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C. A. BASORE ET AL
CONSERVATION ARRANGEMENT

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Fig. 1.

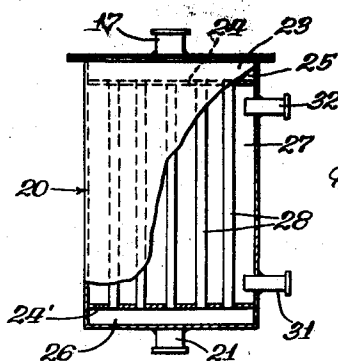
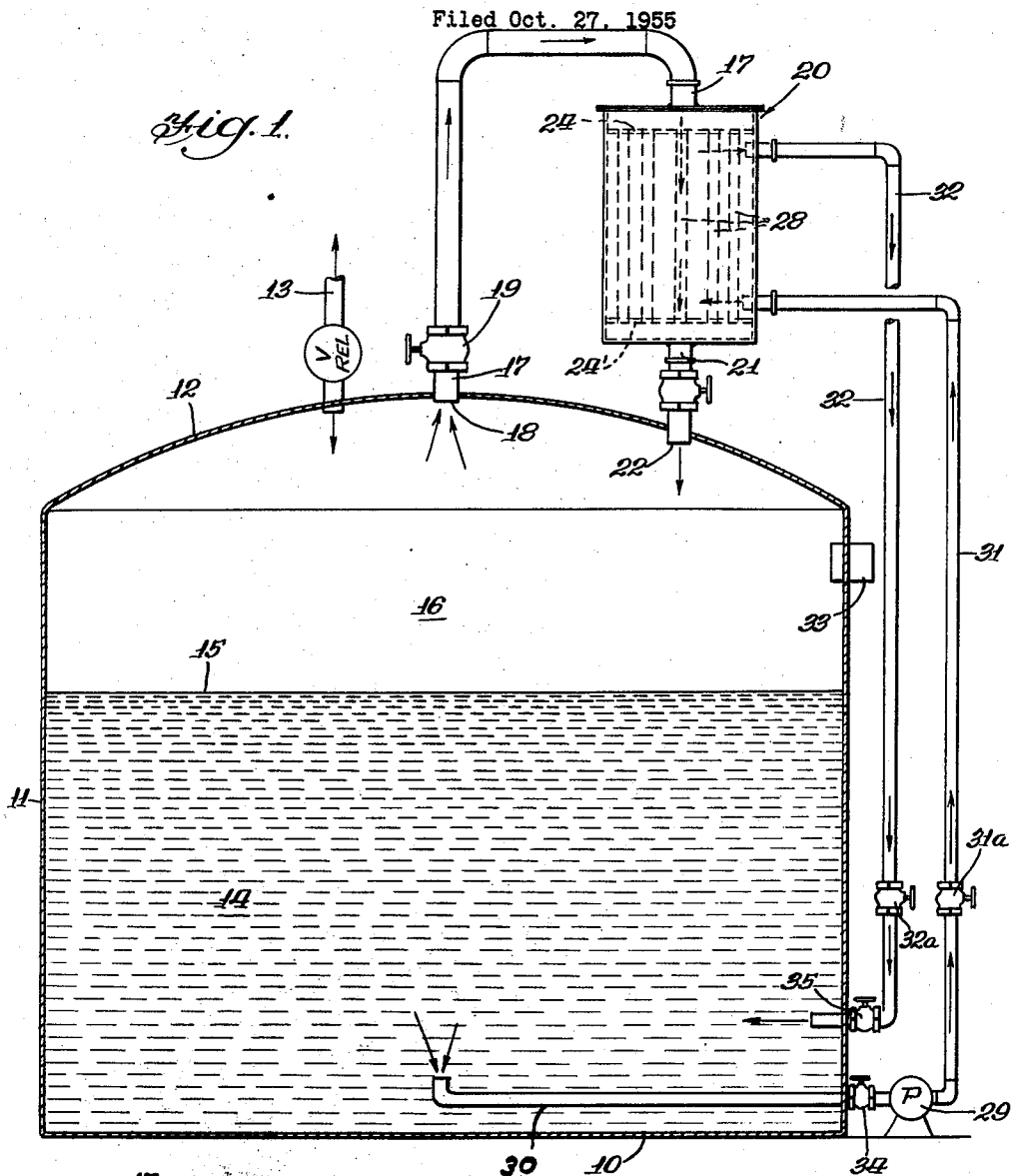


Fig. 2.

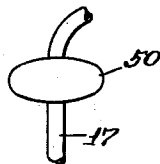


Fig. 3.

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CONSERVATION ARRANGEMENT

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This invention relates to means and method of preventing vapor losses in storage tanks and more particularly to a means and method of reducing differential pressure between the interior and exterior of a storage tank.

Storage tanks today are usually of the type which are mounted above ground and exposed to the elements of nature. These tanks, generally speaking, have a relatively thin wall which defines a space containing liquid in the bottom portion and fumes, gases and vapors in the top or chamber portion.

In the 24 hour cycle of a day the storage tank is usually subjected in the day time to the rays of the sun and general heating, and then at night to a period of cooling when the temperature of the ambient air is below the temperature to which the tank was previously heated. This cycle of heating and cooling is well known in the art, hence is not discussed in more detail.

During the heating phase, it is apparent that the rays of the sun are directed from various angles and at varying intensity on the tank, with substantially no rays being directed against the bottom. Hence, an uneven heating within the tank takes place whereby the liquid surface of the liquid within the tank is heated to a higher temperature than the remaining liquid. This uneven heating results in a relatively cool liquid core within the storage tank which causes a build-up in pressure due to volatilization of the heated surface and expansion of the original air and vapors.

With volatile liquids and fluids such as gasoline, naphtha, ammonium hydroxide and the like, the pressure build-up as a result of heating is appreciable, and if the temperature of the tank drops, a partial vacuum may be induced. For this and other reasons the prior art tanks have usually been provided with a pressure-vacuum relief valve which opens at a predetermined differential pressure to allow either escape of the vapor to the atmosphere when a pressure is built up in the tank or the taking in of air when a partial vacuum is induced in the tank.

It is apparent that many disadvantages accompany the operation of the pressure-vacuum relief valve. Uppermost among these disadvantages is that an appreciable amount of valuable product is lost when the vapors pass into the air. Another disadvantage is that the air which is taken into the tank during partial vacuum is available for expansion and pressure build-up on a following day and becomes a reactant to accelerate the corroding of the inside of the tank.

In the past many devices have been used in an attempt to reduce the pressure build-up in storage tanks and to prevent vapor losses therefrom. Generally these prior art devices may be classified as expansion roofs, floating roofs, vapor bags and refrigeration mechanisms. The devices which incorporate the expansion roofs or vapor bags operate on a principal of providing additional volume into which the vapors may expand, while the refrigeration mechanism attempt to convert the vapors back into liquid to be returned to the liquid phase in the storage

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tank. In the latter instance, the fluid constituting the vapors and gases in the chamber portion of the storage tank must, of necessity be condensable in order for the apparatus to function properly.

In the present invention, contrary to the prior art, the vapors and gases in the chamber portion of the storage tank need not be condensable, even though some condensation thereof may take place as will hereinafter be described.

Briefly, the apparatus of the present invention includes a circulation conduit or passage means which communicates with the vapor phase of the contents of a storage tank at a plurality of points. Circulation of the vapor through the conduit is induced by a temperature differential created by a heat exchanger in the path of the conduit. Many means may be employed as a coolant in the heat exchanger; however, the preferred embodiment of our invention, as hereinafter disclosed, utilizes the liquid phase of the contents of the tank as this coolant.

The method of our invention, wherein this apparatus is employed, may broadly be described as a process of inducing conditions favorable to equilibrium distillation; or, depending on the chemical nature of the liquid, conditions favorable to maximum absorbing or dissolving of the vapor phase into the liquid phase. As pointed out above, the contents of a storage tank are heated unevenly during the day portion of a 24-hour time cycle. Under these climatic conditions, the temperature of the surface of the liquid phase within the tank is much higher than the remaining liquid. In the vapor phase there is also uneven heating, with the vapors adjacent the walls and vapors adjacent the top being heated to a higher temperature than the vapor in the central portion of the tank.

By operating the apparatus of this invention, the vapors which are in the conduit are caused, by passing liquid from the liquid phase adjacent these vapors, to coalesce and become heavier. The heavier vapors, some of which may be condensed but do not necessarily have to be condensed, are directed by the conduit, down along the liquid surface to form what may best be described as a heavy vapor blanket. Concurrently the hot vapors from the sides and top of the tank are urged up and through the conduit where they, in turn, are cooled. As the operation continues, movement of the heavy vapors in the heat exchanger tends to aspirate additional hot vapors which are cooled and distributed as additional vapor to blanket over the liquid surface. Of course, during this process some of the condensed vapors return to the liquid phase.

With the relatively cool vapor over the liquid surface, equilibrium distillation conditions are set up whereby the rate of distillation or evaporation is reduced. Further, the cool vapors tend to cool the liquid surface, thus further reducing the tendency of the liquid to evaporate. The immediate effect of setting up equilibrium distillation conditions is to cause substantial absorption of the vapors of the blanket into the liquid phase, to appreciably reduce the positive pressure within the storage tank. Under these conditions the above operation reduces the positive pressure in the tank to such an extent that substantially no vapors are lost through operation of the conventional pressure-vacuum relief valve.

On the other hand, at night the system is not operated hence there is a pressure build up to overcome the partial vacuum normally encountered. While this operation is not completely understood at this time, it, in all probability, may be described as a gradual release of vapor from the supersaturated liquid surface and a gradual return of the system to one where the vapors and the liquid are in equilibrium at the existing temperature. The pressure build up to overcome the naturally encountered vacuum may be attributed to the fact that the reduction of the

pressure and volume of the vapors over the liquid caused by natural cooling, promotes the evaporation of part of the more volatile liquids into the vapor space. The resulting increase in the volume of the vapors nullifies the reduction in volume mentioned above. This is an application of Henry's law.

Accordingly, it is an object of the present invention to provide a means and method of maintaining the pressure, within a partially filled storage tank which is exposed to the atmosphere, within predetermined limits during the normal heating and cooling cycle of a day.

Another object of our invention is to provide a means and method of creating and maintaining a relatively high concentration of vapors or a heavy vapor blanket over the liquid surface of a liquid within a storage tank.

Another object of our invention is to provide a means and method of cooling the liquid surface of the liquid within a storage tank.

Another object of our invention is to provide a means and method for reducing vapor losses in a storage tank partially filled with liquid.

Another object of our invention is to provide a means for reducing vapor losses in storage tanks which means is economical to construct and install on conventional storage tanks, efficient in operation and durable in structure.

Other and further objects and advantages of our invention will become apparent from the following description when taken in conjunction with the accompanying drawings wherein like characters of reference designate corresponding parts throughout the several views, and wherein:

Figure 1 is a schematic, side elevational view of a conventional storage tank with the apparatus constructed in accordance with this invention being installed thereon.

Figure 2 is an enlarged fragmentary view, partly in section, of the heat exchanger of the apparatus shown in Figure 1.

Figure 3 is an enlarged fragmentary view of a portion of the apparatus herein disclosed and illustrating a modified embodiment of the invention.

Referring now in detail to the embodiment chosen for purpose of illustration, numeral 10 denotes the base of a conventional storage tank having the usual cylindrical body or side 11, and an upwardly concave formed top 12. While we have illustrated but a single embodiment of a storage tank, it will be apparent to those skilled in the art that our invention, as hereinafter disclosed, is applicable to many types of storage tanks and that the specific configuration of storage tank shown is but one of these types.

The conventional storage tank is also shown as having the customary pressure-vacuum relief valve 13 in top 12, which valve communicates with the interior of the tank to allow escape of vapors when a pressure is built up within the tank, and also to permit the taking in of ambient air when a vacuum is induced in the tank. According to the prior art, this pressure-vacuum relief valve 13 may be set to open when there is $\frac{3}{4}$ to $4\frac{1}{2}$ ounces per square inch or more of pressure exerted by the fluid within the tank or when there is a vacuum of approximately $\frac{1}{2}$ ounce per square inch or more within the tank. Of course, the pressure-vacuum relief valve may be set to function at other differential pressure limits; however, it is within the above stated limits of pressure and vacuum that the present invention is particularly adapted to operate.

For purpose of illustration, the storage tank is shown in Figure 1 as being partially full of liquid 14. The type and chemical composition of the liquid is not of great importance in the operation of this invention; however, as pointed out above, the present invention is adapted to volatile liquids of the type usually found in storage tanks and particularly petroleum and its products. The surface 15 of liquid 14 may be higher or lower in the tank, depending upon the quantity of liquid stored. As seen in Figure 1, the liquid surface 15 divides the tank into

a chamber portion 16, and a liquid portion, containing liquid 14.

According to our invention, a pipe 17 is mounted on the roof 12 with the inlet port 18 of the pipe projecting through roof 12 to communicate with chamber portion 16. Pipe 17 extends upwardly and externally of the storage tank and then projects horizontally and downwardly to terminate above roof 12. In some instances it may be found desirable to provide a valve, such as valve 19 in the passage of pipe 17. This valve 19 is used to open and close the passage way of pipe 17 to thereby permit or prevent travel of fluid through pipe 17.

The free end of pipe 17 communicates with a heat exchanger denoted generally by numeral 20. In the present embodiment this heat exchanger 20 is mounted above roof 12 and is connected thereto by a pipe 21 which provides a channel between heat exchanger 20 and chamber portion 16 of the storage tank. Pipe 21 is so connected to roof 12 that its discharge port 22 is spaced from the inlet port 18. The exact location of the respective ports is not critical and it is apparent to those skilled in the art that a plurality of ports and passage ways may be provided for the passage of fluid to and from the heat exchanger. It is desirable, however, that pipe 21 and discharge port 22 direct the fluid toward liquid surface 15.

As best seen in Figure 2, heat exchanger 20 includes a hollow casing 23 and plates 24, 24'. Plates 24, 24' are normally disposed horizontally in casing 23 to divide the same into an upper cavity 25 in communication with pipe 17, a lower cavity 26 in communication with pipe 21 and a central cavity or intermediate chamber 27. Disposed vertically within casing 23 are a plurality of spaced heat exchanger pipes 28 which are retained in position by their respective ends being seated in appropriate apertures in plates 24, 24' thereby providing a plurality of spaced passageways between cavities 25 and 26.

It will now be seen that we have provided a completely closed system wherein the ends of an inverted U-shaped pipe communicate with the chamber portion 16 of the storage tank and that interspersed in the passage of this inverted U-shaped pipe is a valve 19 and a heat exchanger 20. Therefore, under proper conditions, gas and vapors may travel from chamber portion 16, up through pipe 17 past open valve 19 and into upper cavity 25. Thence, down through the channels of pipe 28 through lower cavity 26, through pipe 21 to return to chamber portion 16. It should be noted that any number of pipes 26 within heat exchanger 20 may be provided, that is, there may be one pipe or a plurality of pipes depending upon the size and other easily determinable technical characteristics of the storage tank to which the invention is applied.

To provide a means of circulating a coolant to and from the heat exchanger 20, a suitable pump 29 is positioned adjacent the liquid containing portion of the storage tank. A liquid supply tube 30 is connected between the suction end of pump 29 and extends through side 11 of the storage tank to provide communication between the central portion of liquid 14 and the pump 29 so that pump 29 is provided with a source of relatively cool liquid. The discharge of pump 29 is connected to discharge tube 31 which extends upwardly to terminate at heat exchanger 20 with the mouth of tube 31 in communication with central cavity 27.

To return the liquid in central cavity 27 to the liquid container portion of the storage tank a return tube 32 leads from central cavity 27 and extends downwardly and then through side 11 to a position below the normal level of liquid surface 15. It is desirable to space the respective openings of tubes 30 and 32 which are connected to side 11 since, in this way, circulation of liquid 14 is accomplished when pump 29 is operating. In some instances it may be found desirable to extend liquid supply tube 30 to approximately the axial center of the

storage tank or to other locations to provide access to the relatively cool portion of liquid 14.

It is readily apparent to those skilled in the art that other sources of coolant are available and that in locations where an abundant water supply is available, it may be found advantageous to connect liquid supply tube 30 to the water supply and discharge this circulated water externally of the storage tank, by relocating the discharge end of return tube 32. For this purpose gate valves 31a and 32a are provided in the tubes 31 and 32, respectively.

It will be noted that pump 29 may be any type of conventional pump which will supply sufficient head and capacity to circulate the coolant in sufficient volume for the purposes hereinafter described. It will also be understood that pump 29 may be operated in any conventional manner but since it is preferably to coordinate the action of pump 29 with the build up of pressure within the storage tank, a pressure static switch 33 is connected in communication with chamber portion 16 to actuate pump 29 through appropriate electrical connections (not shown) whereby pump 29 is started and stopped in response to the action of switch 33.

Valves such as valves 34 and 35 may be connected to supply tube 30 and return tube 32, respectively, to seal the coolant in the tubes when the pump is not in operation.

In the operation of the invention, it will be understood that the relief valve 13 is set to open at a predetermined pressure above atmospheric. It will also be understood that switch 33 may be arranged to operate at a pressure less than the opening pressure for the operation of valve 13 whereby upon pressure build-up within chamber portion 16, switch 33 will be actuated to start pump 29 before valve 13 opens. As the sun comes up in the morning, its rays strike the skin or surface of the storage tank, and warms it. Thus, heat is transferred to the gases, vapors, fluids, and liquids which are internally adjacent the surface of the tank. As the sun continues its travel, it is apparent that its rays are directed more and more against roof 12 and therefore, that portion of the fluid within the storage tank which is immediately adjacent roof 12 is usually heated to a greater extent than the remaining vapors and gases. Further, heat is transmitted, probably to a large extent by radiation from the inner surface of roof 12 and also to some extent by convection, to liquid surface 15. It is thus seen that a condition is set up within the tank where the mean temperatures of the gases and vapors in chamber portion 16 of the tank are increased and the temperature of liquid surface 15 is increased leaving a relatively cool volume of liquid 14 in that area of the tank below liquid surface 15. This condition results in a build-up of pressure in chamber portion 16 because of expansion of the gases and vapors within chamber portion 16 and because of evaporation of liquid from the liquid surface.

Now, according to Henry's law, the quantity of gas dissolved in a given quantity of solvent or solution is directly proportional to the gases' partial pressure over the solution. Henry's law applies for the individual components of a gaseous mixture as well as for a single pure gas, the concentration of each component dissolved being, according to the law, proportional to its own partial pressure and not the total gas pressure. Theoretically Henry's law holds true over the range of pressures and temperatures contemplated by this invention. Deviations from this law will occur if liquid 14 and the gases or vapors in chamber 16 undergo molecular change in solution such as dissociation, association or combination with each other. However, in general the law will be followed by substantially all liquids which are contained in storage tanks, those deviations which do occur will usually tend to decrease rather than increase the total pressure exerted in chamber portion 16. Further, Raoult's law states that in vapor-liquid equilibrium the partial

pressure of any component in a liquid is equal to the product of its mole fraction in the liquid and the vapor pressure of the pure component at the same temperature.

From the above laws it will be seen that the area in chamber 16 directly over the liquid surface 15 has a profound effect on the rate of distillation or dissociation. In general it can be said those liquids which have a high vapor pressure have a correspondingly low boiling point since boiling occurs when the vapor pressure of the constituent under standard conditions reaches atmospheric pressure. Thus, the low boiling point constituents of liquid 16 exerts relatively higher partial pressures.

Assume now that liquid 14 is a petroleum product containing for example pentane and hexane. As the storage tank is heated by the sun, the lighter fractions, pentane, will distill or dissociate first and then with further heating the heavier fraction, hexane, in larger quantities will distill or dissociate from the liquid. With this distillation or dissociation, the pressure within chamber 16 increases sufficiently to actuate pressure static switch 33 to start pump 29. Thus, relative cool liquid from liquid 14 is circulated through central cavity 27. This circulation tends to cool those vapors and gases in the heat exchanger pipes 28 to cause the vapors to coalesce, become heavier and pass by gravity and by heat differential circulation down through lower cavity 26 through pipe 21 into chamber 16. Because these coalesced vapors are generally heavier than the surrounding vapors they continue to travel down adjacent liquid surface 15 where some of the vapors reassociate with the liquid 14 while a substantial portion of the remaining coalesced vapors distribute themselves immediately above liquid surface 15.

The coalescing of the vapor as described above has an asperating effect within heat exchanger pipes 28 to thus draw additional vapors and gases through pipe 17 and into the heat exchanger pipes 28. Thus it is seen that a circulation of vapors and gases is set up wherein a portion of the vapors and gases in chamber portion 16 is cooled, coalesced and returned to chamber portion 16, as a vapor blanket along liquid surface 15.

Attention is now directed to Figure 3 which shows the pipe 17 which normally interconnects the chamber 16 and the cavity 25 of the heat exchanger 20. In this embodiment a blower 50 is positioned in the line of the pipe 17 to induce or speed up the circulation of the vapors on those tank installations where the tank size or other conditions such as severe climatic conditions require a vapor flow greater than that induced by the gravity flow described above.

It will be understood that the immediate effect of the circulation of liquid 14 in heat exchanger 20 is an appreciable lowering in the positive pressure within the storage tank. This lowering of pressure cannot be entirely explained by a simple cooling of the vapors. Instead, the concentration of vapors immediately above the liquid surface 15, cools the liquid surface and set up equilibrium distillation conditions. The vapors immediately above the liquid surface 15, that is, the vapor blanket is such that any additional pressure build-up will cause a forcing of this vapor into the liquid. Further, the mole fraction concentration of each vapor is such as to discourage its complementary fraction in the liquid phase from vaporizing.

At night the vapors of the vapor blanket tends to dissipate itself into the other gases and vapors, thereby tending to oppose the creation of a vacuum in the tank.

It will be obvious to those skilled in the art that many variations may be made in the embodiment chosen for purpose of illustration without departing from the scope of my invention as defined by the appended claims.

We claim:

1. In a conservation apparatus for use with a volatile liquid storage tank, said tank defining a liquid containing portion and a chamber portion wherein vapors collect;

the combination of a plurality of openings communicating with the chamber portion, passage means interconnecting said openings and establishing closed constant volume communication therebetween, said passage means being disposed externally of said chamber portion and temperature changing means operatively associated with said passage means to cool said vapors and induce circulation thereof through said passage means, said temperature changing means comprising a chamber surrounding a segment of said passage means and additional means associated with said chamber for circulating a substance therethrough to effect a temperature change of the segment of said passage means, said circulating means comprising passageways for establishing a closed communicating circuit between the chamber and a source of said substance external of the chamber, and a pump mechanism in at least one of said passageways to effect said circulation.

2. A conservation apparatus according to claim 1, wherein one of said openings communicates with said chamber portion at a point vertically above the other of said openings.

3. The conservation apparatus of claim 1, wherein there is additionally provided means to selectively control the operation of said mechanism to provide intermittent circulation of said substance.

4. A conservation apparatus according to claim 3, wherein said last mentioned means is responsive to the pressure in said chamber portion.

5. A conservation apparatus according to claim 3, wherein said last mentioned means comprises a pressure switch arranged to operate said mechanism when the pressure in said chamber portion reaches predetermined limits above or below atmospheric pressure.

6. A conservation apparatus according to claim 1, wherein said source is said liquid containing portion, and the substance comprises the liquid in said last mentioned portion.

7. A conservation apparatus according to claim 5, wherein said source is said liquid containing portion, and said substance is the liquid in said last mentioned portion.

8. In a method of conserving vapors in a tank used for storing volatile liquids, said tank having a liquid containing portion and a vapor containing portion; the steps of accommodating emission of part of the vapor in said vapor portion from one point in said vapor portion, circulating said vapor externally of said vapor portion, changing the temperature of said circulating vapor during said circulation by moving liquid from said liquid portion into such physical relation with the circulating vapor to effect the heat transfer therebetween, and depositing said circulated vapor into said vapor portion.

9. The method of claim 8, wherein there is additionally provided a step of controlling the circulation of the liquid in such a manner that said liquid circulation is responsive to the pressure in said vapor portion.

10. Apparatus for retarding pressure build up in a storage tank mounted at least partially above ground and incidentally subjected to the rays of the sun, said storage tank also having a conical roof and a chamber portion below said roof and a liquid containing portion below said vapor containing portion, said liquid containing portion normally having liquid therein and said chamber portion normally containing vapors from said liquid therein, means to release said vapors from said chamber portion when said pressure in said storage tank reaches a predetermined pressure above the pressure of said ambient air and to permit the influx of ambient air into said storage tank when said storage tank reaches a predetermined vacuum below the pressure of said ambient air, comprising a first pipe mounted externally of said storage tank at the apex of said roof, the entrance to said pipe being in communication with said chamber portion, said first pipe extending upwardly and then horizontally and then downwardly, a vertically disposed second pipe mounted on said

roof and having an exit in communication with said chamber portion at a position spaced from said entrance of said first pipe, said second pipe being aligned with the downwardly extending portion of said first pipe, a heat exchanger externally of said storage tank and connected between the free end of said first pipe and on the top of said second pipe, and means for circulating said liquid from said liquid containing portion through said heat exchanger and back to said liquid containing portion.

11. Apparatus for retarding pressure build up in a storage tank mounted at least partially above ground and incidentally subjected to the rays of the sun, said storage tank having a roof and a chamber portion below said roof and a liquid containing portion below said vapor containing portion, said liquid containing portion normally having liquid therein and said chamber portion normally containing vapors from said liquid therein, comprising a first pipe mounted externally of said storage tank on said roof, the entrance to said pipe being in communication with said chamber portion, a second pipe mounted on said roof and having an exit in communication with said chamber portion at a position spaced from said entrance of said first pipe, a heat exchanger mounted above said storage tank and connected between the free end of said first pipe and on the free end of said second pipe, said heat exchanger being provided with an upper cavity and a central cavity and a lower cavity in vertical relationship to each other, said upper cavity communicating with said first pipe, said lower cavity in communication with said second pipe, said heat exchanger being further characterized by a plurality of vertically disposed heat exchanger pipes extending through said central cavity and forming a path between said upper cavity and said lower cavity, conduit means for the circulation of said liquid from said liquid containing portion through said central cavity and back to said liquid containing portion, pump means connected to said conduit means for circulating said liquor, and control means responsive to the pressure in said tank for actuating said pump means.

12. Apparatus for retarding pressure build up in a storage tank mounted at least partially above ground and incidentally subjected to the rays of the sun, said storage tank being provided with a pressure-vacuum relief valve which opens when the pressure differential between the ambient air and the interior of the storage reaches predetermined limits, said storage tank also having a conical roof and a chamber portion below said roof and a liquid containing portion below said vapor containing portion, said liquid containing portion normally having liquid therein and said chamber portion normally containing vapors from said liquid therein, said pressure-vacuum relief valve being mounted in said roof in communication with the upper portion of said chamber portion to release said vapors from said chamber portion when said pressure in said storage tank reaches a predetermined pressure above the pressure of said ambient air and to permit the influx of ambient air into said storage tank when said storage tank reaches a predetermined vacuum below the pressure of said ambient air, comprising a first pipe mounted externally of said storage tank on said roof, the entrance to said pipe being in communication with said chamber portion at the apex of said roof, a vertically disposed second pipe mounted on said roof and having an exit in communication with said chamber portion at a position below and spaced from said entrance of said first pipe, a heat exchanger externally of said storage tank and connected between the free end of said first pipe and on the top of said second pipe, said heat exchanger being provided with an upper cavity and a central cavity and a lower cavity in vertical relationship to each other, said upper cavity communicating with said first pipe, said lower cavity communicating with said second pipe, said heat exchanger being further characterized by a plurality of vertically disposed heat exchanger pipes extending through said central cavity and forming a path

between said upper cavity and said lower cavity, conduit means for circulation of said liquid from said liquid containing portion through said central cavity and back to said liquid containing portion, pump means connected to said conduit means for circulating said liquid in said conduit means, and means responsive to pressure with said tank for actuating said pump means.

13. Apparatus for retarding pressure build up in a storage tank mounted at least partially above ground and incidentally subjected to the rays of the sun, said storage tank being provided with a pressure-vacuum relief valve which opens when the pressure differential between the ambient air and the interior of the storage reaches predetermined limits, said storage tank also having a roof and a chamber portion below said roof and a liquid containing portion below said vapor containing portion, said liquid containing portion normally having liquid therein and said chamber portion normally containing vapors from said liquid therein, said pressure-vacuum relief valve being mounted in said roof in communication with the upper portion of said chamber portion to release said vapors from said chamber portion when said pressure in said storage tank reaches a predetermined pressure above the pressure of said ambient air and to permit the influx of ambient air into said storage tank when said storage tank reaches a predetermined vacuum below the pressure of said ambient air, comprising a first pipe mounted externally of said storage tank on said roof, the entrance to said pipe being in communication with said chamber portion, a vertically disposed second pipe mounted on

said roof and having an exit in communication with said chamber portion at a position spaced from said entrance of said first pipe, a heat exchanger externally of said storage tank and connected between the free end of said first pipe and on the top of said second pipe, said heat exchanger being provided with an upper cavity and a central cavity and a lower cavity in vertical relationship to each other, said upper cavity communicating with said first pipe, said lower cavity communicating with said second pipe, said first and second heat exchanger pipes extending through said central cavity and forming a path between said upper cavity and said lower cavity, and means for circulating said liquid from said liquid containing portion through said central cavity and back to said liquid containing portion.

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