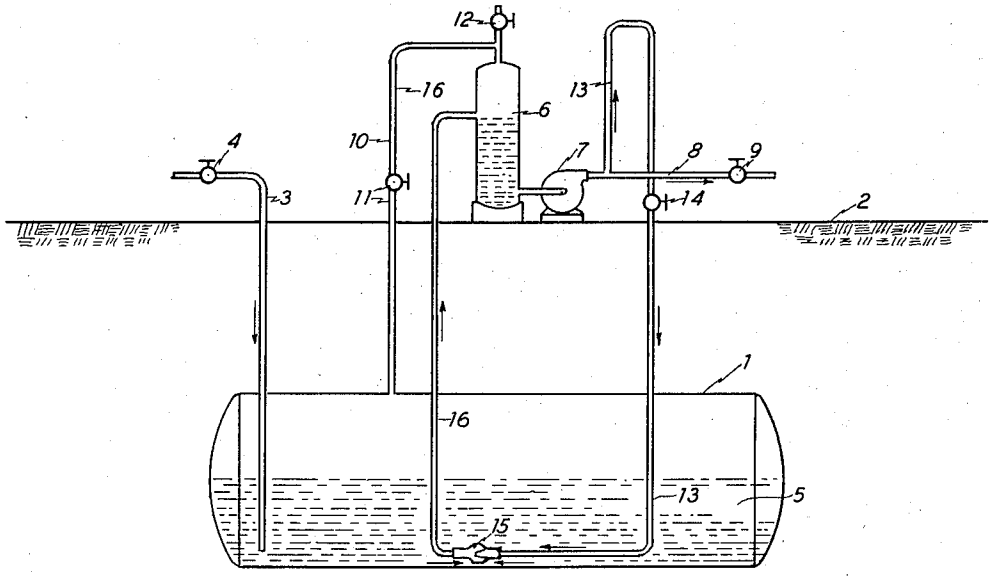
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APPARATUS FOR DISPENSING HIGHLY VOLATILE LIQUIDS

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APPARATUS FOR DISPENSING HIGHLY VOLATILE LIQUIDS

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Liquids of high vapor pressure, such as the liquefied petroleum gas which consists largely of propane and/or butane, are often stored in relatively large quantity in order to be dispensed into truck tanks, automotive vehicle fuel tanks and other smaller containers. For economy of ground space and more particularly for reasons of safety, the storage tanks are usually placed underground, this being in fact a legal requirement in most cities. From these buried tanks the liquid is withdrawn by means of a pump which must usually deliver the liquid at a pressure materially above the vapor pressure.

The use for this purpose of a pump placed at or above the surface of the earth is attended with some difficulty. The liquid body in the storage tank rapidly comes into vapor-pressure equilibrium with the overlying vapors. Thereafter, any attempt to draw liquid from the tank by suction lift from an elevated pump causes more or less vaporization of the liquid in the pump suction pipe, the pressure on the liquid in this pipe being necessarily brought below the vapor pressure in the very act of producing the suction. This vaporization renders the operation of any pump inefficient and uncertain and may entirely prevent the use of the centrifugal type of pump which is most desirable for handling extremely volatile liquids.

This difficulty may be avoided by locating the pressure pump itself at or below the bottom of the tank, as in a deep pit, in a well inside the tank, or in a well exterior to the tank and connected with it by piping. Either of these arrangements, however, is unduly expensive as to installation and renders repairs or replacements awkward and difficult.

The object of my invention is to provide means for lifting the liquid from the underground body to a pump suction at a substantially higher level, or to a second liquid body located above and communicating with the pump suction, without permitting vaporization of the liquid on its way to the pump, which may thus be operated at full efficiency and in a reliable manner at all times.

The form of the invention contemplated in the present application is illustrated in the attached drawing, which shows in a diagrammatic manner a suitable assemblage of apparatus.

Referring to the drawing, 1 is a closed storage tank placed materially below the ground level indicated at 2. A filling pipe 3 having a hand valve 4 provides for introducing the volatile liquid body indicated at 5.

A relatively small secondary tank or receiver 6 is placed above ground and is pipe connected at its lower end with the suction of a pump 7, this pump having a discharge pipe 8 provided with a valve 9.

The upper end of the receiver is connected with the vapor space in the top of tank 1 by means of a pipe 10 having a valve 11. A hand operated vent valve 12 is also aranged at the top of the receiver.

At a point between pump 7 and valve 9, discharge pipe 8 is provided with a branch pipe 13 having a valve 14. This pipe is carried upwardly to a level materially above the top of the receiver and then downwardly through the top of tank 1 to a point near its bottom. At this level it connects with the jet side of a jet-and-Venturi type eductor 15, which has its suction opening in communication with the interior of the tank. The eductor discharges through a pipe 16 which passes through the top of the tank and is connected into the receiver at a point materially below its upper end.

This apparatus functions in the following manner. The main tank 1 is first filled through pipe 3, valves 9 and 11 being closed and valve 12 open to vent vapor until receiver 6 is filled by displacement from tank 16. Valve 12 is then closed and valve 11 opened to equalize the vapor pressures in tank 1 and receiver 6, after which the filling of the tank may be completed without venting vapor.

To make a delivery from tank 1, the receiver being now filled to the level at which it overflows through pipe 16 and the pump suction being thus flooded, the pump is started and valve 9 adjusted to maintain a pressure on the pump discharge higher than the vapor pressure of the liquid. Valve 14 is then opened sufficiently to permit a small proportion of the liquid discharged by the pump to pass through pipe 13 to eductor 15, in which this liquid acts to draw in from the liquid body in tank 1 and to discharge into receiver 6 a supply of liquid at least equal to the total quantity required to supply the pump. Any excess quantity raised by the eductor returns through pipe 10 to tank 1.

This feed to the receiver is continuous so long as the pump is in operation and the pump suction is thus maintained in a flooded condition and vaporization in the pump suction is prevented. When the pump is stopped, the receiver remains filled to the level to which it is drained by pipe 16. As the liquid in the receiver is in vapor pressure equilibrium with the liquid in the tank, the

contents of the receiver cannot escape other than by siphoning through pump 7 and pipe 13, and this siphoning is inhibited by forming this pipe in the inverted U-bend shown in the drawing.

The eductor, otherwise known as the jet pump, is a well known piece of apparatus, commercially available in several forms. It is particularly desirable for the described purpose because of the entire absence of moving parts but I do not restrict my invention to the use of this device, any simple means by which the energy of a relatively small quantity of liquid at high pressure is made available to lift a larger quantity of liquid against a lower head being the equivalent of the eductor for my purpose.

While I prefer to locate the eductor or other liquid lifting means within the storage tank as shown, it may be placed without and below the tank and have its suction side connected with the tank by piping.

I claim as my invention:

1. A storage and delivery system for highly volatile liquids comprising in combination: a closed storage tank; a closed receiver arranged substantially above said tank; a pipe affording communication between the upper portion of said receiver and said tank; a pump arranged to have its suction flooded by liquid from said receiver; a liquid-actuated lifting means arranged below the liquid level in said tank and in unimpeded communication with the liquid body therein, said lifting means discharging into the upper portion of said receiver; a pipe affording communication between the discharge of said pump and the actuating-liquid intake of said lifting means; means for maintaining pressure on the discharge of said pump and within said pipe, and a second pipe affording communication between the discharge of said lifting means and said receiver.

2. A storage and delivery system for highly volatile liquids comprising in combination: a closed storage tank; a closed receiver arranged substantially above said tank; a channel connecting the upper part of said receiver with said tank; a pump arranged to have its suction flooded by liquid from said receiver; a liquid-actuated lifting means arranged adjacent the bottom of said tank and in unimpeded communication with the liquid body therein; means for the passage of lifted liquid into the upper portion of said receiver, and means for withdrawing liquid under pressure from the discharge of said pump to actuate said lifting means.

3. A storage and delivery system for highly volatile liquids comprising in combination: a closed storage tank; a pump arranged substantially above said tank; an eductor arranged adjacent the bottom of said tank and in unimpeded communication with the liquid body therein; a channel affording communication between the discharge of said eductor and the suction of said pump, said channel rising above the level of said pump to maintain said pump continuously flooded, and means for withdrawing liquid under pressure from the discharge of said pump for actuating said eductor.

4. A storage and delivery system for highly volatile liquids comprising in combination: a closed storage tank; a pump; a liquid-actuated lifting means arranged adjacent the bottom of said tank and in unimpeded communication with the liquid body therein; a channel for the passage of lifted liquid from the discharge of said lifting means into the suction of said pump, said channel rising above the level of said pump to maintain said pump continuously flooded, and means for supplying liquid under pressure to actuate said lifting means.

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