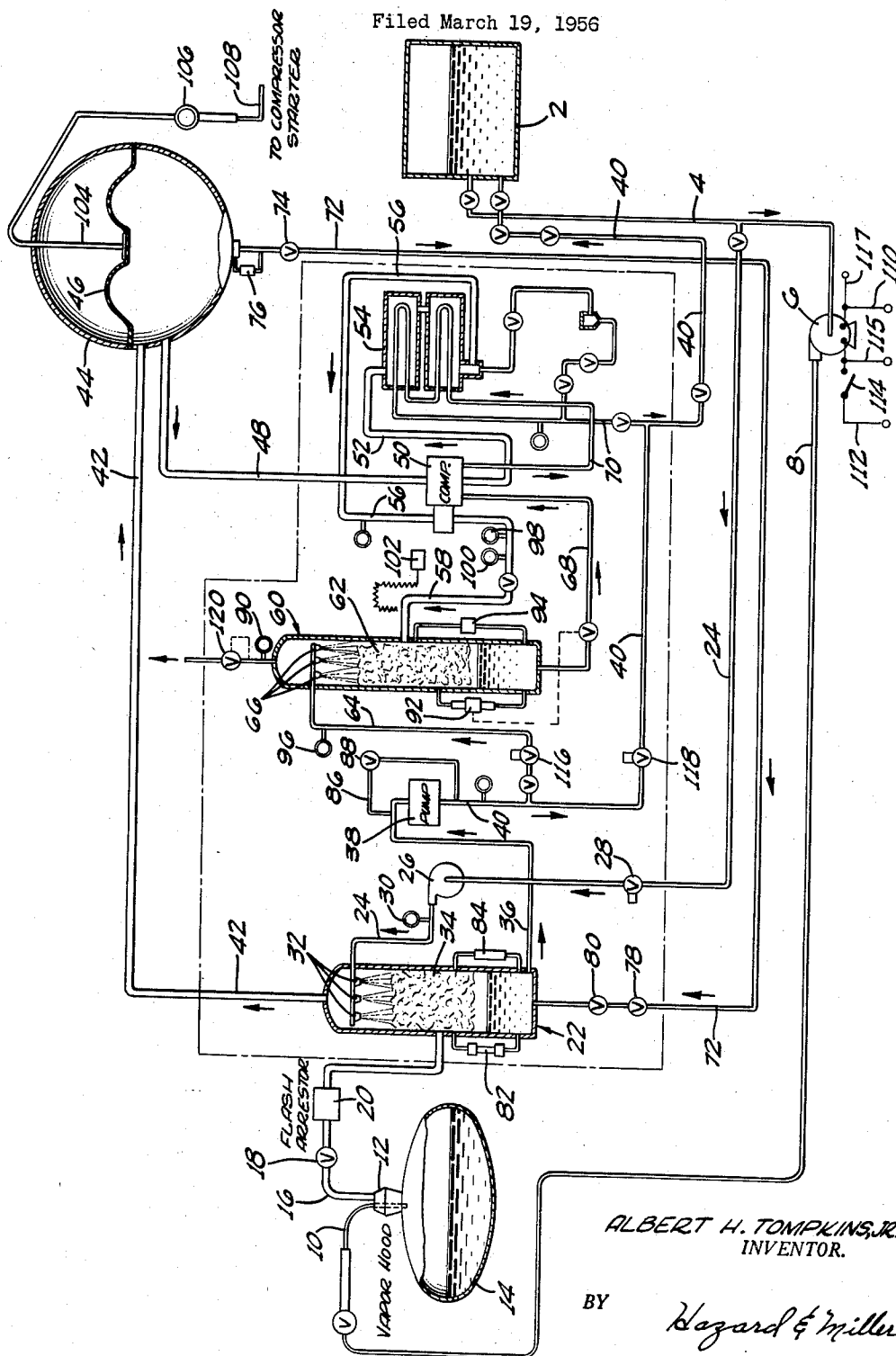


Aug. 26, 1958

A. H. TOMPKINS, JR
VAPOR RECOVERY SYSTEM

2,849,150

Filed March 19, 1956



ALBERT H. TOMPKINS, JR.
INVENTOR.

BY

Hazard & Miller

ATTORNEYS

1

2,849,150

VAPOR RECOVERY SYSTEM

Albert H. Tompkins, Jr., Los Angeles, Calif., assignor to Superior Tank & Construction Co., Los Angeles, Calif., a corporation of California

Application March 19, 1956, Serial No. 572,479

10 Claims. (Cl. 220—85)

This invention relates to a vapor recovery system and a method of recovering vapors from volatile liquids.

In certain heavily populated areas, topographical and other physical conditions cause the accumulation of organic and inorganic irritants in the air, resulting in what is commonly known as smog.

In such areas a number of factors are found to contribute to smog conditions. Among them is the escape of hydrocarbons into the air from gasoline station storage tanks and from tank trucks and similar containers when they are filled with gasoline. Gasoline is treated to reduce its volatility but this does not prevent the vaporization of certain of the lighter hydrocarbons therein. Products such as butane, iso-butane, pentane, and other lighter constituents of gasoline rather readily vaporize and escape from the filler openings of tanks around the filler nozzles. As the tanks are filled with liquid, the vapors are forced from the tanks into the atmosphere.

It is a general object of the invention to provide a method of and means for preventing the escape of such vapors into the atmosphere by collecting them and so treating them that they are reduced to liquid. Thus, the escape of the vapors is prevented and the collected liquids from the vapors have value since they can be reintroduced to the gasoline. While the invention is described in connection with the filling of gasoline storage tanks and tank trucks, it is to be understood that it 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.

The figure in the drawing is a diagrammatic flow diagram of an embodiment of the invention.

At the right side of the drawing is a tank 2 having an outlet line 4 leading to an electrically driven pump 6. A line 8 leads from the pump 6 to a filler hose 10 which extends through a vapor collecting hood 12 adapted to be fitted into the filler opening of a tank 14. This tank may be mounted on a vehicle chassis for the distribution of gasoline to service stations or it may be any other suitable container such as the underground storage tank in a service station.

The collector hood 12 has a vapor outlet tube 16 extending therefrom. The details of the collector hood are not essential to the present invention. However, one type thereof is disclosed in the co-pending application of Albert H. Tompkins and Grover C. Brown, Serial No. 475,752, filed December 16, 1954, now Patent No. 2,763,419.

The vapor outlet tube or conduit 16 passes through a valve 18 and a flash arrester 20 to the interior of a vapor saturator 22. The saturator 22 is adapted to be supplied with gasoline through a line 24 having a pump 26 therein. The line 24 is provided with a solenoid valve 28 and a pressure gauge 30. Said line enters the saturator 22 and

2

terminates in spray nozzles 32 which direct the liquid in the form of a spray downwardly onto a suitable packing material 34. Excess liquid is carried by a line 36 through a pump 38 and line 40, back to the reservoir tank 2.

In the saturator 22 the gasoline vapor is saturated to not less than 20% (when speaking of gasoline), or to a percentage which renders the vapor non-explosive. It is taken from the saturator 22 in a line 42 to a temporary storage chamber 44 which has a flexible diaphragm 46 therein. From the temporary storage chamber 44, the saturated vapor is conducted through a line 48 through a first stage of a compressor 50. It is then conducted through a line 52 to a heat exchanger 54 and from the heat exchanger through a line 56 through a second stage of the compressor 50 and a line 58 to an absorber 60 which is partially filled with a suitable packing 62.

The absorber 60 is supplied with liquid gasoline through a line 64 which branches from the line 40 between the saturator 22 and the supply reservoir 2. The line 64 to the absorber 60 is provided, within the absorber, with spray nozzles 66 which direct a spray downwardly in the absorber to absorb the liquid from the pressurized vapor supplied to the absorber from the compressor 50. Liquid gasoline leaves the absorber through a line 68 and through the compressor 50 from whence it is conducted by a line 70 through the heat exchanger 54, finally to connect with the return line 40 from the saturator 22 to the supply reservoir 2.

While the saturated vapor is temporarily stored in the chamber 44, a certain amount of the vapor may condense to liquid form. A line 72 leads from the bottom of the temporary storage chamber 44 to the bottom of the saturator 22, and since the chamber 44 is higher than the saturator the condensed vapors will flow to the saturator and be returned to the supply reservoir 2 through lines 36 and 40. Adjacent the temporary storage chamber 44 the line 72 is provided with a valve 74 and between the storage chamber and the valve is a gauge glass 76 to indicate when it is desirable to draw condensed vapors from the temporary storage chamber. Adjacent the saturator 22, the line 72 may be provided with a plug valve 78 and a one-way valve 80 to prevent back-flow of liquid into the line 72 from the saturator 22.

Other valves are located in the system at various points as indicated and it is believed that their location does not require explanation.

There are some valves and accessory indicators and controls which do require some explanation. The saturator 22 is provided with a high-low level alarm 82 and a gauge glass 84. The line 24 between pump 26 and the saturator 22 is provided with the pressure gauge 30 to show the pressure under which gasoline is sprayed into the saturator. This preferably is a relatively low pressure operation. The pump 38 is provided with a by-pass line 86 within which is a relief valve 88.

The absorber 60 is provided with a pressure gauge 90, a liquid level controller 92 and a high level alarm 94. The line 64 which supplies liquid gasoline to the absorber 60 is provided with a temperature gauge 96.

The line 58 from the compressor 50 which supplies saturated vapor to the absorber 60 is provided with a pressure gauge 98 and a temperature gauge 100. A high temperature alarm 102 is connected to the line 58 adjacent the absorber 60.

The temporary vapor storage chamber 44 has its diaphragm 46 connected to a pressure responsive device 104 which is connected with a combined tank gauge and switch 106. The switch portion of this element is connected by an electrical conduit 108 to the compressor 50 in such

a way that the compressor will be actuated only upon the accumulation of certain minimum volumes within the temporary storage chamber 44.

It is desirable that the several elements of the system be so controlled that none of it will function unless all portions thereof are in proper operating condition. For this reason several of the electrically operated devices such as valves and pumps are all connected in series so that the entire system must be in proper condition for actuation of any part thereof. The pump 6 which conveys gasoline from the supply tank 2 to the truck tank 14, is supplied with current from wires 110 and 112. The wire 112 is provided with a switch 114. Wire 115 leads successively to the high-low level alarm 82 on the saturator, pump 26, pump 38, solenoid valves 28, 116, and 118, liquid level controller 92, low level alarm 94, high temperature alarm 102 and compressor control switch 106. This circuit is completed through wire 117. If any of these means is inoperative or not in a proper operating position, the circuit to the vapor system is broken and the system will not begin to function. Should any one of the elements malfunction or should liquid levels in the saturator and absorber become too high or too low, the vapor system will be stopped.

Additionally, if the system is used in connection with the filling of tank trucks, it will not begin to function until a sufficient reserve of vapor is built up in the temporary reservoir 44. Until this occurs, the combined tank volume gauge and compressor control switch 106 will keep the entire circuit open. For example, in the morning when a series of tank trucks is filled, the recovery system will not operate until rising liquid in successive tanks 14 will force a sufficient amount of vapor into the saturator 22 to raise the diaphragm in the temporary reservoir 44.

It should be clear that the purpose of saturating the vapor as it is drawn from the tank 14 is to render it non-explosive while it passes through the temporary reservoir 44, compressor 50, heat exchanger 54, and thence to the absorber 60.

When liquid is absorbed from the vapor in the absorber 60, air from the vapor rises to the top of the absorber, and, upon the building up of sufficient pressure, will open a pressure controlled valve 120, permitting air from the absorber to vent to atmosphere.

Not only does the system prevent vapors from tanks being filled from being released into the atmosphere, but it permits the recovery of valuable amounts of gasoline or other liquid being treated so that there is an economical saving of the liquid being handled.

It will be understood that various changes can be made in the form, arrangement and proportions of the various parts and in the steps of the method without departing from the spirit of the invention.

I claim:

1. Apparatus for recovering vapors from a tank into which a volatile liquid is introduced, including a collector for vapors which escape from the tank, a vapor absorbing system independent of the collector and with which the collector is in flow communication, a volatile liquid supply reservoir having an outlet conduit for filling the tank, and an absorbed vapor line from the absorbing system to the supply reservoir.

2. Apparatus for recovering vapors from a tank into which a volatile liquid is introduced, including a closed flow circuit having a volatile liquid reservoir, a tank to be filled, a supply line from the reservoir to the tank, a vaporized liquid return line from the tank to the reservoir, the return line having an absorbing system connected therein between the tank and the reservoir to convert vapors from the tank to liquid condition prior to return to the reservoir, and a pump in said flow circuit.

3. Apparatus for recovering vapors from a tank into which a volatile liquid is introduced, including a vapor collector adapted to fit the filler opening of the tank, a

volatile fluid reservoir, a filler line from the reservoir terminating in said vapor collector, a return line from said vapor collector to said reservoir, and a vapor absorbing system in said return line for converting the vapor to liquid condition between the vapor collector and the reservoir.

4. Apparatus for recovering vapors from a tank into which a volatile liquid is introduced, including a collector for vapors from the tank, a volatile liquid reservoir, means for flowing volatile liquid from the reservoir to the tank, a vapor saturator having a vapor inlet from said collector, a saturating liquid supply line from said reservoir to said saturator, a saturated vapor compressor and cooler in flow communication from said saturator, and a vaporized liquid absorber in flow communication from said compressor and cooler and including a condensing and collecting surface for the compressed vapor.

5. Apparatus for recovering vapors from a tank into which a volatile liquid is introduced, including a volatile liquid reservoir, means for flowing volatile liquid from the reservoir to the tank, a collector for vapors expelled from the tank, a vaporized liquid absorber independent of but in flow communication from the vapor collector, and a liquid flow path from the reservoir to the absorber to absorb liquid from the vapor.

6. Apparatus for recovering vapors from a tank into which a volatile liquid is introduced, including a volatile combustible liquid supply source, means for flowing the liquid from the source to the tank, means in atmospherically sealed flow communication with the tank for saturating the vapor from the tank to render the vapor non-explosive and including means for supplying a stream of the combustible liquid as a saturant, a temporary storage chamber for the saturated vapor in flow communication from the saturating means, a vapor compressor in flow communication from the temporary storage chamber, a control switch for the compressor, said switch having a connection with said temporary storage chamber for volume responsive actuation, a vapor absorber in vapor flow communication from said compressor, and means for supplying a stream of the combustible liquid to said vapor absorber to pick up liquid from the compressed vapor.

7. A method of collecting and recovering vapors which normally escape to atmosphere from tanks being filled with volatile liquids from a source of supply, which includes collecting the vapors, subjecting them to pressure, and while under pressure, absorbing the liquids from the vapors into a flow stream of the liquid from said source of supply.

8. A method of collecting and recovering vapors which normally escape to atmosphere from tanks being filled with combustible, volatile liquids from a source of supply, which includes collecting the vapors, saturating the vapors with the liquid to produce a non-explosive vapor, cooling the vapor, compressing it, and absorbing liquid from the compressed vapor into a stream of the combustible liquid.

9. A method of collecting and recovering vapors which normally escape to atmosphere from tanks being filled with volatile liquids, which includes removing the vapors from a tank, accumulating the vapors in temporary storage, withdrawing and cooling a supply of the vapors from the temporary storage, compressing the cooled vapors, and absorbing the compressed vapors in a stream of the volatile liquid.

10. A method of collecting and recovering vapors which normally escape to atmosphere from tanks being filled with combustible volatile liquids, which includes removing the vapors from the tank, saturating the vapors with the combustible liquid to render the vapors non-explosive, accumulating the saturated vapors in a temporary storage chamber, withdrawing and cooling the vapors from the temporary storage chamber, and absorbing liquid from the compressed vapors into a stream of the combustible liquid.

(References on following page)

References Cited in the file of this patent

UNITED STATES PATENTS

1,269,639	Parr	June 18, 1918
1,315,700	Bregeat	Sept. 9, 1919
1,315,701	Bregeat	Sept. 9, 1919
1,439,451	Seibert et al.	Dec. 19, 1922

5

1,541,591
1,545,352
1,608,365
1,689,352
1,753,401
1,918,100
2,059,942

Sadler	June 9, 1925
Rodriguez	July 7, 1925
Bregeat	Nov. 23, 1926
Maxon	Oct. 30, 1928
Bucking	Apr. 8, 1930
Harnsberger	July 11, 1933
Gibson	Nov. 3, 1936