Oct. 12, 1948. F. C. BYRAM 2,451,151

PUMPING VOLATILE LIQUIDS

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FIG. 1.

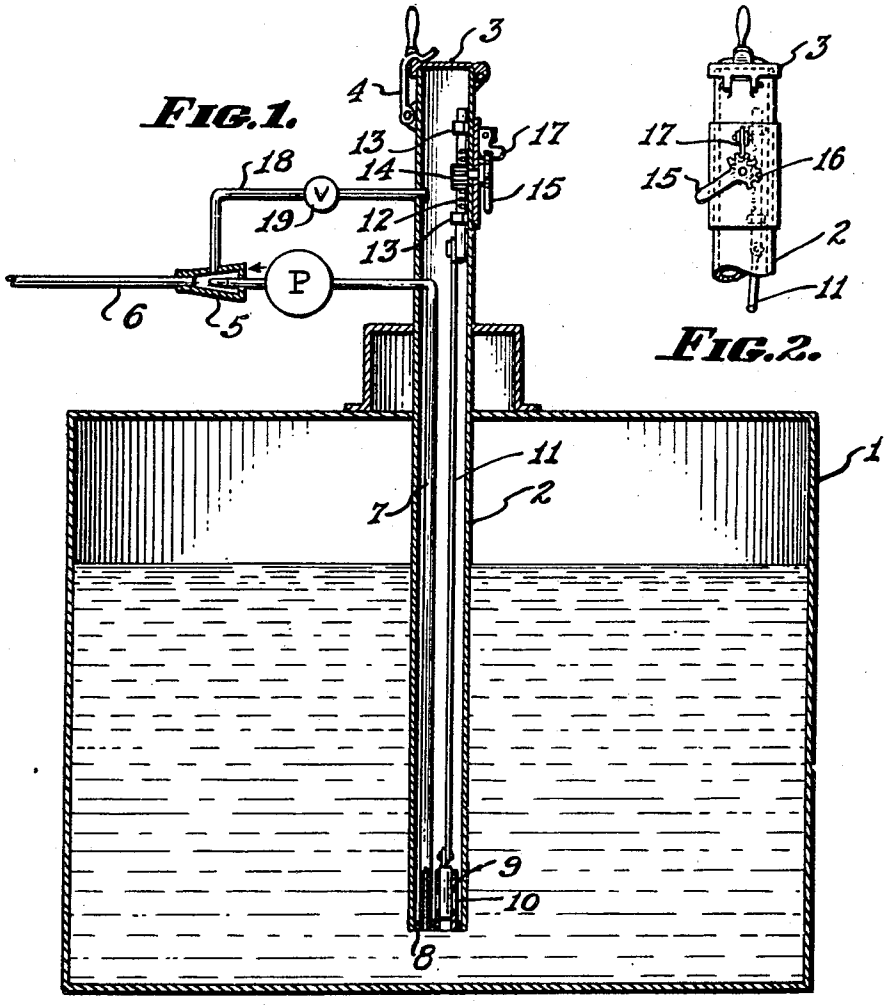


FIG. 2.

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PUMPING VOLATILE LIQUIDS

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In the pumping from closed storage tanks of volatile liquids, such as for example, liquefied gases, there is a difficult problem involved in maintaining the liquidity of the material and avoiding its volatilization to a gas upon reduction of pressure. An attempt to suction lift a liquefied gas requires creating at the pump inlet port a lower pressure than exists within the storage tank for the liquid. Unless some provision is made in connection with the pumping, it becomes evident that the tendency will be to pump nothing but a gas instead of pumping the liquefied gas.

Suggestions have been made that liquid can be displaced from a storage tank for a liquefied gas by increasing the pressure in the tank by an amount necessary to maintain the fluid withdrawn in a liquefied condition. Many difficulties will be encountered in such a process which are entirely avoided by my process in which temperature control is resorted to to permit of pumping for a limited period from a sealed tank of such a volatile fluid.

The particular mechanism illustrated in the drawings is, of course, essentially diagrammatic because the parts shown will be subject to considerable modification without departing from the spirit of the invention to suit various conditions. I will, however, describe the particular installation shown as an example of my invention, the novelty of which will be set forth in the appended claims.

The drawing Fig. 1 is a sectional view of a pumping arrangement according to my invention. Fig. 2 is a detail of the valve control.

The illustrated apparatus consists of a storage tank 1, with a stand pipe 2 therein terminating near the bottom of the tank and having a vent opening at the top. This opening is closed by a hinged cover 3, held down over the top of the pipe by means of a hinged clamp 4.

I have indicated at P the presence of a pump, the outlet of which feeds into an ejector 5, from which a pipe 6 extends to the point of delivery. The intake of the pump is through a pipe 7 which extends into the stand pipe and down through it. The stand pipe is closed at the bottom by a plate 8 through which the pipe 7 extends so that its lower end is open to the liquid in the tank.

There is another port in the bottom plate 8 in which operates a plunger valve 9, in the form of a cylindrical cup, which has slots 10 in its sides and is open at the bottom whereby the contents of the tank may enter the stand pipe, in quantity dictated by the pressure in the tank and by the

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extent to which the slots 10 are raised into the interior of the stand pipe.

The cup valve 9 is secured to a valve rod 11, which extends up to the top of the stand pipe. Where the tank is an underground tank the upper part of the stand pipe, the pump, etc. will be above the ground surface. The valve rod terminates in a rack portion 12, and is guided at this rack portion by straps 13 that slidably hold the rack portion in position. Located in the wall of the stand pipe is a shaft or pin which carries a pinion 14 that meshes with the rack. On the exterior of the stand pipe the shaft is secured to an operating handle 15, which preferably has a toothed sector plate 16 thereon. The sector plate traverses a resilient detent finger 17 held on the side of the stand pipe, so that the handle 15 may be located at various positions and will be held by the detent.

In the drawing, the cup valve is shown as in full open position. When in its lowermost position the slots 10 therein are located in the opening in the base plate 8 or projected beyond it.

Communicating with the stand pipe near the pump is a by-pass pipe 18 equipped with a valve 19, which enters the ejector 5 at the low pressure point thereof.

With the arrangement shown, when it is desired to pump liquid from the tank, the first step will be to adjust the cup valve so as to open a passage or passages into the stand pipe from the storage tank. The vent cap is then swung open for a moment, whereupon the liquid from the tank will flow into the stand pipe and vaporize, thus absorbing a large quantity of heat and chilling the pipe 7. The vent is then closed and the pump P is started up. At the same time the valve in the pipe 18 to the ejector from the stand pipe is opened, and the cup valve is adjusted to permit of some of the fluid in the tank entering the stand pipe under the action of the ejector, sufficient to keep low the temperature of the pipe 7 at the required point.

Since there will be a constant evaporation of liquid in the stand pipe, the pump pipe 7 is highly refrigerated on the inlet side of the pump. At the temperature within the pipe 7 the release of pressure because of the pump will not be sufficient to permit of any great evaporation of liquid in the pump inlet.

At the pump outlet or pressure side, the gases entering the ejector are met with the cold liquid coming from the pump, and under pressure in the outlet of the ejector the major part of this gas will dissolve in the liquid or become compressed

to liquid form again, however one regards the action.

The ultimate result is that a large proportion of the material pumped by the over head pump from the underground tank will be a liquid and not a gas, which was the object in view.

The type of pump to be used should be one which does not readily go out of action due to "vapor locks." One such type of pump is that described in Moineau Patent No. 1,892,217 dated December 27, 1932. Other pumps which will generate sufficient pressure on the ejector and be capable of handling mixtures of gas and liquid for short periods will serve my purpose.

It may be desirable to connect up the tank which is to be filled (using the arrangement of my invention as above described) with the storage tank, so as to equalize pressures between them; but this is normally not required with my arrangement. By my invention I can, in a practical manner, accomplish the most difficult task involved in handling of very volatile liquids, such as liquefied propane, isobutane, butane, butylene, carbon dioxide, etc., to-wit: remove the liquid by suction line from an underground tank or a tank located well below the level of the pumping instrument.

It may be noted that the use of the stand pipe as a refrigerating jacket would be replaced by other heat interchange means supplied with its refrigeration medium in the manner now described. The particular cup valve control and operating means therefor and the mode of venting the stand pipe or other jacket have no limiting characteristics and could be replaced by other available constructions, as will be evident to the designer.

In the above, I have not discussed the elaborations of heat insulation and conduction. It will be desirable to make the outer jacket 2 of material of low heat conduction or else to effectively insulate it throughout its length. Also, the pipe 7 should be of high heat conduction, such as for example, a thin copper pipe. At the branch of this pipe from the jacket to the pump, insulation will be desirable. I have not illustrated the insulation, which can be arranged to suit the conditions of use.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. A pumping device for suction lifting of liquefied gaseous materials from storage tanks, comprising a pump having an intake pipe having a part adapted to extend into a tank, a jacket for said pipe, located about said part and having an opening arranged to open into the tank, an ejector on the delivery side of the pump, and a conduit from the jacket to said ejector, whereby the lowered pressure created by the ejector causes a refrigeration of the intake pipe by expansion of the liquefied gas within the jacket.

2. The device of claim 1 in which the opening of the jacket into the tank is controlled in amount by an adjustable valve.

3. The device of claim 1 in which the jacket is provided with a valved opening to the atmosphere, and a valve capable of adjusting the opening of the jacket into the tank.

4. That method of use of a suction pump for suction lifting liquefied gases from storage tanks which consists in employing an ejector on the pressure side of the suction pump to set up a low pressure refrigerating zone in communication with the interior of the tank, and in heat interchange relation to the intake from the tank to the pump.

5. The device of claim 1 in which the jacket is of low heat conduction value, and the pipe of high heat conduction value within the jacket.

6. A pumping device for suction lifting of liquefied gaseous material from storage tanks, which comprises a pump having an intake pipe having a part to extend into a tank, and means arranged to communicate with the interior of the tank and with a zone of lower pressure than the tank into which the liquefied gas from the tank may flow, said means being in heat interchange relation with the said portion of the intake pipe and being partly within said tank.

7. The combination of claim 6 in which the pump is provided on its outlet side with an ejector connected to said means to create the zone of lower pressure for the said means.

8. The combination of claim 6 in which the pump is provided on its outlet side with an ejector connected to said means to create the zone of lower pressure for the said means, said means having also a valved opening to the atmosphere to set up such lower pressure.

9. The combination of claim 6 in which a valve is provided for controlling the communication of said means with the interior of the tank.

10. In combination with an underground, uninsulated storage tank for liquefied gaseous material, a pumping device for suction lifting of said liquefied gaseous material therefrom, which comprises a pump having an intake pipe having a part to extend into said tank, and means arranged to communicate with the interior of said tank and with a zone of lower pressure than the tank into which the liquefied gas from the tank may flow, said means being in heat interchange relation with the said portion of the intake pipe.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,292,375	Hansen	Aug. 11, 1942