A gasoline dispensing and vapor recovery system in which one or more underground storage tanks are connected to a first conduit system for delivering the gasoline to a vehicle gasoline tank, or the like, under the force of a pump disposed in the storage tank. An injector-pump unit is also disposed in the storage tank and is adapted to create a low pressure zone in the storage tank when actuated. A second conduit system connects the injector to the vehicle gasoline tank to draw the vapors from the latter tank into the storage tank upon actuation of the injector.

9 Claims, 5 Drawing Figures
GASOLINE DISPENSING AND VAPOR RECOVERY SYSTEM

BACKGROUND OF THE INVENTION

This invention relates to a fluid dispensing and vapor recovery system and, more particularly, to such a system in which fluid is dispensed from a storage tank to a receptacle while vapors from the receptacle are drawn to the storage tank.

With the increased emphasis on preventing pollution of the atmosphere, attention has been directed to minimizing the introduction of gasoline vapors into the atmosphere from both permanent type underground storage tanks for the gasoline, and from the vehicles to which the gasoline is ultimately dispensed.

Gasoline vapors can easily be recovered from underground storage tanks by simply providing a separate vapor recovery line which connects the storage tank to the transport truck which periodically fills the tank. In this manner, the gasoline introduced into the tank from the transport truck will displace the vapors and force them through the vapor recovery line to the truck whereby they are ultimately disposed of either by burning or through compression - refrigeration systems.

However, it has been extremely difficult to devise a satisfactory vapor recovery system from the gasoline tanks of vehicles due to the fact that the configurations of the tanks vary to a wide degree and to the fact that many of the tanks have open vents in their fill necks which allows the vapors to be displaced through the vents to the atmosphere during a fill cycle. This problem may become even more acute since some state and federal regulations may very well ultimately require full recovery of vapors from existing automobile gasoline tanks, whether vented or not.

Although it has been suggested to use a vacuum pump assembly including a compressor and an explosion-proof motor, along with a chiller assembly to remove the vapors from the vehicle tanks, this type of installation is disadvantageous in several respects. For example, it takes up considerable space and must be installed in a separate well, or the like, in addition to requiring relatively high maintenance and being relatively high in cost.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide a fluid dispensing and vapor recovery system in which fluid is dispensed from a storage tank to a receptacle while vapors in the receptacle are recovered and delivered back to the storage tank.

It is a further object of the present invention to provide a fluid dispensing and vapor recovery system of the above type in which an injector is disposed in the storage tank to create a low pressure zone therein to draw vapors from the receptacle back to the tank.

It is a further object of the present invention to provide a fluid dispensing and vapor recovery system of the above type which is relatively simple in operation and relatively low in cost.

Towards the fulfillment of these and other objects, the system of the present invention comprises at least one storage means for said fluid, first conduit means adapted to connect said storage means to a receptacle, first pumping means for pumping said fluid from said storage means through said first conduit means and to said receptacle, second pumping means disposed in said storage means for pumping said fluid in a path including said storage means, means for creating a low pressure zone in said storage means in response to operation of said second pumping means, and second conduit means connecting said low pressure zone to said receptacle for drawing the vapors from said receptacle during operation of said second pumping means.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic view of a service station installation having a gasoline dispensing and vapor recovery system of the present invention utilized therein.

FIGS. 2-4 are enlarged fragmentary sectional views of components utilized in the installation of FIG. 1 and FIG. 5 is a view similar to FIG. 2, but depicting an alternate embodiment of the component of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As an example of the use of the fluid dispensing and vapor recovery system of the present invention, it will be described in connection with a gasoline dispensing installation for use in service stations or the like. Such an installation is diagrammatically illustrated in FIG. 1 and includes under ground tank 10 for storing a quantity of gasoline for delivery to a plurality of pedestals 12 mounted above ground in reasonable proximity to the tank 10.

A submersible pump unit 14 is disposed in the tank 10 and operates to pump the gasoline through a riser conduit 15 which extends through a casing 16 to a manifold 18 disposed underground in a well 20. A main conduit 22 extends from the manifold 18 to the vicinity of the pedestals 12, and a plurality of branch conduits 22a respectively connect the conduit 22 to the pedestals.

The pedestals 12, the pump unit 14 and the manifold 18 are all described in detail in U.S. Pat. No. 3,183,723 the disclosure of which is hereby incorporated by reference. Therefore, for the convenience of presentation, the structural details of these units are not shown in the drawings and will be described only generally as follows. The pump unit 14 is an electrical operated centrifugal type which operates to draw the gasoline into the unit through a plurality of intake ports disposed at the bottom thereof and to force the gasoline upward around a sealed electrical drive motor through the riser conduit 15 and to the manifold 18, in a conventional manner.

The manifold 18 supports the upper housing of the pump unit 14 while permitting the electrical connections for the drive motor to be brought outwards for connection to the proper controls. It is understood that an adapter unit or packer (not shown) is supported within the housing of the manifold 18 and has an inlet chamber communicating with the outlet of the pump unit 14 and an outlet chamber adapted for registration with the conduit 22. The packer also includes a port between the inlet chamber and the outlet chamber which cooperates with a check valve to permit the flow of gasoline from the pump unit 14 to the conduit 22 while preventing flow in the opposite direction, also in a conventional manner.

A delivery hose assembly 30 extends from each of the pedestals 12 with each assembly including an inner hose surrounded by a spaced, coaxial, outer hose. A dispensing unit 32 is connected to the free end of each hose assembly 30, it being understood that each unit 32
includes a dispensing nozzle connected to the inner hose of its respective hose assembly which is operated by a manually operated valve 32a, in a conventional manner. As shown schematically in FIG. 1, the inner hose of each hose assembly 30 is connected to a branch conduit 22a for supplying gasoline to the dispensing unit 32 for discharge through its dispensing nozzle.

Each dispensing unit 32 is supported on its respective pedestal 12, and a manually actuated switch 34 is provided on each pedestal for actuating the pump unit 14 in a conventional manner. Although not shown in the drawings, it is understood that the pedestals 12 can also be provided with the proper linkage, interlock valves, meters, etc., in accordance with conventional designs.

It can be appreciated from the foregoing that, upon a dispensing unit 32 being lifted from its support and upon actuation of the switch 34, the pump unit 14 will operate to deliver gasoline through the riser conduit 15, the manifold 18, the conduit 22, the branch conduit 22a associated with the respective pedestal 12, and to the inner hose of the hose assembly 30 which, upon manual actuation of the valve 32a, will permit the gasoline to be dispensed into a receptacle shown schematically which in a great majority of instances would be a vehicle tank.

An assembly is provided to draw vapors from the vehicle tank simultaneously with the dispensing of the gasoline into the tank and includes an injector-pump unit 36 for creating a low pressure zone in the tank 10 in a manner to be described later. A riser conduit 37 extends through a casing 38 and connects the injector-pump unit 36 to a manifold 40. A vapor recovery conduit 42 is connected to the manifold 40 and extends to the vicinity of the pedestals 12 whereby it is connected to same via branch conduits 42a.

The injector-pump unit 36 is shown in detail in FIG. 2, and includes a housing 44 which contains a pump in its lower portion and an injector in its upper portion. In particular, a sealed electrical motor 46 is mounted in the lower portion of the housing 44 for driving a pumping assembly (not shown) disposed immediately below the motor as viewed in FIG. 2, which operates in a conventional manner to pump the gasoline from the tank 10 into the housing through a plurality of inlet openings in the lower portion of the housing and upwardly through an annular passage between the motor 46 and the housing to the upper portion of the housing. The injector is formed by a pair of annular partitions 48a and 48b disposed in the upper portion of the housing 44 and defining annular passages which reverse the direction of gasoline flow through the housing. The partitions 48a and 48b also define an annular nozzle 50 and an annular venturi passage 52 which communicates with one of a series of outlet openings 54 disposed in the housing 44. The nozzle 50 and the venturi passage 52 cooperate in a conventional manner to create a low pressure zone 56 for reasons that will be described later.

The riser conduit 37 is connected to the housing 44 in registry with the low pressure zone 56 and extends through the casing 38, with its end being connected to the manifold 40, the details of which are shown with reference to FIG. 3.

In particular, the manifold 40 is disposed in a well 59 and includes a housing 60 which receives a header, or packer 62. The packer 62 has a tubular extension 62a which receives the riser conduit 37 of the injector-pump unit 36, and a passage 64 is formed in the packer which registers with the interior of the latter housing. The vapor recovery conduit 42 is supported by the housing 60 and extends outwardly therefrom, and a vacuum limiting valve 66 is supported by the packer 62 and operates to control the vapor pressure in the conduit 42.

The vacuum limiting valve 66 is shown in detail in FIG. 4 and includes a housing 68 supporting a diaphragm 70 which divides the housing into an upper and lower portion as viewed in FIG. 4. A hollow stem 72 is mounted to the diaphragm 70 and extends from the upper chamber, through the lower chamber and through a boss 74 extending from the housing 68 and in threaded engagement with the packer 62. A spring 76 is disposed in the upper chamber formed in the housing 68 and normally urges the diaphragm 70 and therefore the stem 72 downwardly.

A hollow sleeve 78 extends from the lower surface of the boss 74 and receives the stem 72. A series of slots 80 are formed through the sleeve 78 and a valve seat 82 is formed at the free end of the sleeve for cooperation with a hollow valve member 84 attached to the free end of the stem 72.

As can be appreciated from FIGS. 3 and 4, with the valve member in its normally open position as shown in FIG. 4, vapors from the line 42 can enter the sleeve 78 through the opening provided in its free end and can exit through the slots 80 into the passage 64 in the packer 62.

As shown in FIGS. 2 and 3, an electrical conductor assembly 88 extends from the motor 46 upwardly through the housing 44, the riser conduit 37, and through the packer 62 where the conductors are adapted for connection to controls (not shown) for operation of the injector motor 46.

Referring again to FIG. 1, the vapor recovery conduit 42 is connected, via branch conduits 42a, to the pedestals 12. The annular space between the inner hose and outer hose of each hose assembly 30 is connected to a corresponding branch conduit 42a to permit the vapors to be withdrawn from the vehicle tanks and passed through an appropriate opening formed in each dispensing unit and into the vapor recovery conduit 42.

It is understood that the electrical connections between the switches 34 disposed on each pedestal 12 and the injector-pump unit 36 is similar to that between the switches and the pump unit 14 so that, upon manual actuation of each switch, both the pump unit 14 and the injector-pump unit 36 will be energized.

In operation, upon actuation of the switch 34 of a particular pedestal 12, the pump unit 14 will be energized and gasoline will be pumped through the manifold 18 and into the main delivery conduit 22, whereby it passes into the branch conduit 22a and into the inner hose of the hose assembly 30 associated with the particular dispensing unit 32 that is operated. Upon manual actuation of the valve 32a, gasoline is thus dispensed into the vehicle tank.

Also in response to actuation of the switch 34, the injector-pump unit 36 will be energized which causes another portion of the gasoline in the tank 10 to be pumped in from the inlets formed at the bottom of the housing 44 of the injector-pump unit upwardly through the annular space between the injector motor 46 and the housing 44. The direction of flow is then reversed in the upper portion of the housing 44 as shown by the solid arrows in FIG. 2 and the gasoline is discharged.
back into the tank 10 through the outlets 54. The low pressure zone 56 thus created by the gasoline flow through the housing 44 draws the vapors through the dispensing unit 32 and into the system where they flow in a path indicated by the dashed arrows in the drawings. In particular, the vapors pass through the annular space between the inner hose and outer hose of the hose assembly 30, and through the branch conduit 42a into the main vapor recovery conduit 42. With the valve 66 in its normal, open position, the vapors then pass through the opening in the end of the sleeve 78 and out through the slots 80 into the passage 64, where they pass through the manifold 40 and into the riser conduit 37 of the injector-pump unit 36, before entering the housing 44 where they are entrained with the gasoline in the low pressure zone 56 before being injected back into the tank 10 through the outlets 54.

The negative pressure created by the injector-pump unit 36 is transferred through the hollow valve member 84 and the stem 72 into the upper chamber in the housing 68 of the vacuum limiting valve 66. Therefore, if this pressure falls below a predetermined value, the diaphragm 70, the stem 72, and, therefore, the valve member 84 will move upwardly against the force of the spring 76 until the valve member is in close proximity to, or engages, the seat 82 and limits the minimum value of pressure in the vapor recovery conduit 42. This will protect the system and the vehicle tank from possible damage resulting from too great a vacuum being created in the low pressure zone 56.

It can be appreciated that in a relatively large installation in which gasoline of various octave ratings are separately stored in different tanks 10, a pump unit 14 will be installed in each tank while the injector-pump unit 36 need only be installed in one of the tanks, and connected to all of the dispensing units 32 of the pedestals 12. In this context, preferably the injector-pump unit 36 will be disposed in the tank containing gasoline of the lowest octave rating in the installation so that the vapors being drawn thereinto by the injector will not deteriorate the quality of the gasoline.

It is understood that the vapors collected in the tank 10 can be disposed of by a gasoline transport truck, or the like, which normally supplies gasoline into the tank periodically in accordance with conventional practice.

An alternate from of the injector is shown in FIG. 5 and is referred to in general by the reference numeral 90. This injector consists of a housing 92 which contains a series of venturi passages 96 registering with a plurality of outlet openings 98, respectively, formed in the housing 92. A lower housing 100 defines a series of nozzles 102 which are aligned with the venturi passages 96 and which cooperate with the passages to form a plurality of low pressure zones 104.

The injector 90 functions in a similar manner to the injector 36 of FIG. 2 in that pumping of gasoline in the inlet openings (not shown) formed in the bottom portion of the housing 100 and upwardly through the nozzles 102 creates the low pressure zones 104 which will draw the vapors downwardly from the riser conduit 37 and into the venturi passages 96 where they will be entrained with the gasoline in the low pressure zones 104 and will pass through the venturi passages 96 and injected into the tank through the openings 98.

It is noted that the vapors, while passing through the injectors 36 and 90, are compressed slightly which promotes their condensation into a liquid and thus reduces the quantity of the vapors in the tank 10.

The system of the present invention therefore enables vapors in the vehicle tank to be recovered and delivered back to the storage tank simultaneously with the dispensing of the gasoline into the tank. This is accomplished in a relatively inexpensive manner since a standard pump can be utilized and modified in accordance with the foregoing, yet can be conveniently disposed in the gasoline storage tanks.

Of course, other variations of the specific construction and arrangement of the system disclosed above can be made by those skilled in the art without departing from the invention as defined in the appended claims.

We claim:

1. A fluid dispensing system comprising at least one storage means for a supply of said fluid; first conduit means connecting said storage means to a receptacle; first pumping means in said storage means for pumping a portion of said fluid supply from said storage means through said first conduit means and to said receptacle, a pump injector unit disposed in said supply of fluid in said storage means and comprising a housing, second pumping means for circulating another portion of said fluid supply in a closed path through said housing and back to said storage means; and means for creating a low pressure zone in said housing in response to said circulation of said fluid; and second conduit means connecting said low pressure zone to said receptacle for drawing vapors from said receptacle to said storage means during operation of said second pumping means.

2. The system of claim 1 wherein said means for creating a low pressure zone in said housing comprises a nozzle and venturi formed in said housing.

3. The system of claim 1 wherein at least a portion of said first conduit means and said second conduit means are coaxially arranged.

4. The system of claim 1 further comprising means for limiting the minimum value of pressure in said second conduit means.

5. The system of claim 4 wherein said limiting means comprises a normally open valve unit disposed in said second conduit means and adapted to move towards a closed position in response to the pressure in said storage means attaining a predetermined minimum value.

6. The system of claim 1 further comprising a dispensing unit connected to said first and second conduit means for dispensing said fluid into said receptacle and for drawing vapors from said receptacle.

7. The system of claim 6 wherein said fluid is fuel, said storage means is an underground storage tank, and said receptacle is a vehicle fuel tank.

8. The system of claim 6 wherein said second conduit means connects each dispensing unit in the system to said pump injector unit.

9. The system of claim 6 further comprising a support means for said dispensing unit and switch means disposed on said support means for turning on said first and second pumping means.

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