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METHOD OF REDUCING EVAPORATION LOSSES

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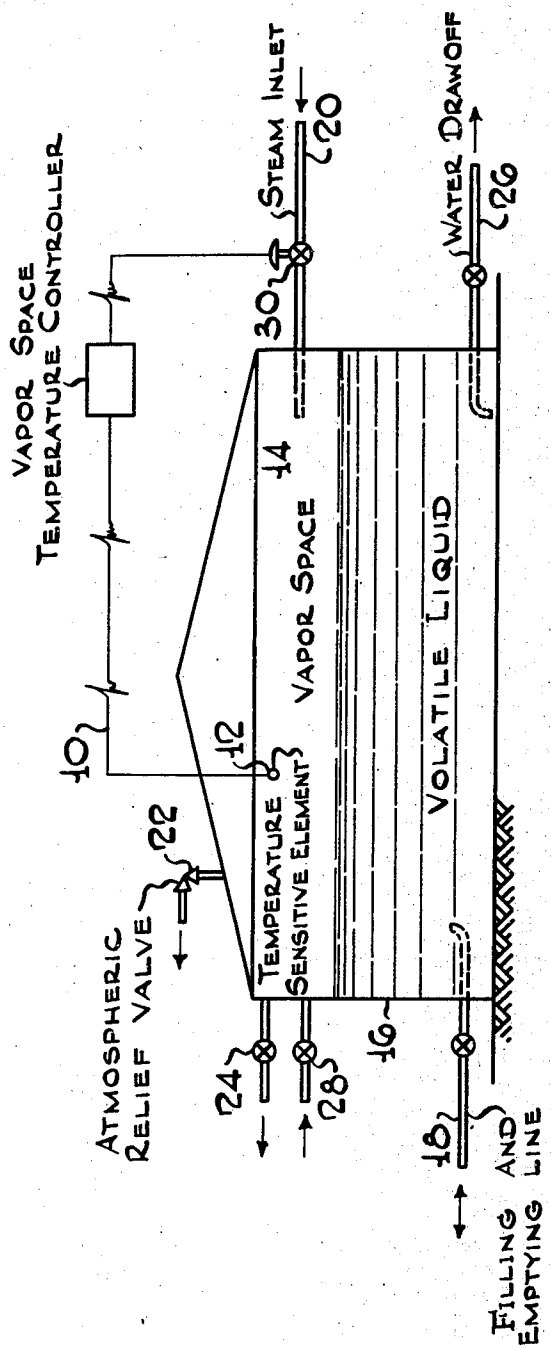

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METHOD OF REDUCING EVAPORATION LOSSES

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5 Claims. (Cl. 220—85)

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This invention relates to equipment for storing volatile liquids in bulk and in particular to a method of reducing evaporation losses in tanks containing relatively volatile petroleum liquids.

In the storage of large volumes of volatile liquids, particularly evident expansive and contractive effects in the vapor space occur as the result of daily changes in weather conditions. This "breathing" of the tank is particularly marked in climates and during seasons in which marked differences occur between day and night temperatures. In the prior art, the effect has been considered in the building of tanks of many types of construction to care for either withstanding the pressure changes or various means of absorbing the volume and changes in additional equipment as in balloons or gas plants. The present invention is a departure from such type corrective measures in employing controlled amounts of condensing steam in the vapor space as a means of maintaining relatively uniform temperature and pressure conditions despite changes in the surrounding atmospheric conditions.

Thus the invention contemplates any means by which controlled supply of heat is furnished to the vapor space in storage equipment for relatively volatile liquids through the medium of condensing steam in order to maintain the temperature and incidentally the pressure when the tank is not heated by the rays of the sun during a portion of each day. When the heat input from the sun to the vapor space is at a maximum almost no steam is being introduced into the vapor space. During the colder part of the day when there would be a heat loss from the tank, steam is supplied to the vapor space to furnish heat to prevent the cooling and contraction of the vapor space which, if permitted to take place, would result in a reduction in pressure and infiltration of air. Also to be considered within the concept of the invention is that when an inert gas is also employed in the vapor space and use made of condensing steam in order to maintain relatively uniform temperature and pressure conditions. Thus the use in conjunction with an inert gas blanketing system is an alternative use of the invention.

A typical embodiment of the invention is diagrammatically represented in the accompanying drawing in which a pressure controller system **10** with a sensitive temperature element **12** is connected to the vapor space **14** of a cone-roof tank **16** supplied with a voltaile liquid by means of filling line **18**. The vapor space is initially heated by steam admitted through line **20** to approximately the maximum temperature which is expected to be encountered for a given season of the year or other period between manual adjustments; any vapor expelled in such an adjustment passing out through valve **22**. When the temperature is falling surrounding the tank, there is a tendency for the vapor space to lose heat and to contract. Initiation of contraction, however, tends to establish a vacuum on the tank. This may be allowed to proceed to the point where additional vacuum would open the vacuum release valve **24** and allow air to enter into the vapor space. Before this latter point is attained, however, the pressure controller system **10** is set so as to admit steam through line **20** directly into the vapor space of the tank. In the tank, the steam condenses giving up its latent heat to warm the vapors in the tank and produce an expansion to prevent the intake of air from the atmosphere. The condensed water sinks through the hydrocarbon product to the bottom of the tank where water from atmospheric condensation and other sources is always present and may be drawn off through line **26** from time to time. When the addition of steam has raised the temperature of the tank contents to such a degree that the pressure in the vapor space has increased almost to the setting of the pressure valve **28** on the vapor space, the pressure controller system **10** can be made to cut off the steam supply by means of the valve system **30**. Under these conditions, the amount of steam flowing into the vapor space will be such as to balance the pressure between the setting of the vacuum and pressure valves **24** and **28** respectively on the tank and no air will thus be drawn into the tank or discharged from it despite changes in external weather conditions.

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The advantages of protecting the product or minimizing the product loss are evident from the above description. Compared with other means of accomplishing the same end, the process proposed is much cheaper than changing tanks to floating roofs, and the providing of vapor balloons, etc. Almost no investment cost is involved to equip existing tanks with the system and the operating costs per year under average conditions have been estimated at only a few hundred dollars to effect a saving in the case of gasoline amounting to several thousand dollars.

The invention may be applied practically in the case of cone-roofs which are undergoing evaporation losses but which cannot economically be taken care of by existing systems. Thus a

given tank field may be too far from the gas plant to recover the losses economically and no space may be available for the installation of balloons to provide for the vapor space volume changes. Moreover, the cost of prior art installations is also relatively great while on the other hand, steam is or can be made easily available in such fields. Furthermore, the invention is of wide application. In the case of alcohols or other water miscible compounds, an indirect heat exchanger may be employed rather than injecting steam directly into the vapor space.

The invention now having been described and specifically illustrated, what is claimed is:

1. The method of reducing evaporation losses in closed storage equipment containing relatively volatile liquids which comprises first heating the closed vapor space just above the maximum temperature to which the storage equipment is to be exposed, then exposing the system to the temperatures of the atmosphere and passing into the vapor space steam in amounts so controlled by the vapor temperature as to maintain relatively uniform temperature conditions in the vapor space and to prevent an excessive pressure drop in the vapor space due to decreasing atmospheric temperatures.

2. The method according to claim 1 in which the amount of steam admitted varies inversely with the pressure in said vapor space.

3. In closed storage equipment containing relatively volatile liquids and exposed to the temperature of the atmosphere, the method of reducing evaporation losses, which comprises first heating the closed vapor space just above the maximum temperature to which the storage equipment is to be exposed, and then passing steam into the vapor space in amount so controlled by the vapor temperature as to maintain relatively uniform temperature conditions in the vapor space and to prevent an excessive pressure drop in the vapor space due to decreasing atmospheric temperatures.

4. In closed storage equipment containing a vapor space above relatively volatile liquids and exposed to varying atmospheric temperatures whereby the temperature of the vapors varies, the vapor space being shut off from communication with the atmosphere over a definite temperature range only, the method of reducing evaporation losses, which comprises introducing steam into the vapor space to heat the same to approximately the maximum temperature to which the vapors are expected to rise during a given increment of time but below the upper limit of said temperature range, then cutting down the flow of steam into the vapor space until the temperature within the vapor space approaches the lower end of said range of temperatures, then reintroducing steam into the vapor space in amount sufficient to offset the reduction in temperature whereby the temperature within the vapor space is maintained at all times within the said range during varying atmospheric temperatures.

5. In closed storage equipment containing a vapor space above relatively volatile liquids and exposed to varying atmospheric temperatures whereby the temperature of the vapors varies, the vapor space being shut off from communication with the atmosphere over a definite temperature range only, the method of reducing evaporation losses, which comprises introducing heat of steam into the vapor space to heat the same to approximately the maximum temperature to which the vapors are expected to rise during a given increment of time but below the upper limit of said temperature range, then cutting down the flow of steam heat into the vapor space until the temperature within the vapor space approaches the lower end of said range of temperatures, then reintroducing steam heat into the vapor space in amount sufficient to offset the reduction in temperature whereby the temperature within the vapor space is maintained at all times within the said range during varying atmospheric temperatures.

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