

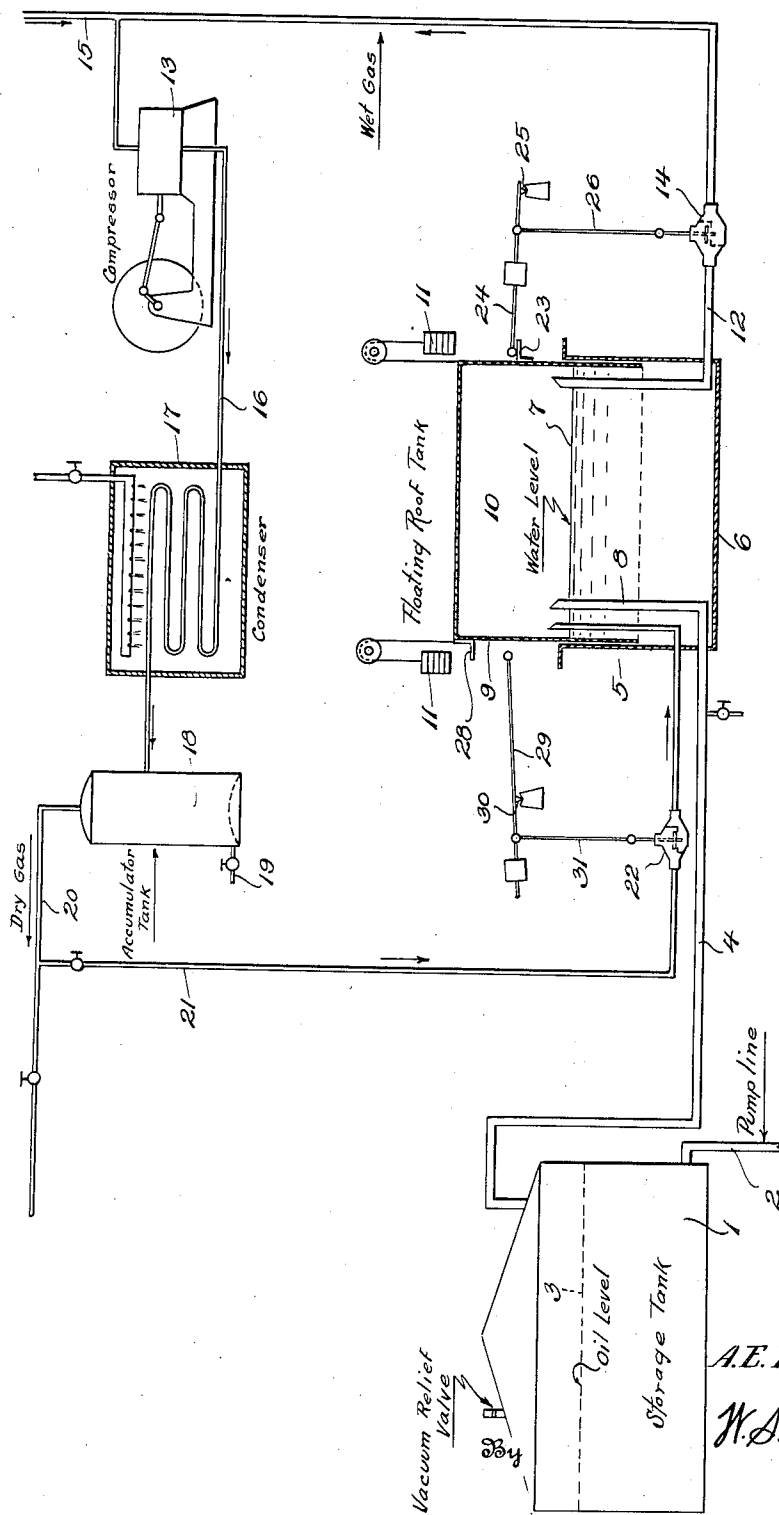
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GAS GATHERING SYSTEM

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GAS GATHERING SYSTEM

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This invention relates to an improved gas gathering system which is adapted to be employed in connection with the large storage tanks of oil refineries, and the invention has for its primary object the provision of a method and apparatus for maintaining a hydrocarbon gas at all times within said tanks above the liquid levels thereof with the specific end in view of preventing air or oxygen from entering said tanks and mixing with the gases contained therein.

In oil refineries and other places of gasoline storage it is customary to connect the tanks or other receptacles in which the liquid motor fuels are stored with draw-off lines by which the gasoline-containing vapors, which develop in the upper portions of said tanks, may be removed and by being passed through a compressor and subsequent condenser the gasoline content of said vapors or gases is removed in liquid form separate from the dry or permanent gases. Due to the fact that said tanks have their upper portions provided with vacuum relief valves, air is admitted at intervals into the tanks where it mixes the gasoline vapors and produces a dangerous combustible mixture. Furthermore, in the storage of certain types of gasolines, particularly gasolines containing unsaturated compounds, it has been found that the contact of air or oxygen with said motor fuels results in a greatly accelerated rate of gum formation. Again, the admittance of air into the tanks causes excessive evaporation and corrosion to tank roofs, especially in the case of gasoline storage. Moreover, if air is commingled with the tank gases it passes with said gases into the compressor system with consequent hazards of a combustible mixture and produces a formation of carbon on the compressor valves which causes frequent cleanings. Also, there is a reduction in the gasoline yield due to the partial pressure effect exerted by the air, this partial pressure effect making the pressure carried on the compression system much less effective from the standpoint of gasoline extraction.

It is another object of the invention to provide a system of gasoline recovery from hydrocarbon gases wherein the apparatus uti-

lized is so constructed that corrosion due to sulphur compounds in the gas will not cause the system to fail to operate.

In most regulating systems now in use, the valves employed are equipped with rubber or leather diaphragms which have but short life due to the destructive or solvent action thereon of the gasoline vapors. It is another object of the invention to provide apparatus wherein said rubber or leather diaphragms are not utilized.

For a further understanding of the invention reference is to be had to the following description and to the accompanying drawing, wherein the figure is a diagrammatic view of the apparatus employed in connection with the present invention.

Referring more particularly to the drawing, the numeral 1 designates an oil storage tank. While only one of such tanks has been illustrated, it will be appreciated that any number thereof may be used through the employment of manifolding or common connections. These tanks are of usual form and may be of any desired capacity, oil being forced therein through a pump line 2 and by means of which line the oil may be removed from said tank or tanks. Ordinarily, an oil level indicated at 3 is maintained in said tanks which level, of course, fluctuates from time to time, depending upon the uses to which the oil in the tank is placed. Due to evaporation and other kindred causes, hydrocarbon gases or vapors form to collect in the upper portions of the tanks 1 and systems have been devised and are now in use for the purpose of removing such gases or vapors from the tops of the tanks and for stripping or depriving the same of their liquefiable content. In the storage of volatile motor fuels the recovery of liquids in this manner is a very important economy, although economies are likewise effected in the storage of less volatile oils such as crudes, gas-oil, or kerosene. The hydrocarbon vapors thus removed from the tops of the tanks are passed through compressors and following condensers by which the liquefiable portions of the gases are recovered and separated from the fixed or permanent gases.

Thus, as shown in the accompanying drawing, there is employed a vapor line 4 which connects with the upper portion of the tank 1 and permits of the removal of gases and vapors from the upper regions of the tank. The line 4 is extended so as to enter the lower portion of a floating roof tank 5. This latter tank is of the type commonly found in connection with cylindrical side walls and an open top, the section 6 constituting a receptacle in which is contained a desired quantity of water or other equivalent liquid, water being maintained in said section to approximately the level indicated at 7. The vapor line 4 enters the bottom of the section 6 and terminates in an upwardly directed vertical leg 8 which terminates above the water level 7.

Further, the tank 5 involves a floating roof section 9, formed to constitute in effect a diving bell, the circular side walls of the section 9 being received within the corresponding walls of the base section 6 in such manner that the roof section 9 may freely rise and fall in response to variations in the effective gas pressures developed within the section 9 above the liquid level 7, this being termed for convenience in description the gas space 10. Connected with the roof section 9 are counter-weights 11 which function to permit the roof section 9 to rise and fall freely in response to variations in the space 10.

Carried by the base section 6 is a gas outlet pipe 12 which also communicates with the space 10. The outlet pipe 12 leads to the inlet side of a compressor 13, there being an automatic valve 14 arranged in the pipe 12 to control the flow of gas and vapors from the space 10 to the compressor. Communicating with the pipe 12 is another pipe 15 by means of which gas from sources other than the tank 1 may be led into the compressor.

Assuming the valve 14 to be open, it will be seen that liquid-laden gases pass from the tank 1 into the gas space 10 of the floating roof tank by way of the open vapor line 4. From the gas space 10 the vapors pass by way of the outlet pipe 12 into the compressor 13. Within this unit the pressure of the gases is raised sufficiently to liquefy the liquefiable constituents of said vapors. After passing from the compressor, the vapors flow through the line 16 to a water-cooled condenser 17 to reduce the temperature thereof sufficiently so that when the gases or vapors are discharged, after flowing through the condenser, into an accumulator 18 a sharp separation is made between the liquids and gases, the liquids being collected in the bottom of the accumulator 18 and removed therefrom by way of an outlet 19. The gases pass from the top of the accumulator 18 into a pipe line 20 and may be led to burners or other utilizing apparatus.

Connected with the line 20 is a pipe line 21 which leads back to the gas space 10 provided in the tank 5. In the pipe line 21 there is interposed an automatically operating valve 22 by means of which the dry gases discharged from the accumulator may be bypassed into the tank 5 and then into the oil tank or tanks 1 in the event the pressure within the gas space 10 falls below a predetermined mean.

For example, as the pressure within the gas space 10 increases the floating roof section 9 moves upwardly, thereby maintaining the valve 14 in an open position to permit of unrestricted gas flow to the compressor 13. A simple mechanical way of accomplishing this is to provide the exterior of the roof section 9 with a stationary bracket 23, which engages a counter-weighted arm 24 pivotally mounted as at 25 in connection with a stationary support. The arm 24 is connected with a depending stem 26 having its lower end pivotally connected with the operating stem of the valve 14. Thus when the roof section 9 moves upwardly the bracket 23 contacts with a roller on the outer end of the arm 24, lifting said arm and with it the stem 26 so as to elevate the valve 14 above its seat 27 within the valve casing, thus opening the outlet pipe 12 to permit the gas to flow to the compressor.

Similarly, when the pressure within the gas space 10 decreases, the fixed bracket 28 provided upon the exterior of the section 9 descends and contacts with a roller provided upon the outer end of a counter-weighted arm 29, which is pivotally mounted intermediate of its ends as at 30. Connected with the arm 29 is a depending stem 31 which is connected with the stem of the valve 22. Thus when the section 9 descends to a predetermined degree the valve 22 is opened and the valve 14 closed, with the result that dry gas is admitted into the space 10 and the upper portions of the tank or tanks 1 to establish and maintain a desired gas pressure therein to prevent the entrance of air.

By way of further illustration, the floating roof tank possesses a diameter of about six feet, and its movable roof section 9 is properly counter-balanced so that one-quarter inch of water negative pressure will cause the roof section to rise and likewise one-quarter inch of water positive pressure will cause the roof section to sink. When the roof rises the valve 14 is opened and the gas allowed to pass to the suction side of the compressor. This gas is compressed and cooled and the condensate collected in the accumulator tank 18 and the dry gas conducted away to gas burners under stills or put to other desired use.

However, at time, especially on summer nights, the gasoline storage tanks cool off due to atmospheric conditions, and there is a

shrinkage in the volume of the gas above the oil level, or at times these tanks are pumped out through the pumping out line 2. During either of the above periods in ordinary systems heretofore in use, the vacuum relief valves on the tank 1 open and air is admitted into the tank, which is not only dangerous but causes excessive evaporation and corrosion to tank roofs in the case of gasoline storage. Also, in the case of certain types of gasoline or motor fuels, particularly motor fuels containing large quantities of unsaturates, the presence of air greatly accelerates the rate of gum formation, which is most undesirable.

In the present invention, however, as soon as a slight negative pressure occurs under the floating roof section 9, the roof section will fall when the negative pressure reaches the value of one-quarter inch of water, and at a predetermined point will admit dry gas into the holder which will pass back through the gathering lines into the tanks and thus prevent air admission into said tanks.

I am aware of the fact that efforts have been made to secure somewhat similar results by the employment of automatic regulators involving flexible diaphragms. Experience has shown that with diaphragms of limited size, it is impossible to obtain enough mechanical force in the case of one-quarter inch of water pressure to make these valves or regulators function, especially when there are traces of sulphur corrosion present in the gas. Failure of these regulators causes air to be admitted into the gas compression system with consequent hazards and formation of carbon on valves and other compressor parts. Also there is a reduction in the gasoline yield due to the partial pressure effect exerted by the air, this partial pressure effect making the pressure carried on the compression system much less effective from the standpoint of gasoline extraction.

In accordance with the present invention, however, with a floating roof section having a diameter of approximately six feet with one-quarter inch of water pressure, will exert a working force of 75 pounds which is entirely ample to work the control valves and overcome friction of the counter-weights, cables, pulleys and the like. It will be observed that the present invention eliminates entirely the use of flexible diaphragms which are so perishable when subjected to the solvent action of gasoline vapors. The system also has a further advantage that corrosion due to sulphur in the gas will not cause the system to fail to operate. One-quarter inch of water positive or negative pressure is considered necessary since most tank relief valves are designed for one inch positive and negative pressure, the difference between the one-quarter inch and the one inch being allowed so that the gas will flow in and out of the

system, which with ordinary size pipe lines constitutes an ample pressure differential.

What is claimed is:

1. In a gas gathering system, an oil storage tank, a compressor, a floating roof tank, said latter tank being adapted to contain a body of liquid, a pipe line between the gas space in the storage tank and the gas space in the floating roof tank, a pipe line between the gas space in said floating roof tank and the inlet side of said compressor, a valve in said latter pipe line, means following said compressor for separating liquid and gaseous content of the fluids discharged from the compressor, a pipe line for receiving the separated gases and leading the same back to the gas space in said floating roof tank, a valve in said latter pipe line, and means responsive to the rise and fall of the movable section of said floating roof tank to regulate the opening and closing of said valve.

2. In fluid storage apparatus, a container for storing hydrocarbon oils, a bell type gas holder, a pipe line providing for balanced gas pressures in the gas spaces of the container and holder, a constantly operating compressor, a valved pipe line leading from the gas space of said holder to the suction side of said compressor, means for cooling fluid discharged from said compressor, an accumulator for the reception of the cooled fluid, a dry gas outlet leading from said accumulator, a valved pipe line extending from said outlet to the gas space of said holder, and means responsive automatically to the variations in pressure in the gas space of said holder and the consequent movement of the bell section of the holder to actuate alternately the valves of said valved pipe lines, whereby to relieve the container of excessive gas or vapor pressures and to supply said container with a dry gas from said accumulator when the internal pressure of the container recedes to a predetermined degree.

3. In fluid storage apparatus, a container for storing hydrocarbon oils, a bell-type gas holder, means for maintaining balanced fluid pressures in said container and holder, a compressor, a pipe line provided with a valve leading from the gas space of said holder to the intake side of said compressor, means for separating fluid discharged from said compressor to admit of the separate withdrawal of a gaseous fraction from a liquid fraction, a pipe line provided with a valve for transferring said gaseous fraction to the gas space of said holder, and devices automatically operated by the rise and fall of the floating bell section of the gas holder to admit of the introduction of said gaseous fraction into said gas holder and container when the internal pressures therein recede below a predetermined point and close the valve in the pipe line leading from the gas holder to the inlet

side of the compressor and, conversely, when the gas pressures in the holder increase to a predetermined degree to arrest the flow of the gaseous fraction into said holder and admit of the passage of gas from the holder to the inlet side of the compressor.

4. In a gas storage system, a container for storing vaporizable hydrocarbon oils, a gas holder including stationary and floating sections, means for maintaining a substantially uniform and predetermined gas pressure in the gas spaces of the container and holder comprising a pipe line establishing open communication between said spaces, a valved outlet leading from the gas space of said holder, a valved gas inlet entering the gas space of said holder and leading from a source of gas supply disposed extraneously of said gas holder and container, and means operable by the rise and fall of the floating bell section of said holder in response to fluctuating gas pressures therein to open or close said valve inlet and outlet whereby to release gases from said holder and associated container when the gas pressures therein exceed said pre-

terminated pressure and to admit extraneous gases therein when said gas pressures recede from the desired predetermined pressure.

5. A gas storage system comprising a container for the reception of hydrocarbon oils in storage, a bell-type gas holder, said container and holder being provided with communicating gas spaces in the upper portions thereof above the liquids adapted to be contained therein, means for maintaining a desired predetermined gas pressure in the gas spaces of said holder and container, including a valved gas inlet entering the gas space of said holder, a valved outlet communicating with the gas space of said holder, and automatic means responsive to the rise and fall of the movable section of said gas holder to open or close said valves whereby to admit gas into said holder or expel gas from the holder to maintain substantially constant the desired predetermined pressures existing in the gas spaces of the holder and container.

In testimony whereof I affix my signature.

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