

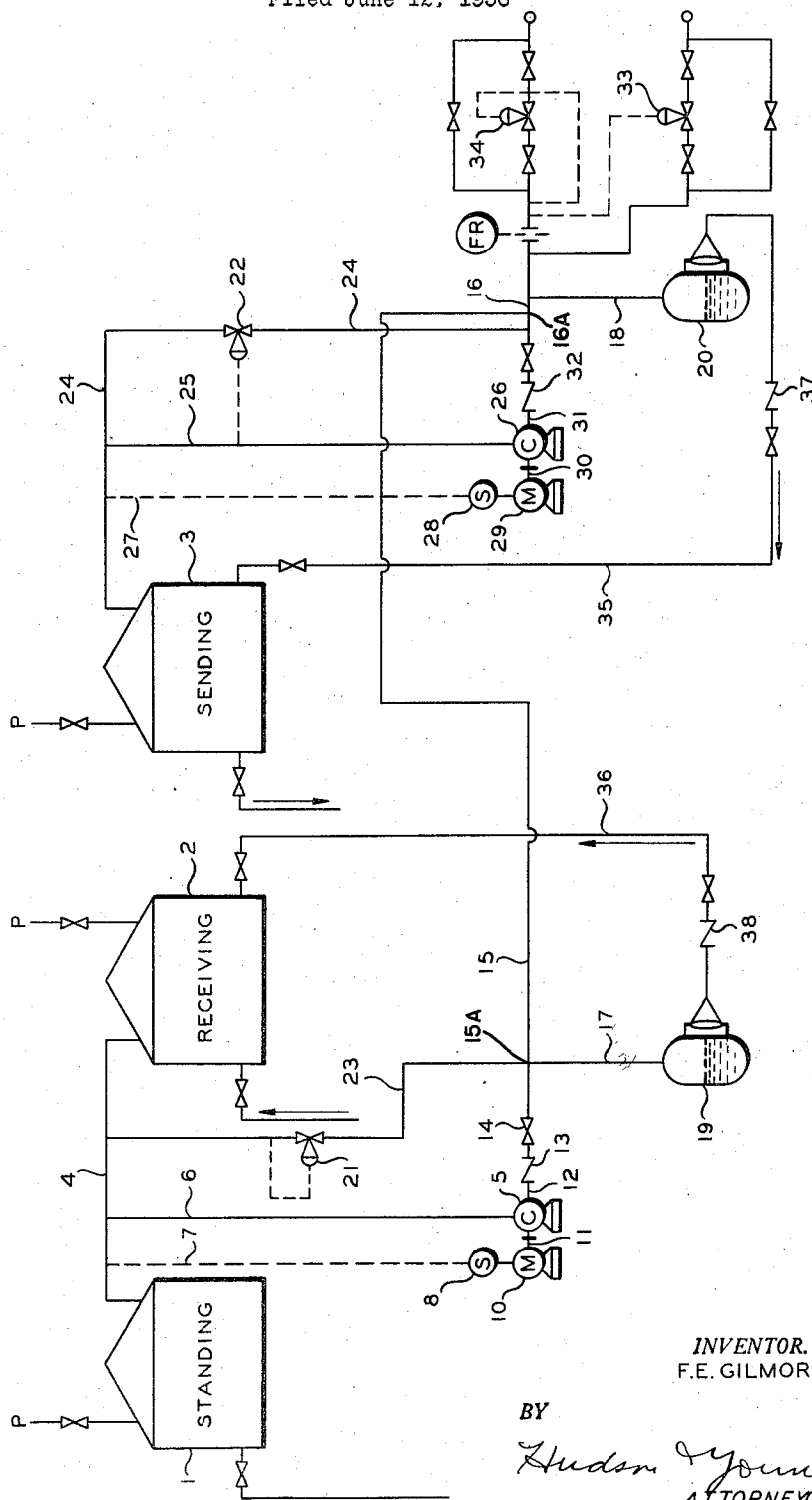
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VOLATILE LIQUID STORAGE TANKS OPERATION AND SYSTEM

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VOLATILE LIQUID STORAGE TANKS OPERATION AND SYSTEM

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This system relates to a volatile liquid storage tanks operation and system. In one of its aspects, the invention relates to a storage tank operation and system having at least two tanks, which are maintained at a predetermined or positive pressure of vapors of a volatile liquid stored in each of them in which operation and system vapors from a tank in which the pressure exceeds a predetermined maximum are pumped by, say, a compressor to a common conduit or zone which is common to tanks of this system and which is maintained at a pressure above said predetermined pressure, or the pressure in any of the tanks, and from said common zone, as needed, to another tank in which the pressure has fallen below a predetermined or positive pressure of vapors due to pumping out of liquid or other reason, for example, cooling at night. In an important modification, a liquid trap zone is provided in communication with said common zone to separate from vapors any liquid present or formed therein. The liquid is passed to one of the tanks in the system under the pressure maintained in said common zone. This liquid may be formed due to increase of pressure upon the vapors and/or to cooling of the compressed vapors. There is provided in one embodiment a source of vapors extraneous to the system for passing vapors into said common zone whenever the overall supply of vapors to said zone from said tanks is insufficient to maintain said common zone at a predetermined minimum pressure of vapors. Also, in one embodiment, there is made provision for releasing vapors from said common zone whenever the pressure therein exceeds a maximum predetermined pressure. In a preferred embodiment of the invention, the operation is completely automatic based upon certain aspects and concepts as described, upon other aspects and concepts among which are included operation of vapor pumping zones automatically responsive to tank pressure and vapor to tank feed zones also automatically responsive to tank pressure including certain interpositioning of vapor flow control or check zones, and upon aspects and concepts as will appear from the following:

It is an object of the invention to provide a volatile liquid storage tanks operation and system. Another object is the provision of an operation in which all tanks are protected against drawing in outside atmosphere, or air, or drawing a vacuum. Another object of the invention is to provide an automatic method and means for maintaining a plurality of tanks at a predetermined maximum pressure in each. A still further object of the invention is to provide for the utilization or removal from the storage tanks of vapors in excess of that required to render the operation effective, as desired. Another object is to provide for a source of vapors with which to supply sufficient vapors for the operation and system at those times when the system does not contain sufficient vapors, for example, on a cold day or at night. Other objects are apparent from this specification, the appended claims and the drawing, in which there is illustrated diagrammatically an embodiment of the invention composed of

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three tanks. One skilled in the art in possession of this disclosure will realize that for sake of simplicity only a sufficient number of details and component parts are shown to describe the invention and its underlying concepts to him.

Referring now to the drawing, 1, 2 and 3 are storage tanks in which a volatile liquid, for example, a hydrocarbon such as gasoline, is stored. Tank 1 is standing, that is, nothing is being pumped into or out from the tank. It is storing gasoline. Tank 2 is receiving gasoline and tank 3 is being pumped out and is, therefore, sending gasoline, say to a gasoline blending plant, market, etc. Tanks 1 and 2 are connected by equalizing line 4 and this line is connected to compressor 5 by way of line 6. Compressor 5 is operative responsive to the pressure in equalizing line 4 as indicated by the broken line 7, switch 8, motor 10 and drive shaft 11. Switch 8 is a pressure responsive switch, which in this embodiment, is set to shut off compressor 5 when the pressure in line 4 is approximately 0 inch of water and to place compressor 5 into operation whenever the pressure in line 4 reaches approximately 3 inches of water. The vapors from compressor 5 when it is in operation pass by way of line 12, check valve 13, block valve 14 (open when the system is in operation), line 15 into line 16. Lines 15 and 16 are in communication with lines 17 and 18, leading to liquid traps 19 and 20. Also, lines 15 and 16 are in communication by means of valves 21 and 22 in lines 23 and 24, respectively, with equalizing line 4 and tank 3. Lines 23 and 24 are in open communication with common conduit lines 15 and 16 at 15A and 16A, respectively. Since equalizing line 4 is in open communication with tanks 1 and 2, all three of the tanks can receive vapors through valves 21 and 22, which, in this embodiment, are adjusted to open only when the pressure downstream of the valves in lines 23 and/or 24 has fallen to a pressure below atmospheric of approximately $\frac{3}{4}$ inch of water or below. Substantially as described in connection with tanks 1 and 2, which are connected by way of equalizing line 4 and line 6 with compressor 5, tank 3 is connected by way of line 24 and line 25 with compressor 26. Compressor 26 is adjusted by means of broken line 27, switch 28, motor 29 and drive shaft 30 to be responsive to the pressure in tank 3 and will be operative when the pressure in tank 3 exceeds approximately 3 inches of water and will cease operation when the pressure in said tank has been reduced to about 0 inch of water. As described in connection with compressor 5, compressor 26 discharges into a line 31 equipped with a check valve 32 and a block valve (open when the system is in operation) and through the block valve into line 16. Line 16 is provided with outflow back pressure controller valve 34 and inflow pressure controller valve 33. Valve 34, in this embodiment, is adjusted to allow vapors from line 16 whenever the pressure therein is in excess of approximately 18 p.s.i.g. to flow to a gasoline recovery plant, not shown. Whenever the pressure in line 16 falls to below approximately 3 p.s.i.g., valve 33 will open to admit natural gas from a source not shown into line 16.

From the foregoing, it will be obvious to one skilled in the art in possession of this disclosure that a completely automatic operation and system have been set forth and described permitting a plurality of tanks to be maintained under a predetermined or positive pressure regardless of whether the tanks are merely standing, receiving or sending and further regardless of variations in temperature which occur each day.

Certain modifications of the system will become apparent to one skilled in the art studying this disclosure. By way of modifications which are already shown in the drawing, can be mentioned pressure relief valves P at

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the top of each tank. These valves can be so constructed as to admit outside atmosphere into the tanks in the event of a power failure or other occurrence necessitating momentarily the admission of outside atmosphere into one or more tanks to prevent their collapse due to too high a vacuum. Of course, valves P are adjusted to prevent excessive pressures on each tank; usually the safe working pressure of the tank, which for cone roof tanks ranges from 2 inches to 6 inches of water pressure. This predetermined pressure in this embodiment is approximately 1½ inches of water pressure.

Other modifications are possible and, in the drawing, there are shown return lines 35 and 36 which are equipped with flow check valves 37 and 38, respectively. These lines return liquid which has been trapped out in traps 19 and 20 to tanks 2 and 3, respectively. Of course, the liquid can be returned to other tanks in the system or, in fact, to any other place in the storage field.

Not shown on the drawing but by way of further modification, traps 19 and 20 can be equipped with cooling coils or fins or otherwise positioned to receive a cooling atmosphere such as furnished by a fan or a water spray. In such event, the vapors will be considerably reduced by condensation of liquid therefrom, and may, in some instances, be completely condensed.

It is believed clear that valves 21 and 22 are open only at a time when compressors 5 and 26 are not in service. Flow control or check valves 37 and 38 will not be operative when the pressure in line 16 and, therefore, in traps 19 and 20 is not greater than the pressure in lines 35 and 36, respectively.

While the invention has been described in a specific embodiment thereof with respect to a specific example in which gasoline is being stored, received or pumped from respective tanks of the system, it will be clear that different fractions or volatile materials can be stored in different tanks so long as their vapors can be acceptably admixed with each other. In the event the vapors cannot be admixed each with the other, suitable surge areas with seals can be provided to avoid such admixture.

Reasonable variation and modification are possible within the scope of the foregoing disclosure, drawing and the appended claims to the invention the essence of which is that there has been provided a volatile liquid storage tanks operation and system, as described, wherein each of the tanks of the system automatically is maintained

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above a predetermined minimum pressure and wherein a common zone of vapors is provided from which vapors are automatically supplied to tanks requiring the same to maintain the pressure in the said tanks and from which common zone also liquid from the vapors is removed and sent to storage as desired also as described.

I claim:

1. A storage tank system which comprises a plurality of tanks, a vapor line connected to each of said tanks and to a compressor respectively, a conduit means connecting said compressor to a common vapor conduit common to each of said tanks and to a vapor recovery system respectively, pressure responsive control means responsive to pressure in at least one of said tanks to render said compressor operative to remove vapors from one of said tanks whenever the pressure therein is above a predetermined maximum and to compress vapors therefrom into said common vapor conduit, a conduit connecting each of said tanks with said common vapor conduit, means responsive to the pressure in each of said tanks operative to permit flow through said last-mentioned conduit from said common vapor conduit into the tank to which said last-mentioned conduit is connected whenever the pressure in said last-mentioned tank falls below a predetermined minimum, and means responsive to the pressure in said common vapor conduit adapted to control flow of vapor from said recovery system into said common vapor conduit whenever the pressure therein falls below a predetermined minimum which is above the maximum pressure in any of said tanks and to release vapors from said common vapor conduit to said vapor recovery system whenever the pressure in said common vapor conduit exceeds a predetermined maximum.

2. A system according to claim 1 wherein said common vapor conduit is provided with a liquid trap means arranged to trap liquid from the compressed vapors therein and wherein a conduit connects said liquid trap to at least one of said tanks to permit flow of liquid only from said trap to said last-mentioned tank.

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