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SYSTEM FOR DISPENSING AND METERING VOLATILE LIQUIDS

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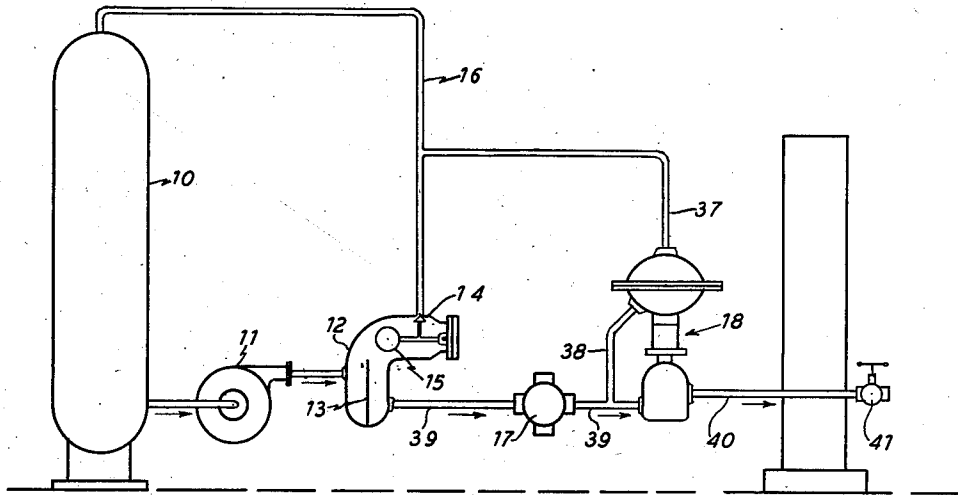


FIG. 1

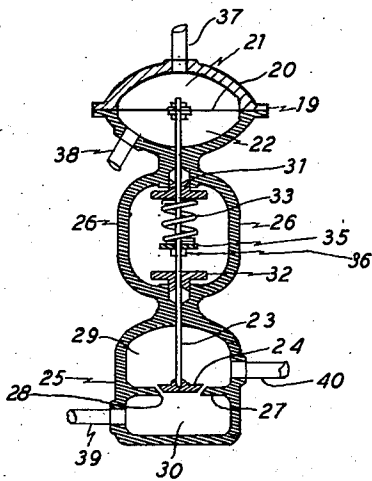


FIG. 2

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SYSTEM FOR DISPENSING AND METERING
VOLATILE LIQUIDSFrancis W. Wilcox, Alhambra, Calif., assignor to
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3 Claims. (Cl. 221-95)

In the dispensing and metering of extremely volatile liquids, such as butane or propane or mixtures thereof, some difficulty has been experienced in utilizing conventional types of positive displacement meters for the measurement of the liquid dispensed, due to the fact that such liquid will form vapor if the pressure maintained on the liquid at any point in the system is less than the vapor pressure of the liquid at the temperature prevailing at the corresponding point. Such vaporization is particularly likely to occur in piping systems associated with service stations designed to dispense such liquids to automotive vehicles and the like.

In such stations the volatile liquid is ordinarily stored in large tanks, which may be installed either above ground or underground. Such tanks, on account of their large heat capacity and, in the case of underground tanks, on account of the heat insulation afforded by the burial of the tanks, maintain a more or less constant average temperature, which temperature is substantially lower than the temperature attained in the piping and other apparatus associated with the tanks during exposure to sunlight.

On account of such exposure of the associated piping and equipment, it has been found necessary to take extreme precautions to prevent vaporization of the liquid in these parts of the equipment. Obviously, if partial vaporization of the liquid occurs before its delivery to the meter, the meter will operate partly on vapor and will give volume indications in excess of the true volume of liquid actually passed through the meter.

Since a liquid pump is ordinarily used in these systems for delivering such liquids from storage tanks to the receiving fuel or transport tanks on automotive equipment, one method of eliminating this difficulty and insuring true readings of the metering device is to discharge the liquid through a relief or back pressure valve immediately ahead of the receiving tank, such back pressure valve being set to maintain a back pressure on the system between itself and the pump in excess of the maximum vapor pressure which it is possible for the liquid to reach in this part of the system. This requires that the back pressure valve be set to hold and maintain a pressure somewhat greater than that corresponding to the vapor pressure of the liquid under the most extreme conditions of sun exposure. This set pressure is greatly in excess of the back pressure which would be required under average operating conditions, and consequently a great deal of pumping power is wasted in forcing the delivered liquid through

the back pressure valve at this excessively high setting.

The present invention provides means for ensuring that no vaporization can occur in the delivery line entering the meter nor within the meter itself, while the back pressure held on the system is only such as is momentarily required to prevent vaporization at the existing temperature. Thus the power required to pump the liquid against the high pressure necessary to prevent vaporization at high temperature is used only when the temperature is high, while advantage is taken of all periods of lower temperature to correspondingly reduce the pressure and the power consumption.

This result is produced by using a differential pressure regulator to control the back pressure in the system in place of the simple pressure regulator having a manually controlled setting.

The objects and advantage of the invention will be evident on inspection of the attached drawing, in which

Fig. 1 is a diagrammatic elevation of the system as a whole, and

Fig. 2 is a vertical section through a suggested type of differential pressure regulator, as indicated at 18 in Fig. 1.

Referring first to Fig. 1, 10 is a storage tank, indicated in this illustration as a vertical tank mounted above ground, it being understood that the tank may be of any shape and may be located beneath the surface if desired. 11 is any pump of suitable volume and pressure capacity for making deliveries at the required rates. 12 is a vapor trap for separating any fixed gas which may be disengaged in the pump. This trap is preferably provided with a vertical baffle 13 and has in its upper portion a release valve 14 actuated by a float 15. This valve is opened by the float when the liquid level in the trap is depressed below a predetermined point by the accumulation of gas, which is thus vented from the trap and returns to the top of tank 10 through pipe 16. The insertion of the trap at this point ensures a liquid free from gas bubbles on the downstream side of the trap.

The stripped liquid from the trap next passes through a meter 17, which may be of any preferred type. Experience has indicated that meters of the piston or positive displacement type are best suited for the handling of liquids of this nature.

The system up to this point is maintained under such pressure as will prevent vaporization in the meter or between the meter and the trap by the differential pressure governor generally indicated

at 18. A governor suited to this service is shown in more detail in Fig. 2, it being understood that these details are illustrative only. In this figure, 19 is a diaphragm case divided by a flexible diaphragm 20 into two chambers 21 and 22. To this diaphragm is attached the stem 23 of a valve 24 situated in a valve body 25 which is spaced from the diaphragm case by a plurality of arms 26—26. The valve body is divided by a web 27 having a valve seat 28 into two chambers 29 and 30. The valve stem passes out of chamber 22 through a packing gland 31 and into chamber 29 through a packing gland 32. A spring 33 bears against gland 31 and urges the stem downwardly, i. e., in a direction to close valve 24, this spring being held by a washer 35 and a nut 36 which can be adjusted up and down on the stem to vary the tension of the spring.

Referring now to both Figs. 1 and 2, a pipe 37 connects chamber 21 with pipe 16 through it with the upper side of tank 10. A pipe 38 connects chamber 22 with pipe 39 and through it both with the discharge side of meter 17 and with valve chamber 30. A pipe 40 connects valve chamber 29 with a hand valve 41 to which a hose may be connected for filling the tanks of vehicles or otherwise withdrawing liquid from the system.

It will be seen that the vapor pressure existing in tank 10 is transmitted through pipes 16 and 37 to chamber 21 and is thus exerted on the upper side of diaphragm 20, tending to move valve 24 into a closed position. At the same time the pump discharge pressure is exerted through pipes 39 and 38 against the lower side of the diaphragm, tending to open valve 24 and to permit liquid to flow from chamber 30 into chamber 29 and thence through pipe 40 to the delivery point. To cause this valve to open the pressure beneath the diaphragm must exceed the pressure above the diaphragm, and the extent of this excess pressure will be fixed solely by adjustment of the tension of spring 33, which urges the valve into closed position. It follows that the pump pressure required to open the valve and permit delivery of liquid will be the momentary vapor pressure in tank 10 and chamber 21 plus the resistance offered by the spring, and will vary with the momentary vapor pressure. Thus, regardless of the vapor pressure existing in the system, no vaporization can take place because the back pressure against the pump is always in excess of the vapor pressure by a fixed and controllable amount. The amount of this excess may be as small as may be desired, but in practice I prefer to so adjust the tension of the spring as to maintain an excess of 10 to 15 pounds per square inch.

It is obvious that, with this arrangement, as the general temperature level rises or falls the vapor pressure of the liquid in the storage tank will correspondingly rise and fall, thereby changing the reference pressure to which the operation of the differential regulator responds. For example, on a hot day the vapor pressure in the storage tank may rise to say 100 lbs. per square inch gauge. The differential governor will then ensure that no liquid can be delivered through the meter at a pressure less than 110 to 115 lbs. per square inch gauge, thus maintaining the pressure on the liquid in the meter at a point higher than the vapor pressure of the liquid itself. During cold weather the vapor pressure in the storage tank will naturally decline, with the result that the total pressure held on the meter will correspondingly decline, but will always be higher than the vapor pressure of the liquid by the set amount predetermined by the adjustment of the regulator.

One of the important advantages of this system of control as compared with the use of a simple back pressure regulator lies in the fact that the excess pressure against which the pump must deliver in order to insure correct metering is limited to a definite and fixed amount; instead of varying according to general temperature conditions at the installation, and being an excessively high amount under average operating conditions.

I claim as my invention:

1. In a system for dispensing and metering highly volatile liquids, in combination: a liquid storage tank; a pump arranged to take suction from said tank; a gas trap arranged in the discharge of said pump and a gas channel connecting said trap with said tank; a liquid meter arranged to be fed by said trap, and a differential pressure governor disposed in the discharge of said meter, said governor being arranged and connected to maintain a constant pressure differential between the discharge of said meter and the vapor space of said tank.

2. In a system for dispensing and metering highly volatile liquids, in combination: a liquid storage tank; a pumping means; a liquid meter; a gas trap between said pump and said meter, and pressure responsive means adapted to maintain a constant differential between the pressure in said meter and the vapor pressure in said tank.

3. In a system for dispensing and metering highly volatile liquids, in combination: a liquid meter, and pressure responsive means adapted to maintain a pressure on said meter exceeding by a constant quantity the vapor pressure of the liquid entering said meter.

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