

[54] GASOLINE VAPOR RECOVERY

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220/85 VR

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62/50, 51, 54, 17; 220/85 VR, 85 VS

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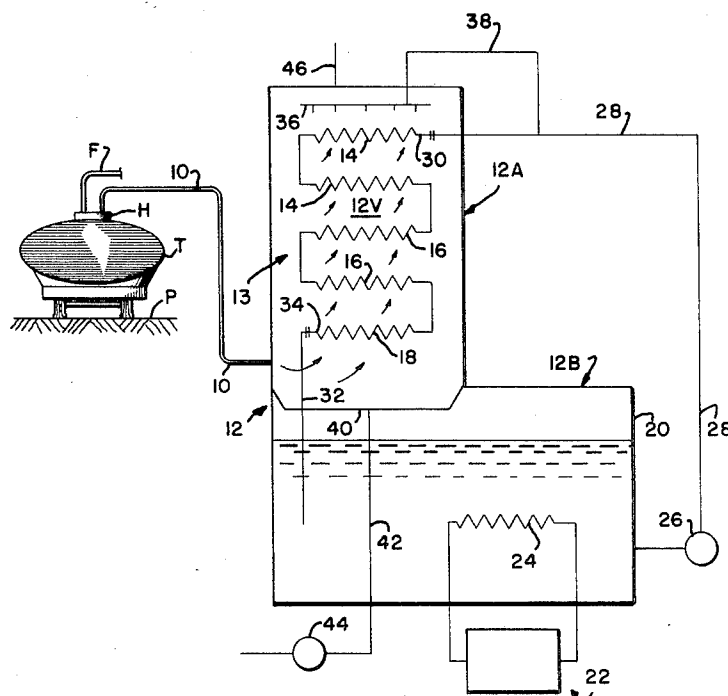
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[57]

ABSTRACT

A vapor recovery device in which the vapors expelled from a tank into which gasoline is being pumped is conducted into a container in which cooling coils are disposed for cooling of the vapors flowing upwards around these coils. Also disposed in the container, downstream of the flow path of the vapors, is a spray ring for spraying refrigerated gasoline downwardly for absorption of the vapors cooled by the cooling coils. The coolant for the cooling coils and the spray ring is obtained from the lower section of the container containing gasoline refrigerated by means of a commonly known refrigeration system. The device may include beds of packing material positioned in the flow path of the vapors and refrigerated gasoline to increase vapor recovery.

8 Claims, 3 Drawing Figures



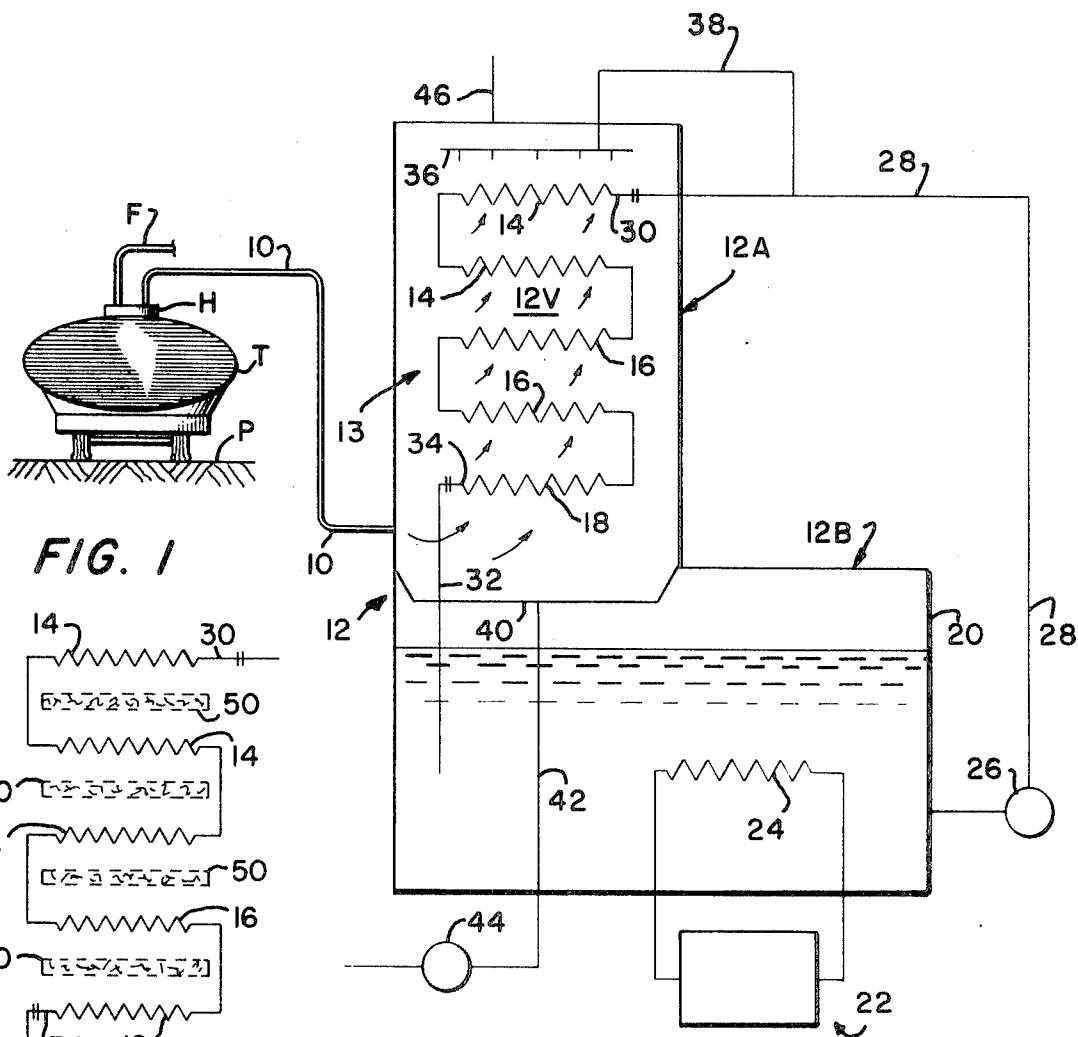


FIG. 1

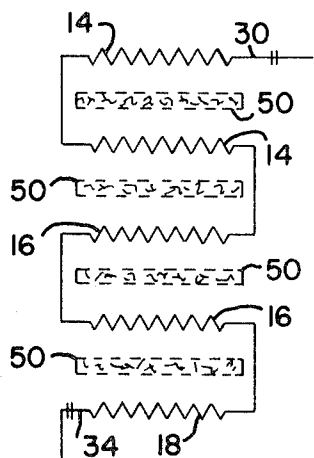


FIG. 3

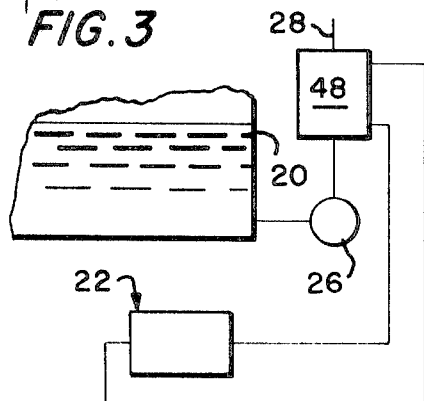


FIG. 2

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GASOLINE VAPOR RECOVERY

This invention relates to a system for the recovery of liquefiable components of hydrocarbon vapors, and more particularly to the recovery of gasoline components from vapors expelled from tanks during filling thereof.

In loading truck, railroad, ship and other tanks with volatile hydrocarbon liquids, in particular gasoline, the space within the tanks will decrease progressively, and because of the lighter components vaporizing rapidly, substantial quantities of vapor are forced to escape from the filler openings around the filler nozzles of the tanks into the atmosphere and lost therein. Such escape is undesirable not only because the vapors involved often create serious health, fire, air pollution and explosion hazards, but also because of the attendant economic loss of hydrocarbon components.

Presently used vapor recovery systems generally require rather extensive apparatus and systems including equipment for pumping, compressing, refrigeration, condensating, and fractionating operations which are generally expensive and comparatively inefficient, in particular that equipment for refrigeration to substantial low temperatures.

An object of the present invention is to provide a novel system of vapor recovery which is simple and relatively inexpensive.

While the invention is shown and described in connection with the filling of gasoline truck tanks it is to be understood that the novel system according to the invention is adaptable for use in connection with other volatile liquids which may be combustible or not.

The above and other objects will become apparent from the following description in connection with the accompanying drawing in which:

FIG. 1 shows a flow diagram of a tank filling and vapor recovery system according to the invention,

FIG. 2 shows a modified portion of the system of FIG. 1, and

FIG. 3 shows another embodiment of the invention.

Referring to FIG. 1 the novel vapor recovery system includes a loading platform P on which is disposed a tank truck T for receiving a volatile hydrocarbon liquid such as gasoline pumped to the tank truck through a filler pipeline F, partly shown. Filler pipeline F extends through a vapor collecting hood H adapted to be fitted around the filler nozzle, not shown, extending from the filler pipeline F into the interior of tank truck T. The vapor collecting hood H is in free communication with the interior of the tank truck and is provided with a vapor outlet conduit 10 extending therefrom. Conduit 10 extends into a container 12 into which the vapor from tank truck T is conducted for reduction to liquid and collection thereof for further suitable use or reintroduction into the gasoline being pumped.

Container 12 includes two sections, an upper section 12A and a lower section 12B. Upper section 12A includes a vapor space 12V in which is provided a coolant spraying or distribution device 36 and a cooling unit 13 comprising a plurality of cooling coils 14, 16 and 18 through which a coolant is pumped, as will be explained hereinafter. Lower section 12B is in the form of a reservoir 20 for storage of a predetermined quantity of coolant, preferably gasoline. Since the gasoline in reservoir 20 is to serve as a coolant for the spraying device 36 and the cooling unit 13, a refrigeration system 22 of conventional design is provided to refrigerate the gasoline in reservoir 20 by means of a cooling coil 24 extending into reservoir 20. In order to supply the cooling unit 13 and the spraying device 36 with the coolant, a pump 26 is provided to pump the refrigerated gasoline from reservoir 20 through a conduit 28 to the inlet 30 connected to coil 14 of cooling unit 13 in the upper section 12A thereof. For the discharge of the coolant pumped through coils 14, 16 and 18 of cooling unit 13, there is provided a discharge conduit 32 connected to the discharge 34 of coil 18 of cooling unit 13 and extending into the gasoline in reservoir 20.

The coolant spraying or distribution device provided in upper section 12A is preferably in the form of a spray ring 36

positioned up-stream of or above coils 14, 16 and 18 and adapted to spray or distribute a coolant downwardly into vapor space 12V, for purposes to be explained hereinafter. The supply of coolant to spray ring 36 is achieved by means of a branch conduit 38 having one end connected to spray ring 36 and its other end connected to conduit 28. With this arrangement a portion of the coolant pumped by pump 26 is conducted to coils 14, 16 and 18 of cooling unit 13 while the other portion of the coolant pumped by pump 26 is conducted to spray ring 36.

Also provided in container 12 is a tray 40 suitably positioned at the lower end of vapor space 12V to catch and accumulate the sprayed coolant and vapor absorbed therein flowing downwards from vapor space 12, as will be explained hereinafter. The coolant and vapor absorbed therein accumulated in tray 40 is discharged therefrom through a conduit 42 connected to a pump 44 for further conveyance and use. A conduit 46 is provided at the upper end of upper section 12A for the conductance to atmosphere of the uncondensable gases introduced into vapor space 12V.

Operation of the vapor recovery device is as follows: As gasoline is being pumped from a source of supply, not shown, through filler pipeline F, partly shown, into tank truck T, the vapors displaced by the gasoline as it is being pumped into the tank truck T, are displaced therefrom into hood H by the gasoline introduced into the tank. The vapors forced from tank T into hood H are conducted therefrom through conduit 10 into the lower portion of upper section 12A of container 12. After introduction into the lower portion of upper section 12A the vapors flow upwardly into vapor space 12V in which cooling coils 14, 16 and 18 of cooling unit 13 are disposed. Since coils 14, 16 and 18 are being cooled as a result of refrigerated gasoline from reservoir 20 being drawn therefrom by pump 26 and pumped through conduit 28, inlet 30, coils 14, 16, 18 discharge 34, and discharge conduit 32, the vapors flowing around cooling coils 14, 16 and 18 are cooled. It is to be noted that refrigeration of the gasoline in reservoir 20 is achieved by means of the refrigeration circulating coil 24 disposed within the gasoline in reservoir 20 and extending from a commonly known refrigeration system 22. It is to be noted that refrigeration of the gasoline for distribution to spray ring 36 or cooling coils 14, 16 and 18 can also be achieved by modifying the system shown in FIG. 1, namely by applying the circulating coil 24 of refrigeration system 22 in a heat exchanger 48 connected to conduit 28, as shown in FIG. 2. With this arrangement the gasoline to be pumped from reservoir 20 to cooling coils 14, 16 and 18 is cooled in heat exchanger 48 as it flows through conduit 28.

As the vapors are being cooled by flowing around cooling coils 14, 16 and 18, refrigerated gasoline is also pumped by pump 26 to conduit 38 and spray ring 36 so that refrigerated gasoline is sprayed into vapor space 12V and cascades over and around cooling coils 14, 16 and 18 for purposes of absorbing and recovering the cooled vapor in vapor space 12V. The sprayed refrigerated gasoline and vapors absorbed thereby flows downwards and is accumulated in tray 40 from where the gasoline and recovered vapors are drawn off through conduit 42 by pump 44 and further conducted to storage or any suitable use.

It is to be noted that recovery of the vapors may be increased by the provision of one or more beds of packing material, such as Raschig rings, in the flow path of the vapors and the sprayed refrigerated gasoline. As shown in FIG. 3 the beds of Raschig rings or other suitable packing material, designated numeral 50, are positioned between the cooling coils 14, 16 and 18. With this arrangement the area of exposure of the sprayed refrigerated gasoline and the vapors to each other is increased, thus ensuring a maximum recovery of the vapors. By the time the vapors have reached the space above the distributor or spray ring 36, practically nothing but air or other non-condensable gases remain for venting through conduit 46.

While a preferred embodiment of the invention is shown, it is to be understood that various changes and modifications can be made in its construction without departing from the scope of the invention as defined in the appended claims.

We claim:

1. Apparatus for recovering vapors from a tank into which a volatile liquid is introduced and said vapors are forced out of said tank, comprising

a container connected to said tank for flow of said vapors in said container,

means to cause said vapors in said container to be cooled, a source of refrigerant,

means to conduct said refrigerant for exposure thereof in said container to the flow of said cooled vapors to absorb said vapors, and

means to discharge only said exposed refrigerant and absorbed vapors from said container.

2. Apparatus for recovering vapors from a tank into which a volatile liquid is introduced and said vapors are forced out of said tank, comprising

a container connected to said tank for flow of said vapors in said container,

means in said container to cause said vapors to be cooled, a source of refrigerant,

means to distribute said refrigerant in said container for exposure thereof to said flowing cooled vapors to absorb said vapors, and

means to discharge only said distributed refrigerant and absorbed vapor from said container.

3. Apparatus for recovering vapors from a tank into which a volatile liquid is introduced and said vapors are forced out of said tank, comprising

a container connected to said tank for flow of said vapors in said container,

a source of refrigerant,

a cooling coil disposed in said container in the flow path of said vapors connected to said source of refrigerant to cool said vapors flowing therearound,

distribution means in said container positioned downstream of the flow path of said vapors connected to said source of refrigerant to cause said refrigerant to be distributed for exposure to said flowing cooled vapors to thereby absorb said vapors, and

means to discharge only said exposed refrigerant and said absorbed vapors from said container.

4. Apparatus for recovering vapors from a tank into which a volatile liquid is introduced and said vapors are forced out of said tank, comprising

a container having an upper section and a lower section, said upper section of said container being connected to said tank for said vapors to flow from the lower end portion towards the upper end portion of said upper section of said container,

a cooling coil disposed in said upper section of said container in the flow path of said vapors,

distribution means disposed in said upper section of said container downstream of the flow path of said vapors, said lower section of said container containing a portion of

said volatile liquid,

refrigeration means operably associated with said volatile liquid in said lower section of said container to refrigerate said volatile liquid,

means to supply said refrigerated volatile liquid to said cooling coil and said distribution means to cause said vapors to be cooled and to cause said volatile liquid to be distributed and exposed to said flowing cooled vapors to effect absorption of said cooled vapors by said refrigerated volatile liquid, and

means to discharge only said exposed volatile liquid and vapors absorbed thereby from said container.

5. Apparatus according to claim 4 including at least one body of packing material positioned in the flow path of said vapors and said distributed liquid to increase exposure of said distributed liquid to said vapors.

6. Apparatus for recovering vapors from a tank into which a gasoline is introduced and said vapors are forced out of said tank, comprising

a container having an upper section and a lower section, said upper section of said container being connected to said tank for said vapors to flow from the lower end portion towards the upper end portion of said upper section of said container,

a cooling coil disposed in said upper section of said container in the flow path of said vapors,

distribution means disposed in said upper section of said container downstream of the flow path of said vapors, said lower section of said container containing a portion of said gasoline,

refrigeration means operably associated with said gasoline in said lower section of said container to refrigerate said gasoline,

means to supply said refrigerated gasoline to said cooling coil and said distribution means to cause said vapors to be cooled and to cause said gasoline to be distributed and exposed to said flowing cooled vapors to effect absorption of said cooled vapors by said refrigerated gasoline, and

means to discharge only said exposed gasoline and vapors absorbed thereby from said container.

7. Method of collecting and recovering vapors evolved during the filling of a tank with a volatile liquid, comprising:

collecting the vapors in a container,

cooling said vapors,

cooling a portion of said volatile liquid,

absorbing said cooled vapors in a flow of said cooled volatile liquid within the container, and

recovering only said flow of volatile liquid and vapors absorbed therein from the container.

8. Method of collecting and recovering vapors evolved during the filling of a tank with gasoline, comprising:

collecting the vapors in a container,

cooling said vapors,

cooling a portion of said gasoline,

distributing said cooled gasoline within the container in the flow of said vapors to absorb said vapors, and

recovering only said distributed gasoline and said vapors absorbed therein from said container.

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