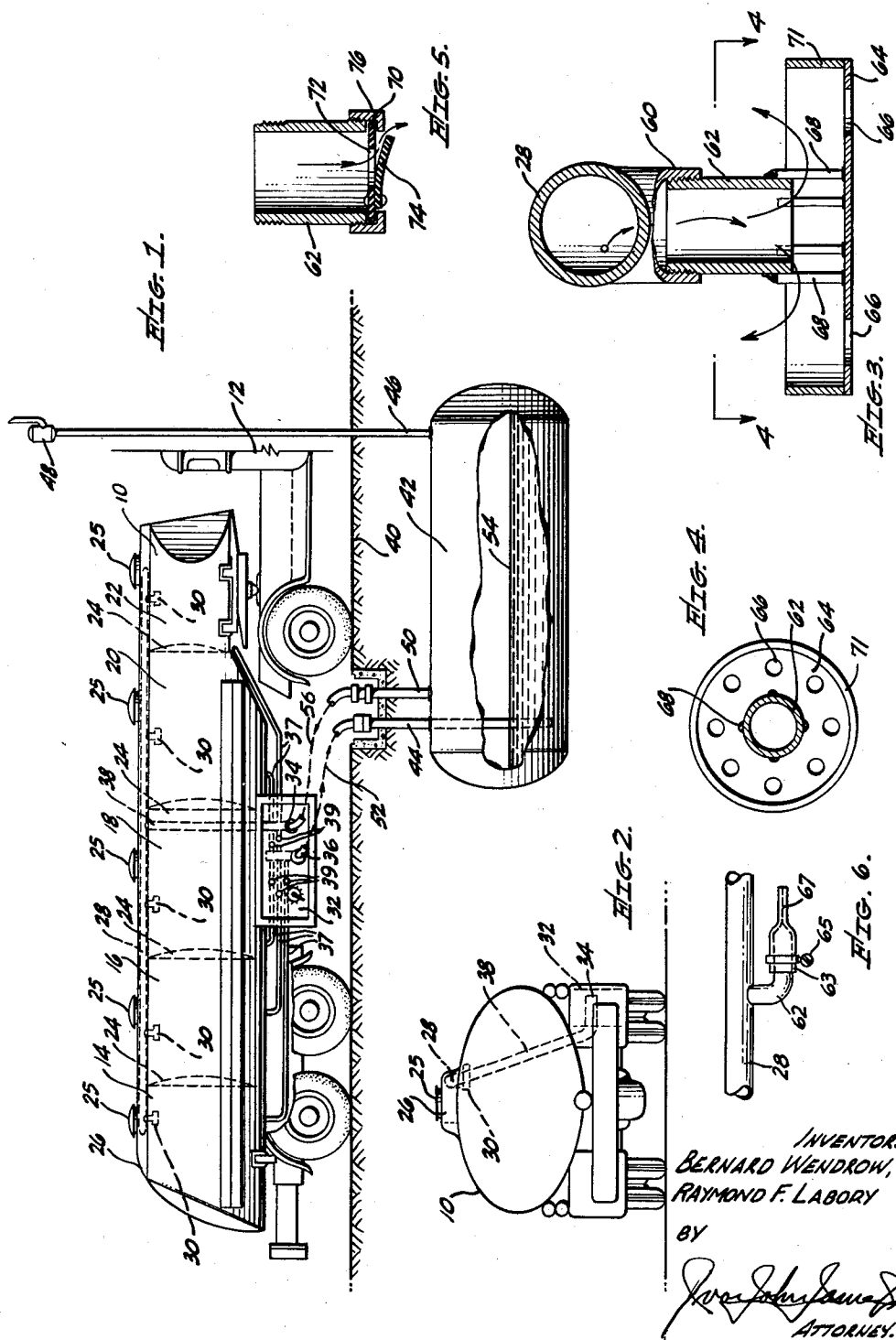


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VAPOR SEALED LIQUID CARRIERS

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VAPOR SEALED LIQUID CARRIERS

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This invention relates to the dispensing of liquids and particularly to apparatus for liquid dispensing and simultaneous vapor recovery. More particularly this invention relates to an improved apparatus for the transfer of volatile liquids of relatively low boiling point such as in the filling of vessels therewith under circumstances involving the generation and/or displacement from the vessel of relatively large quantities of vapors.

Light, low boiling liquids present considerable problems from air pollution and fire explosion hazard standpoints during the transfer thereof from one vessel to another. Such liquids comprise solvents including the low molecular weight alcohols, ketones, and esters, and including the light hydrocarbon solvents such as naphtha, and the relatively low boiling internal combustion engine fuels such as gasoline. These liquids have relatively high pressures under normal temperature conditions and evaporate very readily, especially during agitation. The vaporization occurs at substantial rates from vessels open to the atmosphere and occurs at considerably higher rates when the liquid is in motion such as during the introduction of liquid into the vessel. Exceedingly high rates of vaporization occur when the liquid is introduced into the vessel under conditions which cause it to splash either against the bottom or walls of the vessel or against the liquid level therein.

Under these conditions of liquid transfer where vaporization takes place, serious hazards due to possibility of fire and/or explosion, fume generation, and air pollution present themselves. Furthermore, these light solvents are frequently very expensive and any vaporization loss is expensive and wasteful of materials. Often local regulations govern the type and amount of such vaporized materials which can be handled in the open air in order to minimize the possibility of air pollution or the damage from fire or explosion.

One specific application of this invention is in the delivery of volatile liquids from tank trucks, railroad cars, tank ships, and other liquid carriers into other vessels such as storage tanks. Particularly this invention is applicable to the delivery of gasoline in tank trucks to the underground storage drums at service stations. This is not to be considered limiting however, since the same invention is well applied to the delivery of such volatile fuels such as gasolines, solvents, and the like from any portable container to any stationary or non-stationary storage tank.

Tank trucks and railroad cars, which will be hereinafter discussed by way of illustration only, have liquid capacities which vary from about 4,000 to 8,000 gallons for trucks, while railroad cars have capacities on the order of from 30,000 to 50,000 gallons. In emptying liquids from such tanks, and depending upon the circumstances and the manner in which they are unloaded, displaced vapors evolve from the tanks being filled amounting to between about 0.5 and about 5.0 gallons of vaporized material per thousand gallons of liquid unloaded.

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Beside constituting an economic loss, there is thus generated a serious fire and explosion hazard with flammable liquids and in many cases atmospheric contamination occurs which is highly undesirable.

Such apparatus as described below according to this invention is efficiently operated in conjunction with improved stationary vapor recovery equipment presently available at tank truck and tank car loading stations. The vapors displaced at the delivery point into the carrier tank by the means of this invention are again displaced from the carrier tank when it is reloaded at the liquid source. This displaces the recovered vapors into suitable vapor treating equipment whereby the volatile liquid is recovered from the displaced air. At petroleum refineries this displaced vapor can be displaced from the carrier tank on refilling into vapor recovery equipment consisting of oil adsorbers, solid adsorbent treaters, compression and cooling systems, and the like to recover the gasoline vapor.

It is therefore a primary object of the present invention to provide improved liquid carrying and delivery equipment which is sealed against vapor loss.

It is a more specific object of this invention to provide improved tank truck and railroad car apparatus for the delivery of volatile and flammable liquids whereby the complete recovery of evolved vapors is permitted.

Other objects and advantages of the present invention will become more apparent to those skilled in the art as the description and illustration thereof proceed.

Briefly the present invention comprises a portable delivery tank, such as tank truck or railroad car or tank ship, operated between a source of volatile liquid and a delivery point for the liquid. The delivery point includes a stationary storage or receiving tank provided with a conventional liquid inlet, and ordinarily provided with a vapor vent or escape line. According to this invention a relief valve, adjusted to open at a low pressure of 0.1-5.0 p.s.i., is added to the existing vent line and a new vapor outlet line is added, usually disposed adjacent to the liquid inlet.

The portable delivery vessel is modified to provide a vapor header communicating all individual liquid compartments which may be provided in the vessel and to this vapor header is provided a new vapor connection. Both the delivery vessel and the storage vessel involved in the apparatus of this invention are thus provided with a liquid and vapor connection preferably disposed adjacent each other. Two portable connections such as hoses or the like then connect the liquid connections and the vapor connections respectively. When the liquid is then drained or pumped from the delivery vessel into the storage vessel, the displaced vapor from the receiving vessel passes back through the vapor connections into the increased vapor space present in the delivery vessel. In most cases there need be no vapor escape whatsoever and all the vapor displaced from the storage vessel accumulates in the delivery vessel. The portable delivery vessel is returned to the source at which point it is refilled thereby delivering the recovered vapors back to suitable treating facilities to separate volatile materials in the vapor phase from this volume of vapor. Only under unusual circumstances, as where excessive turbulence occurs or where liquid delivers into a warmer storage tank than the delivery tank from which it is taken, is any material quantity of excess vapor generated which need be vented. In these instances the excess vapor is vented to the atmosphere to prevent undue pressure generation in the system or interference with the liquid delivery from taking place.

It is thus seen that employing this invention, no vapor is lost to the atmosphere to constitute a hazard or cause

atmospheric contamination and that the vapor is accumulated in the portable delivery tank for return to suitable treating facilities which permit its recovery.

The present invention will be more readily understood by reference to the accompanying drawings in which:

Figure 1 is a side elevation view showing a portable delivery tank connected to a stationary storage tank utilizing the improvements of the present invention,

Figure 2 is an end view of the delivery tank showing the disposition of the vapor manifold and the vapor connection,

Figure 3 is a detailed cross section view of one form of baffle employed at the points of connection between the vapor manifold and the individual compartments in the delivery tank,

Figure 4 is a view of the apparatus in Figure 3 taken at right angles thereto, and

Figure 5 shows an alternate means for preventing liquid entry into the vapor manifold.

Figure 6 shows still another means for preventing liquid entry into the vapor manifold.

Referring now more particularly to Figure 1, the apparatus shown is illustrative of the system of liquid delivery according to the present invention as applied to the delivery of gasoline from tank trucks and trailers to underground storage drums at gasoline service stations. In Figure 1 tank trailer 10 drawn by truck 12 is provided with a plurality of compartments 14, 16, 18, 20, and 22. These are separated one from the other by several dished heads 24. Each compartment has a separate liquid inlet or loading hatch 25. In the dome 26 of trailer 10 is provided an elongated vapor manifold 28 which opens through a series of connections 30 into each compartment.

Trailer 10 is provided along its lower side with meter and unloading valve compartment 32. Within this compartment is a vapor inlet connection 34 and liquid outlet connection 36. The vapor inlet communicates through line 38 with vapor header 28. Liquid outlet 36 communicates by means of lines 37 controlled by valves 39 with each of the individual compartments so that individual unloading of different liquids may be effected.

Disposed below ground level 40 is storage tank 42. Tank 42 is provided with liquid inlet 44 and the usual existing vent pipe 46. According to the present invention vent pipe 46 is provided with a new vent valve 48 and a new valve vent line 50. Liquid inlet line 44 is shown extending down through tank 42 to a point near the bottom thereof and this serves to minimize vapor generation so that the vapor displaced ordinarily from such a tank is very nearly equal in volume to the volume of liquid introduced into the tank.

The liquid from the tank trailer 10 is discharged through its liquid outlet 36 and through a flexible hose or conduit indicated generally as 52 connected to liquid inlet line 44 of the underground storage tank 42. As this liquid is quietly discharged into the storage tank, liquid level 54 therein rises reducing the vapor space above it and displacing a substantially equal volume of vapor through vapor outlet 50, through vapor hose 56, through vapor inlet 34 on tank trailer 10, and through the vapor header 28 to the compartment or compartments being emptied.

In the preferred modification of this invention the already existing liquid inlet 44 on the delivery tank 42 and the already existing outlet 36 on the tank trailer 10 is used in this invention together with the flexible hose for connecting these two points. At some point in the vapor flow path a check valve is provided which permits flow only out of the stationary tank into the tank trailer. Preferably this check valve is disposed at the vapor inlet on the tank trailer and the flexible vapor hose connected thereto is provided with an actuating pin which serves to open the vapor inlet to the truck only

when the hose is connected and after the truck has been positioned to deliver its liquid cargo.

Referring now more particularly to Figure 2, an end view of the tank trailer 10 in Figure 1 is shown illustrating vapor dome 26 and showing the disposition of vapor header 28 and baffles 30 therein. Vapor inlet line 38 opens upwardly through tank 10 to header 28 from the inlet connection 34 in pump and unloading valve compartment 32.

Referring now more particularly to Figure 3 an elevation view in partial cross section of baffle means indicated generally at 30 in Figures 1 and 2 is shown. Herein the end view of vapor manifold 28 is indicated provided with a downwardly opening connection 60. A short section of steel tubing 62 is threaded into the downwardly opening connection 60. From the steel tube a transverse baffle 64 provided with a vertical circular flange 71 and further provided with openings 66 in its lower surface is suspended by means of several steel rods 68. The direction of vapor flow from header 28 past this baffle means and into the individual tank compartments is indicated by the arrows. The purpose of this baffle is to prevent any of the liquid contents present in each of the compartments from splashing into the vapor header and impeding entry of the vapor through the header. Any liquid readily drains from connection 60 through openings 66.

In Figure 4 is shown a view at right angles of the device shown in Figure 3. Tubular element 62, baffle element 64 provided with vertical circular flange 71 and apertures 66, and the connecting rods 68 are all shown herein.

Referring now to Figure 5, an alternate and preferred element for preventing liquid entry into the vapor manifold is shown. Steel tube 62 is shown, as in Figure 3, adapted to be attached to vapor manifold 28 by means of threaded connection 60. A normally closed flapper valve is employed consisting of stationary member 70 provided with opening 72 and flapper element 74. The stationary element may be fabricated of metal or of the same or similar resilient material as the flapper element 74. For service with hydrocarbons, synthetic rubber such as neoprene and the like is used in the flapper. Other materials with these qualifications can be selected considering the properties of the liquids being handled.

The flapper 74 normally closes opening 72 so that no liquid can enter vapor manifold 28 from the compartment. Also of significance is the fact that the compartments are sealed from one another so that no vapor interchange can occur between them. This permits carriage of different liquids in each compartment without danger of contamination. When one compartment discharges, the liquid level drops, forcing the displaced vapors through the vapor manifold forcing only the appropriate flapper valve open, and flow into that same compartment.

Referring particularly to Figure 6 which shows another element for preventing liquid entry into the vapor manifold, steel tube or nozzle 62 is shown to be connected to a synthetic rubber valve. The valve consists of tubular portion 63, clamp 65 and flattened portion 67. The flattened portion is held normally closed by the resilience of the material of which it is constructed but opens for vapor flow when the pressure in the compartment is less than that in the manifold system.

The present invention has been described specifically with respect to the delivery of volatile liquids from tank trucks and railroad cars and the like together with provision for recovering valuable or dangerous vapors displaced during liquid delivery. It should be understood, as indicated above, that the same invention may be employed in connection with the recovery of such vapors as they are evolved during the delivery of such liquids from tank trucks, trailers, railroad cars, tank ships, barges, and any other portable or moveable carrier for liquids.

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A particular embodiment of the present invention has been hereinabove described in considerable detail by way of illustration. It should be understood that various other modifications and adaptations thereof may be made by those skilled in this particular art without departing from the spirit and scope of the invention as set forth in the appended claims.

We claim:

1. An apparatus for dispensing a volatile liquid without vapor loss and atmospheric contamination, which comprises a movable delivery vessel, which vessel contains a plurality of individual compartments, a liquid receiving vessel, separate liquid inlet means communicating with each of said compartments, separate valve controlled liquid outlet means from the bottom of each of said compartments, said outlet means communicating with a conduit for liquid which in turn communicates with said liquid receiving vessel, thus permitting the flow of liquid from individual compartments of said delivery vessel to said receiving vessel, a conduit for vapor opening from the top of said receiving vessel and communicating with a vapor manifold conduit extending along the top of said delivery vessel adjacent each of said compartments, means connecting said vapor manifold conduit with the top of each of said individual compartments, said connecting means having means at their lower ends and located within each of said individual compartments for preventing entry of liquid from said compartments into said vapor manifold conduit and for preventing liquid flow between said individual compartments, and means for venting vapor from the closed system thus formed only upon generation therein of pressures in excess of a predetermined value.

2. An apparatus according to claim 1 wherein said means for preventing entry of liquid into said vapor manifold conduit and for preventing liquid flow between said compartments comprises a perforated plate dependent from said connecting means and disposed substantially horizontally in the top of each of said compartments and

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a substantially vertical circular flange extending upwardly from the outer edge of said plate.

3. An apparatus according to claim 1 wherein said means for preventing entry of liquid into said vapor manifold conduit and for preventing liquid flow between said compartments comprises a flapper valve of resilient material dependent from said connecting means, said flapper valve being normally closed and adapted to be opened by the existence of a pressure in said compartment which is less than that on the other side of the flapper valve disposed in that compartment.

4. An apparatus according to claim 1 wherein said means for preventing entry of liquid into said vapor manifold conduit and for preventing liquid flow between said compartments comprises a valve dependent from said connecting means, said valve being constructed essentially of resilient material and of tubular cross section at one end and flattened at the other, said valve being normally closed at the flattened end by the resiliency of the material and having a clamp means connecting the tubular end of said valve to said connecting means, said valve thus being adapted to be opened by the existence of a pressure in said compartment which is less than that on the other side of said valve.

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