This invention relates to a method and apparatus for transferring liquefied combustible gases, particularly those having a low pressure at working temperatures, such as for example as propane and butane.

Liquefied gases, such as propane and butane, are employed for a great variety of technical purposes and require frequent transferring, as, for instance, from a transporting to a stock vessel.

A method and apparatus for transferring liquefied gases have already been proposed, wherein the liquefied gas is transferred from a transportation drum to a buoy or the like, using an intermediate container. In this instance the liquefied gas is first passed from the transportation drum to be emptied into the intermediate container by means of a vacuum pump, the pipe line to the buoy or ultimate receptacle being kept closed. When a sufficient quantity of liquefied gas has been accumulated in the intermediate receptacle, communication between the latter and the transportation drum is cut off and that between the intermediate container and the buoy used is forced to the intermediate container into the buoy or the like.

The object of this prior method and of the apparatus for carrying it into effect is to enable the liquefied gas to be transferred without the necessity of vaporizing more than a small part of the transferred liquefied gas, and in fact this process provides for the recondensation of the comparatively small proportion of vapor drawn off by the vacuum pump during the operation.

Moreover the prior method has the advantage that it can be used where only one filling orifice is available in the buoy or like receptacle to be supplied.

It is an object of the present invention to achieve all the advantages presented by this proposal, and at the same time to provide a method of transferring liquefied combustible gases, which is continuous and in which there is no interruption of the flow of liquefied gas to the buoy or like ultimate receptacle, while an intermediate container is being filled.

It is a further object of the invention to avoid the use of a liquid pump for the transfer operation, so as to eliminate risk of interruption of the flow of liquefied gas on the suction side of the pump due to rapid evaporation of the liquefied gas on account of the vacuum produced.

According to the present invention two intermediate and interconnected containers are provided between the supply vessel and the container, such as a buoy, to be filled, and one of said intermediate containers is adapted to pass liquid to the container to be filled while the other intermediate container is being filled from the supply vessel, and vice versa, the two operations being effected by means of the same pump.

A vacuum pump is used to effect the transfer and evolves a certain quantity of vapor on the suction side of the pump. This results in heat being taken up from the surroundings. At the same time heat is liberated on the discharge side of the pump because of the recondensation of vaporized gas, and a further feature of the present invention resides in the provision of heat-exchange or heat-equalizing means between the suction and discharge sides of the pump. Advantageously such means may assume the form of a water tank in which the intermediate containers are immersed.

The invention is illustrated by way of example in the accompanying drawing which shows an apparatus for transferring the contents of a transporting vessel to another container, for example a buoy adapted to be lighted with propane gas. The receiving container may be filled in a continuous manner by the apparatus illustrated, even although it is provided with one filling orifice only.

Referring to the drawing, 1 designates a pump capable of compressing and forwarding gas. 3 represents a transporting vessel fitted with a stop valve 2 and containing liquefied gas to be transferred to the container 4, which is provided with a stop valve 5. 6 and 7 are two additional containers disposed in a water tank 8. The containers 3, 4, 6, and 7 are interconnected by the conduits 9, and the conduits 10 connect the containers 6, 7 with the pump 1. The conduits 9 and 10 are fitted with the valves 11, 12, 13, 14, 15, 16, 17, 18, divided into two groups, viz. 11 to 14 and 15 to 18. The valves of each of these groups may be opened or closed together. Valves 11 and 15 are connected to the inlet of pump 1, and valves 12 and 16 to the outlet thereof.

The apparatus shown in the drawing functions in the following manner:

It will be first assumed that the container 7 is filled with or contains a substantial amount of a liquefied gas to be transferred to the container or buoy 4, as in the particular instance illustrated in the drawing. Valves 11 to 14 are opened and valves 15 to 18 closed. The pump 1 is actuated and the valve 2 of the vessel 3 opened.
A certain amount of residual gas or vapor is present in the container 6 from the previous working phase and this, together with a certain amount of vapor which is evolved by the suction effect on the open contents of container 6, is drawn out of the container 6 by the pump and forced into the container 7. Pressure is thereby gradually built up in the latter until it is in excess of that obtaining in the container or buoy 4.

Simultaneously with this building up of pressure in 7, however, the withdrawal of the gas or vapor from container 6 by the pump has the effect of reducing the pressure in this container, so that the eventually liquefied gas flows from the vessel 3, through valves 2 and 3 into the container 6 as a result of the difference of pressure between container 6 and vessel 3. The operation of pump 1 is preferably discontinued when container 7 is empty or practically empty of liquefied gas, in which event it will be found that container 6 is full or nearly full of fresh liquid from 3.

The valves 11 to 14 are now closed and 15 to 18 opened, and the pump 1 operated. Gas or vapor is now withdrawn from the container 7 in the same way that it was withdrawn from 6 in the previous case, and the gas accumulated in container 6 flows out into 4 while container 7 is being refilled with liquefied gas from the vessel 3 by suction. When all or most of the liquid has been discharged from 6 into the container or buoy 4 and the container 7 correspondingly filled, the situation illustrated in the drawing has again been reached and the apparatus is ready for a fresh working cycle.

The operation outlined above may be repeated as often as is necessary to transfer the requisite amount of gas, e.g. propane, from the transporting vessel 3 to the container or buoy 4. The capacity of containers 6 and 7 is preferably calibrated so that the amount of liquefied gas transferred to the container 4 may be readily determined.

When liquefied gas is drawn off (for example into container 6), vapor, e.g. gaseous propane, is evolved and heat accordingly taken up from the surroundings. On the other hand, the vapor is recondensed in the other container (for example, 7) and liberates the latent heat of evaporation. If the two containers are disposed in a common water tank, the necessary heat exchange from container 7 to container 6, or vice versa, can readily be effected.

I claim:

1. The method of transferring liquefied combustible gases, such as propane, between a supply vessel and a container to be filled with the use of first and second auxiliary containers, which comprises exerting a suction on the first auxiliary container and thereby passing the gas in substantially liquefied condition from said supply vessel to said first auxiliary container while simultaneously exerting a pressure on said second auxiliary container to pass gas in substantially liquefied condition from said second auxiliary container to the container to be filled, and then exerting a pressure on said first auxiliary container and thereby passing said gas still in substantially liquefied condition from the first auxiliary container to the container to be filled, while simultaneously exerting a suction on the second auxiliary container and thereby drawing gas in substantially liquefied condition into said second auxiliary chamber from the supply vessel.

2. The method of transferring liquefied combustible gases between a supply vessel and a container to be filled with the use of two auxiliary containers, which comprises exerting a suction on the first auxiliary container to withdraw gas in gaseous state therefrom to draw gas in substantially liquefied condition from said supply vessel to the first auxiliary container, passing said withdrawn gas from said first auxiliary container to the second auxiliary container, thereby exerting pressure on said second auxiliary container and forcing liquefied gas from the second auxiliary container into the container to be filled and then exerting suction on said second container to withdraw gas in gaseous state therefrom and thereby to draw gas in substantially liquefied condition from said supply vessel to the first auxiliary container, passing said withdrawn gas from said first auxiliary container to the second auxiliary container, thereby exerting a pressure in said first auxiliary container to force gas in substantially liquefied condition from the first auxiliary container to the second auxiliary container and discharging of said auxiliary containers being carried out continuously.

3. The method of transferring liquefied combustible gases between a supply vessel and a container to be filled with the use of two auxiliary containers, which comprises exerting a suction on the first auxiliary container to withdraw gas in gaseous state therefrom and thereby to draw gas in substantially liquefied condition from said supply vessel to the first auxiliary container, passing said withdrawn gas from said first auxiliary container to the second auxiliary container, thereby exerting a pressure on said second auxiliary container and forcing liquefied gas from the second auxiliary container into the container to be filled together with gas in substantially liquefied condition drawn from said first into said second auxiliary container under the suction effect of the gas in the gaseous state passing from the first to the second auxiliary chamber, and then exerting suction on said second container to withdraw gas in gaseous state therefrom and thereby to draw gas in substantially liquefied condition from the supply vessel into the second container, passing said withdrawn gas from said second auxiliary container into the first auxiliary container, thereby exerting a pressure in said second auxiliary container to force gas in substantially liquefied condition from the first auxiliary container to the container to be filled, the alternate charging and discharging of said auxiliary containers being carried out continuously.

4. The method of transferring liquefied combustible gases between a supply vessel and a container to be filled with the use of two auxiliary containers, which comprises exerting a suction on the first auxiliary container to withdraw gas in gaseous state therefrom and thereby to draw gas in substantially liquefied condition from said supply vessel to the first auxiliary container, passing said withdrawn gas from said first auxiliary container to the second auxiliary container, thereby exerting a pressure on said second auxiliary container to withdraw gas in gaseous state therefrom and thereby to draw gas in substantially liquefied condition from said supply vessel into the second auxiliary container, passing said withdrawn gas from said second auxiliary container into the first auxiliary container, thereby exerting a pressure in said first auxiliary container to force gas in substantially liquefied con-
from the first auxiliary container to the container to be filled, the alternate charging and discharging of said auxiliary containers being carried out continuously, and utilizing the cold produced by the evaporation of part of the liquefied gas in one of the auxiliary containers under the suction effect of the drawn-off gas for cooling the same gas in the other auxiliary container.

5. Apparatus for transferring combustible liquefied gases, such as propane, between a supply vessel and a container to be filled, comprising first and second auxiliary containers, conduit means connecting the upper portions of said auxiliary containers, a gas pump in said connecting conduit means, means to reverse the flow created by said pump in said conduit means, and further conduits connecting each of said auxiliary containers to the supply vessel and to the container to be filled.

10. Apparatus for transferring combustible liquefied gases, such as propane, between a supply vessel and a container to be filled, comprising first and second auxiliary containers, a gas pump in said connecting conduit means, means to reverse the flow created by said pump in said conduit means, and further conduits connecting each of said auxiliary containers to the supply vessel and to the container to be filled, and a cut-off valve in each of said last conduits.

15. Apparatus for transferring combustible liquefied gases, such as propane, between a supply vessel and a container to be filled, comprising first and second auxiliary containers, a gas pump in said connecting conduit means, means to reverse the flow created by said pump in said conduit means, further conduits connecting each of said auxiliary containers to the supply vessel and to the container to be filled, and means for cooling the contents of said auxiliary containers.

20. Apparatus according to claim 9 wherein the cooling means is a water tank in which the auxiliary containers are placed.

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