invention to provide a simple and positive operating transfer device for low boiling point liquids which provides for the convenient transfer of liquefied gas to and from the container.

It is another object of this invention to provide a transfer device for low boiling point liquids which minimizes contamination of the liquefied gas.

A further object of this invention is to provide a transfer device which is conveniently attachable to all standard liquefied gas containers and which may be left permanently attached thereto and utilized in the transfer of liquefied gas to and from the container.

The foregoing statements are merely illustrative of the various aims and objects of this invention. Other objects and advantages will become apparent upon a study of the following disclosure when considered in conjunction with the accompanying drawing, in which the single figure thereof illustrates a longitudinal, sectional view of a transfer apparatus for low boiling point liquids embodying the principles of this invention.

In the drawing, the container for the liquefied gas is generally designated 1. No attempt has been made in this illustration to show in detail the thermal container 2 for the liquefied gas which is supported within the metal housing 1. However, it is to be appreciated that such a thermal container is employed in liquefied gas storage containers. The transfer apparatus includes a plate 3 having an opening 5 transversely therethrough. A tube 7 of a material of low thermal conductivity is fitted through the opening 5 and is sealed thereto as indicated at 8 by any suitable means to form a gas tight connection with the plate. A hole 9 is drilled laterally of the plate 3 from left to right thereof as illustrated. This hole extends through the walls of the tube 7 providing communication between the left and right-hand portions of the hole 9 and the tube 7. The open end of the hole 9 is sealed by a plug 11 which is fitted into and sealed in the open extremity of the hole.

This assembly is supported above the opening 13 in the container 2 by a plurality of supports 15. Two of these supports are illustrated. However, in practice, three supports in circumferentially

spaced relation about the container are employed. The bottom ends of each of the supports are bifurcated to slide over studs 17 which are fastened in correspondingly spaced relation about the container 1 and the supports are locked in position by the wing nuts 19, only one of which is illustrated. The plate 3 is secured between the upper extremities of the supports 15 to form a rigid mounting therefor. In this assembled position, the end of the tube 7 projects to a point within a short distance of the extremity of the opening into the container 2 and is coaxially disposed with respect thereto. A gas tight seal is formed between the opening 13 and the tube 7 by means of a tubular section 21 of pressure rubber tubing which is disposed about the tube 7 and about the opening in the conductor 13. The upper end of tube 7 projects above the plate 3 as viewed, and is provided with an internally threaded adapter 23 which is fitted into the end of the tube and sealed thereto.

This adapter supports a tube and valve assembly generally designated 25. The valve 27 of this assembly is a conventional hand-operated valve. The lower extremity thereof being provided with a fitting 29 which threads into the end of the valve and also threads into the adapter 23 in the upper end of tube 7. A tube 31 of a material of low thermal conductivity is provided with a suitable connection at the upper extremity thereof, not shown, which secures the tube 31 to the valve 27. Thus, this tube is opened and closed by means of the valve 27. Tube 31 projects to a point spaced a short distance from the bottom of the container of the liquefied gas.

An upper surface of plate 3 is provided with a tapped opening into the hole 9 for receiving a second valve of the type of valve 27. This valve is designated 33 and when threaded into the opening in the upper surface of plate 3, communicates with the hole 9 and consequently with the tube 7. On the left of tube 7 the upper surface of the plate 3 is provided with another tapped hole communicating with the hole 9. A T-shaped fitting 35 is threaded into this hole. One branch of the T has connected thereto a gauge 37 of a type suitable for indicating a range of pressures below and above atmospheric pressure. The remaining branch of the T 35 has fitted thereto a relief valve 39 which is shown in cross-section.

As noted in the statement of objects of this invention, it is intended that the transfer apparatus herein described be permanently attached to the container for the liquefied gas. Thus, this equipment is utilized for both filling and emptying the container. To this end, both of the valves 27 and 33 are provided with flare type fittings 41 and 43, respectively. The container is conveniently filled by making a suitable connection of the liquefied gas to the fitting 41. Thereafter both of the valves 27 and 33 are opened. Valve 27 permits the liquefied gas to enter the container therefor through the tube 31, while valve 33, when open, acts as a vent for venting the gas which is displaced by the entering liquefied gas and which results from evaporation. When the container is filled, both valves 27 and 33 are closed and the connection made to the fitting 41 for admitting the liquefied gas is then broken. The normal heat leak of the container for the liquefied gas causes pressure to build up in the container and the maximum attainable pressuring is controlled by the pressure setting of the relief valve 39. In practice, relief valve 39 is set to limit the maximum pressure to approximately 10 lbs. per square inch.

To remove the liquefied gas from the container the usual practice is to connect an inverted U tube to flare fitting 41. Thereafter, valve 27 is opened and due to the pressure built up in the container, as above noted, liquefied gas is forced upwardly through the U tube 41 and out of the container.

Both theoretical and experimental checks show that during transfer, the pressure above the liquid remains virtually constant for a given rate of removal or transfer of the liquefied gas. This point may not be obvious but is due to the fact that the pressure above the liquid is tied to the vapor pressure thereof. In practice, the transferring out of 50% of the contents of a 50 liter container caused a drop in pressure of less than ½ lb. per square inch from the initial liquid pressure of 6 lb. per square inch. In the case of a particular device which was constructed, the transfer rate was very nicely controllable and could be made as high as 3 liters per minute, which is more than adequate for most purposes.

If the liquid is to be gasified an evaporation coil fitted either with a needle or regulator valve is attached to the flare fitting 41. Thus, the gas resulting from the evaporation of the liquid up to a pressure determined by the setting of the relief valve 39 may be bled off. This expedient has many advantages from the application and handling point of view, but probably more importantly, contamination of the gas produced by this method is minimized and in addition the evaporated gas is extremely dry.

The relief valve 39 per se forms no part of this invention. This valve is disclosed and claimed in a copending application of A. Wexler and G. Cunningham, Serial No. 145,533, filed on the same date as this application, entitled, "Valve" and assigned to the same assignee as this invention. This valve is preferred in the system illustrated because it is especially adapted for use on low pressure systems of the type herein considered and because it is designed to have a very small pressure differential between the opening and closing pressures. Hence, in addition to functioning as a relief valve for simply venting excess pressure developed in the liquefied gas container, this valve, in effect, also functions as a regulating valve to maintain the pressure within the container at a substantially constant value.

The valve 39 has a housing which is formed in two sections including the valve chamber section 45 which threads onto the fitting 35 and the extension 47 which threads over the valve chamber housing 45 and is sealed therewith by means of a washer 49. Extension 47 is threaded externally at its opposite end to receive thereon a cap 51 having an opening in the end thereof in which is secured a reentrant tubular section 53 which projects into the section 47 and is sealed therewith by means of a ring of resilient material 55. A valve member 57 straddles the inlet port 59 to the valve 39 and effects a seal thereover by means of a ring of resilient material 61 which seats on a valve seat formed in the bottom of the valve chamber about the inlet port 59. The area of valve member 57 presented to the gas when closed very closely approximates the area presented to the gas when the valve is open. Since the opening and closing pressures are a function of the valve area for the two different conditions, it will be appreciated that maintaining the valve areas substantially the same when closed and

when open minimizes the pressure differential between opening and closing pressures and as a consequence serves to regulate the pressure in the container within close limits. Valve member 57 is seated by means of a spring 63 which is compressed between the extremity of the tubular member 53 projecting within the extension 47 and the valve member. Further details of this relief valve may be had by reference to the above mentioned copending application of A. Wexler and G. Cunningham.

While but one embodiment of this invention has been herein illustrated and described, it will be readily appreciated by those skilled in the art that numerous variations in the details of the components and in the arrangement of the components may be had without departing from the spirit and scope of this invention. Accordingly, it is intended that the foregoing disclosure is to be considered only as illustrative of the principles of this invention and not interpreted in a limiting sense.

I claim as my invention:

1. In a device for transferring liquefied gas to and from the container therefor, the combination of, means forming a gas tight chamber, resilient means having low thermal conductivity connected with said chamber for connecting said chamber to communicate with said container, a tube having an opening externally of said chamber and extending through a wall of said chamber in gas tight relation therewith, said tube extending through said chamber to a point adjacent the bottom of said container, a first normally closed valve connected to said tube externally of said chamber for opening and closing said tube, a relief valve connected to said chamber for venting said chamber of excess pressure, and a second normally closed valve connected to said chamber, said container being filled by opening said first and said second normally closed valves and passing liquefied gas into said container through said first valve and said tube, excess gas being vented through said second valve.

2. In a device for transferring liquefied gas to and from the container therefor, said container having an opening therein, the combination of, a plate having a hole substantially centrally therethrough, a tube fitted through said hole and sealed to said plate in gas tight relation therewith, said plate having a second hole laterally thereof extending through the wall of said tube, means supporting said plate on said container with one extremity of said tube adjacent said opening, a connector of a material of low thermal conductivity for connecting said one extremity of said tube and said opening in gas tight relation, a second tube having a valve connected to one end thereof for opening and closing said one end of said second tube, said second tube being of a material of low thermal conductivity, sealing means securing said second tube within said first mentioned tube in spaced relation therewith, said sealing means forming a gas tight connection, the open end of said second tube extending into said container to a point adjacent the bottom thereof, a second valve connected with said second hole in said plate, said first mentioned valve and said second valve being normally closed, a relief valve connected with said second hole in said plate, said first mentioned valve being opened for removal of liquefied gas from said container, said liquefied gas being expelled through said second tube by gas pressure developed in said container, said container being filled through said first mentioned valve and said second tube, said second valve being opened for venting gas during filling of said container.

3. In a device for transferring liquefied gas to and from the container therefor, the combination of, means forming a gas tight chamber, a connector of a material of low thermal conductivity connecting said chamber to communicate with said container in gas tight relation therewith, a tube of a material of low thermal conductivity extending into and through said chamber into said container to a point adjacent the bottom of said container, said tube and said chamber being joined in gas tight relation, a valve connected to said tube for opening and closing said tube, a second normally closed valve connected with said chamber for venting said chamber and container upon filling of said container through said tube, and a relief valve connected to said chamber for venting excess pressure from said container.

4. In a device for transferring liquefied gas to and from the container therefor, the combination of, means forming a gas tight chamber, a connector of a material of low thermal conductivity connecting said chamber to communicate with said container, a tube of a material of low thermal conductivity, a valve connected to one end of said tube for opening and closing said tube, said tube extending through a wall of said chamber through said chamber into said container and terminating adjacent the bottom of said container, means connecting the end of said valve connected with said tube to said wall of said chamber to form a gas tight joint and to support said valve, a second normally closed valve connected with said chamber, said second valve being opened upon filling said container through said first mentioned valve and tube for venting said container, and a relief valve connected with said chamber for venting excess pressure from said container.

AARON WEXLER.

No references cited.