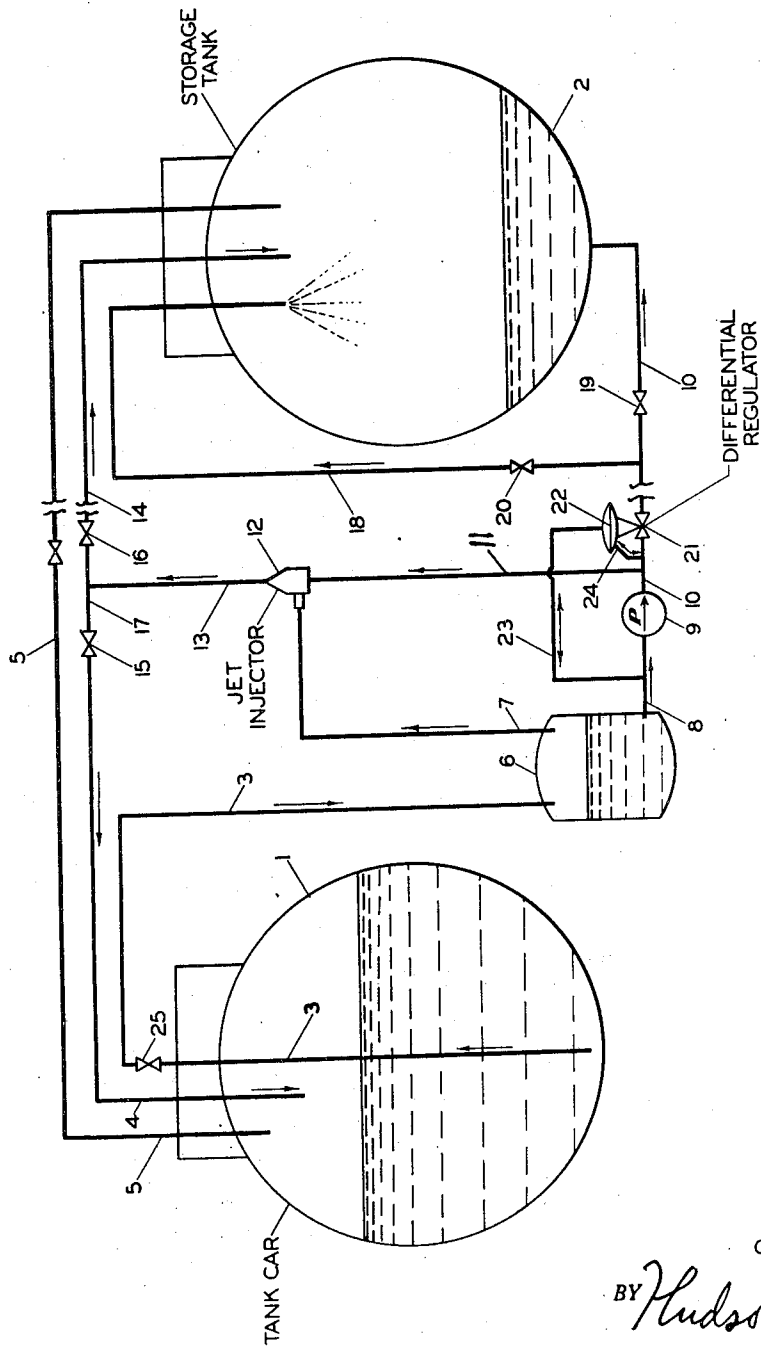


Nov. 15, 1949

O. L. GARRETSON  
TANK CAR UNLOADING SYSTEM  
Filed July 1, 1946

2,487,863



INVENTOR.  
O. L. GARRETSON

BY *Hudson & Young*

ATTORNEYS

## UNITED STATES PATENT OFFICE

2,487,863

## TANK CAR UNLOADING SYSTEM

Owen L. Garretson, Bartlesville, Okla., assignor to  
Phillips Petroleum Company, a corporation of  
Delaware

Application July 1, 1946, Serial No. 680,318

7 Claims. (Cl. 62—1)

1

This invention relates to a method for the transfer of volatile liquids from one container to another. In one of its more specific aspects it relates to a method for the transfer of liquefied petroleum gas from one container to another. In a still more specific aspect my invention relates to a method for the elimination of vapor lock in pumps used in the transfer of such volatile liquids as propane, or butane or mixtures of these.

Because of their high vapor pressure at atmospheric temperature, liquefied gases are difficult to pump. This difficulty becomes apparent in the formation of vapor at points of reduced pressure, such as the suction intake of transfer pumps. The formation of vapors in a liquid conveying conduit under such conditions that liquid flow through that conduit is stopped is termed "vapor lock." The formation of vapor in the suction inlet portion of a centrifugal pump interferes seriously with pumping capacity, and in many instances will even prevent flow of liquid through the pump. Vapor formation in a positive displacement pump markedly reduces pumping capacity and may even cause pounding and ultimate damage to the pump.

An object of my invention is to provide a method for the elimination of vapor lock in transfer pumps operating in volatile liquid service.

Another object of my invention is to provide a method for the rapid and uninterrupted transfer or pumping of a volatile liquid from one container to another.

Still another object of my invention is to provide a method for the elimination or prevention of vapor lock in the suction side of transfer pumps operating in liquefied petroleum gas service.

Many other objects and advantages of my invention will be realized by those skilled in the art from a careful study of the following description and drawing which respectively describes and illustrates a preferred embodiment.

Referring to the drawing, numeral 1 refers to a container or tank in which is a volatile liquid to be transferred to another tank 2. Tank 1 is equipped with a pipe or tube 3 entering the tank through the top and extending to a point adjacent the bottom. A second pipe 4 extends through the top into the vapor space while a third pipe 5 may or may not be used. The pipe 3 extends from the bottom of this tank through the top and into the top portion of a priming tank 6. This priming tank carries an overhead

2

vapor line 7, and a lower liquid outlet line 8. The lower liquid line 8 is connected with the suction side of a transfer pump 9 while the outlet of the pump is connected to the bottom of the receiving tank 2 by a pressure line 10. A bypass pipe 11 connects this pressure line 10 with a jet injector mechanism 12, the discharge end of which is connected to pipe 17 by means of pipe 13. One end of the pipe 17 connects with pipe 4 through a valve 15 while the other end connects with a pipe 14 through a valve 16. Pipe 14 enters the top of the tank 2. The pipe 10 carries a side line 18 which enters tank 2 through its top. Pipes 10 and 18 carry valves 19 and 20, respectively.

The pressure pipe 10 carries a differential regulator 21, the diaphragm 22 of which is connected by pipe 23 to the pump suction pipe 8 and by pipe 24 to the pump discharge line 10 upstream of the regulator valve 21.

One application of my invention may be in the transfer of liquid propane or liquid butane from a tank car to a storage tank. Thus, in this case propane, for example, is to be transferred from a tank car 1 to a storage tank 2. Due to the low boiling point of propane, and its high vapor pressure at atmospheric temperature, it is shipped in a thick walled tank car under its own vapor pressure. At 100° F. the vapor pressure of propane is of the order of 180 pounds per square inch.

In this example, the pipe connections may be made as hereinabove mentioned. If the assembly is of new construction and as yet unused, there will of course be no liquid propane in the storage tank 2, priming tank 6 nor in any of the pipes or pump. Under such conditions, upon opening a valve in outlet line 3, propane will flow through the line 3 into the priming tank 6 until the pressure in tank 6, pipe 8, pipe 7, injector 12, pipe 13, pipe 17 and pipe 4 is equalized, the valve 15 of course being open. Upon manually opening the regulator valve 21 and valve 19, propane can flow from the priming tank 6 through pump 9 in case this pump is a centrifugal pump, through line 10, valves 21 and 19 and thence into the bottom of the storage tank 2, or valve 16 may be opened to let fluid pass through pipe 14 into tank 2. When sufficient propane has thus flowed into the storage tank that the storage tank pressure is equal to the propane pressure in the tank car, the flow will obviously cease. Under such conditions the priming tank will contain some liquid propane which in turn will fill the pump suction line 8.

The pump now may be started and liquid propane may then be drawn from the tank car into the priming tank, and passed through the pump into the storage tank.

In the flow of liquid propane into the priming tank a certain amount of vaporization occurs and soon the accumulation of vapor builds up sufficient pressure that liquid propane ceases to flow through line 3 into the priming tank. To prevent the accumulation of vapor in the priming tank I have devised a means for continuously withdrawing the vapor so that the flow of liquid through the line 3 will be continuous and uninterrupted.

This means comprises a bypass line 11 having a jet injector 12 connected by means of line 13 to pipe 17 and thence by pipe 4 to the tank car 1 or by pipe 14 to the storage tank 2. The pipe 7 connects the vapor space of the priming tank 6 with the side arm tube of the injector 12. When the pump 9 is operating and liquid under pump pressure is flowing through pipe 10, some of this liquid flows through the bypass line 11, through the injector 12 and pipe 13 to be returned to the tank car through pipe 4 or to be flowed into the storage tank 2 through pipe 14. The liquid flowing through the venturi of the injector causes a suction in line 7 which operates to remove the vapor from the vapor portion of the priming tank.

By continuously removing the accumulating vapor from the priming tank in this manner I find that ample liquid propane is present in the priming tank so that only liquid passes through line 8 into the suction of the pump 9.

To make certain that the jet injector may remove the necessary volume of gas, I have provided a differential regulator in the pump discharge line for maintaining a substantial pressure on the liquid passing through the jet. This regulator may be of any type regulator desired, provided of course it be adapted to function as desired. In the valve or regulator, as shown, I have illustrated a diaphragm valve in which pressure on the discharge side of the pump is transmitted to the underside of the diaphragm. In this manner, when the pump discharge reaches any predetermined maximum pressure, the diaphragm raises to open the valve and permit passage of liquid to the storage tank. In a similar manner as the pressure in suction pipe 8 decreases the pressure on top of the diaphragm 22 decreases which action works in cooperation with the just mentioned high pressure in pipe 10 to raise the diaphragm.

When the pressure in pipe 8 increases through the formation of excessive gas in tank 6, this increase of pressure tends to retard or to stop the flow of propane through pipe 3 from the tank car. This high pressure in pipe 8 is transmitted to the top of the diaphragm 22 which then drops to close or to close in part the valve 21. This closing of valve 21 then increases the pressure on the liquid passing through the injector which then accelerates the gas removed from the priming tank, and liquid then can flow from the tank car into the priming tank. The high pressure in suction pipe 8 is also transmitted through the pump to increase the pressure in pipe 10, which increase as mentioned causes increased functioning of the jet. The increase of pressure in pipe 10 above a certain predetermined value causes the diaphragm to raise and to permit increased flow of liquid to the storage tank.

#### Operation

In operation an equilibrium is reached in relation to the above mentioned pressures and the valve 21 is opened to permit some liquid flow to storage 2 tank while at the same time causing sufficient liquid to pass through the jet that the vapor or gas is removed from the priming tank as fast as it is formed, and operation progresses smoothly in this manner.

In installations when the storage tank 2 can be situated relatively close to the tank 1, a vapor equalization line 5 may be used. This line is for the purpose of permitting out-flow of gas from tank 2 as the liquid level therein increases. The displaced gas is conducted through the equalization line 5 into tank 1 to prevent a drop in pressure due to removal of liquid. Under these conditions, the injector discharge of liquid and gas is passed through valve 16 and pipe 14 into the storage tank 2. This operation permits more rapid transfer of liquid contents from tank 1 to tank 2. Under these conditions pipe 4 may not be needed.

In installations wherein tank 2 is relatively far removed from tank 1, as for example, the storage property may be a half mile or more from the railroad siding, the running of various pipes from one tank to the other is an expense. Under such conditions, the pressure equalization line 5 is not used and the injector discharge of liquid and gas is diverted through pipe 4 into the tank car tank since the priming tank-pump-injector assembly is adjacent the tank car 1, and the pipe 14 is not installed. The section of pipe 10 shown broken is long and extends from the railroad siding and pumping unit to the property on which is situated the storage tank 2. To prevent excessive pressure increase in the storage tank 2 as the liquid level raises, the liquid may be introduced into the tank through line 18 by opening valve 20 and closing valve 19. The tank end of pipe 18 may be equipped with a spray device so that as liquid enters the tank it is sprayed in such a manner as to dissolve the gases therein and prevent undue increase in pressure.

I have found that a proper setting of the regulator valve 21 is one that causes removal of sufficient gas from the priming tank to maintain a pressure differential of about 5 pounds per square inch between the pressure in the tank car and the pressure in the priming tank. By using a pump of about 25 gallons per minute capacity and diverting about 5 gallons per minute from the pump discharge line 10 into the injector line 11 and ultimately through the injector 12, about 10 gallons of vapor per minute are removed from the vapor space of tank 6 and this vapor removal lowers the pressure in the tank 6 about 5 pounds per square inch. Under such pressure conditions liquid propane flows from tank 1 to tank 6 in sufficient volume to maintain a continuous supply of liquid feed to the pump 9 and vapor locking of pump 9 substantially does not occur.

It will be obvious that at the starting of a pumping operation when the liquid level in a tank car is high less than 5 pounds pressure differential is sufficient to maintain a constant supply of liquid to the pump, while as the tank car level becomes lower this pressure differential must be increased some to ensure a constant flow of liquid into the priming tank.

Materials of construction for the tanks and piping for use as herein described may be selected from among those commercially available. The

tanks 1, 2 and 6 should of course be thick walled pressure tanks. The pump may be a centrifugal or positive displacement pump as desired. The jet injector may be of conventional and standard design as furnished by equipment manufacturers. Similarly the differential regulator may be selected from among those commercially available and suitable for the purpose at hand.

While I have described my invention as adaptable to the transfer of such volatile liquids as propane and butane, it is also adaptable for use in the transfer of other such volatile liquids as high vapor pressure natural gasoline, acetone or carbon disulfide, or other low boiling organic liquids.

It will be obvious to those skilled in the art that many variations and alterations of my broad idea may be made and yet remain within the intended spirit and scope of my invention.

Having described my invention, I claim:

1. A method for mechanically transferring volatile liquid from a first container to a second container comprising the steps of passing said volatile liquid from said first container into an auxiliary container wherein some vaporization of said liquid occurs; pumping liquid from said auxiliary container to said second container; diverting a portion of said pumped liquid through a jet injector zone, said injector zone being in vapor communication with said auxiliary container; removing vapors from said auxiliary container by drawing them into admixture with said diverted portion of liquid; controlling the volume of said diverted liquid in accordance with a pressure differential taken between a point intermediate said auxiliary container and a pumping zone and a point intermediate said pumping zone and said second container; passing said admixture from said injector zone into said first container.

2. The method of claim 1, wherein said undiverted pumped liquid is injected into the upper portion of said second container in the form of a spray, whereby gases are dissolved therein.

3. A method for the prevention of vapor lock in a transfer pump in service for the transfer of volatile liquid from a first container to a second container comprising passing said volatile liquid into an auxiliary container wherein some vaporization occurs; allowing liquid to settle to the bottom and vapors to rise to the top of said auxiliary container; pumping said settled liquid from the bottom of said auxiliary container into

said second container; diverting a minor portion of said pumped liquid through a vapor removing means in communication with the vapors in said auxiliary container; removing vapors from said auxiliary container by liquid flow through said vapor removing means; and passing said diverted minor portion of pumped liquid and said vapors removed from said auxiliary container to said second container.

4. The method of claim 3, wherein vapor communication is maintained between said first and second primary containers.

5. A method for transferring volatile liquid from a first primary container to a second primary container comprising the step of passing said volatile liquid from said first container into an auxiliary container wherein some vaporization of said liquid occurs; pumping liquid from said auxiliary container to said second container; diverting a portion of said pumped liquid through a jet injector zone, said injector zone being in vapor communication with said auxiliary container; removing vapors from said auxiliary container by drawing them into admixture with said diverted portion of liquid; and passing said admixture into both of said primary containers.

6. The method of claim 4, wherein at least a portion of the undiverted pumped liquid is injected into the upper portion of said second container in the form of a spray whereby gases are dissolved therein.

7. A method for transferring volatile liquid from a first primary container to a second primary container comprising the steps of passing said volatile liquid from said first container into an auxiliary container; pumping said volatile liquid from said auxiliary container to said second primary container; passing vapors from said auxiliary container to said second container; and maintaining a greater pressure in said first liquid container than in said auxiliary container thereby effecting the flow of liquid from said first container to said auxiliary container.

OWEN L. GARRETSON.

#### REFERENCES CITED

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

#### FOREIGN PATENTS

| Number  | Country | Date          |
|---------|---------|---------------|
| 678,986 | Germany | July 26, 1939 |