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A. E. HARNSBERGER

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METHOD AND APPARATUS FOR STORING HYDROCARBON MOTOR FUELS

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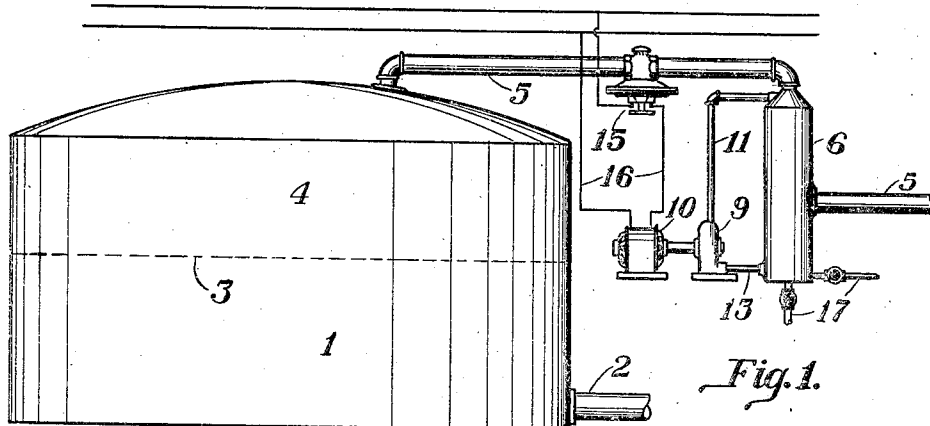


Fig. 1.

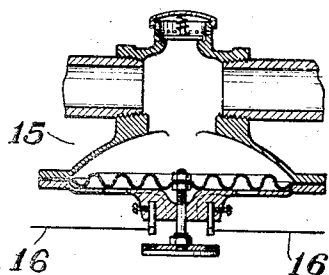


Fig. 3.

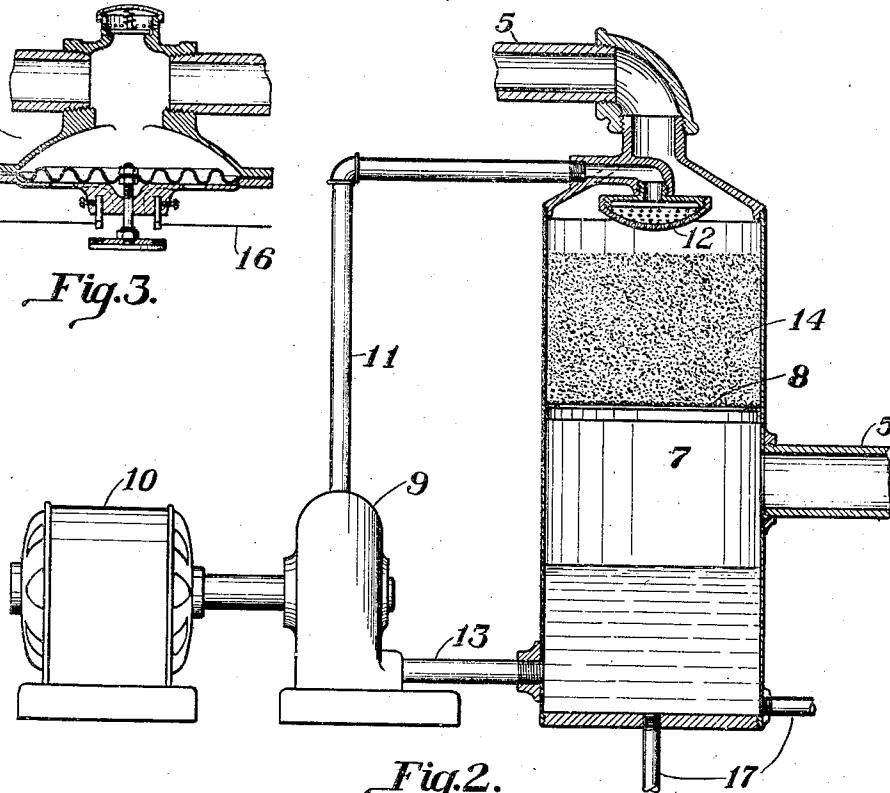


Fig. 2.

Inventor
Audley E. Harnsberger

By

W. D. Milowell

Attorney

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METHOD AND APPARATUS FOR STORING
HYDROCARBON MOTOR FUELSAudley E. Harnsberger, Chicago, Ill., assignor to
The Pure Oil Company, Chicago, Ill., a cor-
poration of Ohio

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12 Claims. (Cl. 23—244)

This invention relates to the storage of hydrocarbon motor fuels and especially those fuels which upon standing tend to produce deleterious compounds of a gum-like or resinous character and which interfere with the utility of the fuel when the latter is used in connection with the operation of internal combustion engines.

Cracked hydrocarbon oils which have an aromatic content or which contain unsaturated compounds produce the objectionable gums freely under ordinary conditions of storage, and this condition obtains even after careful commercial treatments for the removal of gums. It is my opinion that these gums which form in stored oils are produced through oxidation, that is, air which enters an ordinary storage tank combines with hydrocarbons of the unsaturated type to produce the heavier resinous bodies ordinarily termed "gums". Storage tanks receive fluctuating bodies of these oils and due to the rise and fall of the liquid level and to variations in temperature and atmospheric conditions, which affect the internal pressures of the tank, it is necessary to provide a vent leading from the interior of the tank to the atmosphere to maintain substantially constant pressure conditions within such a fuel storage tank. These automatic vents therefore provide for the so-called "breathing" of the tank, but permit air to enter the vapor space and to freely contact with the liquid oils stored in the tank, and it is my belief that it is this air or oxygen which results in or accelerates the formation of the objectionable gum compounds or polymers in the liquid motor fuel oil.

Therefore, it is an outstanding object of the present invention to employ in, or in communication with, the vapor space of such a tank a reagent which functions to rapidly absorb oxygen in such vapor area or vent, to the end of permitting of the necessary breathing of the storage tank and yet to prevent or minimize contact between oxygen-containing gases and a cracked motor fuel oil stored in the tank. In the specific aspect of the invention, the breathing vent of the fuel storage tank is provided with a chamber containing pyrogalllic acid or an equivalent oxygen-absorbing medium which is so disposed that when air is drawn through the vent toward the vapor space of the tank the oxygen of the air unites with the pyrogalllic acid so that inert gases will be delivered to the vapor space of the tank. This serves to maintain the desired internal tank pressures and provides an inert atmosphere over the stored motor fuel oil of substantially constant pressure.

For a further understanding of the invention, reference is to be had to the following description and the accompanying drawing wherein:

Figure 1 is a diagrammatic view of a conventional oil storage tank vented in accordance with the principles of the present invention,

Figure 2 is an enlarged vertical cross-sectional view taken through said vent,

Figure 3 is a detail sectional view of the switch mechanism controlling the operation of the pump motor.

Referring more particularly to the drawing, the numeral 1 designates a storage tank adapted for the reception of fluctuating quantities of cracked motor fuel oils which possess gum-forming proclivities. The tank may be of any desired mechanical design, but is preferably of the usual metallic construction of the type commonly found in connection with oil refineries or bulk storage stations. A pipe line 2 communicates with the bottom of the storage tank through which the liquid oil is introduced into or withdrawn from the interior of the tank. This results in constant variation of the liquid level, indicated at 3, of the tank. The vapor space 4, which is formed in the tank above the level 3, communicates with the conduit or vent 5 leading to the atmosphere and which serves to maintain substantially constant pressures within the tank in spite of fluctuations of the liquid level 3 or in the matter of variations in exterior temperature conditions, such as when the tank is subjected to exposure of the direct rays of the sun during daylight periods and then to the relative coolness of the following night periods. Briefly, the vent 5 provides for the so-called "breathing" of the tank and the maintenance of substantially constant internal pressure conditions. The usual vent or conduit, as above stated, results in the presence of air in the vapor space 4 and it is my belief that this air or oxygen results in producing in the stored motor fuel oil the oxidized hydrocarbon products known as "gums" or "polymers."

Therefore, to prevent the formation of these gums and yet to provide for the necessary breathing of the tank, I have provided the vent 5 with a casing 6 intermediate of the length thereof which is formed to produce a treating chamber 7. Arranged in this treating chamber is a horizontal screen 8 which effects the support of a body of steel wool, charcoal or the like, through which the gases traversing the vent 5 are passed. To remove oxygen from the gases, I provide in connection with the treating chamber 7 a small

circulating pump 9 driven by an electrical motor 10. A pipe line 11 extends from the outlet side of the pump 9 to a spray nozzle 12 situated in the top of the chamber 7, while a corresponding
 5 pipe line 13 connects a reservoir formed in the bottom of the chamber 7 with the inlet side of the pump 9. The reservoir in the bottom of the chamber 7 receives a body of pyrogallic acid which, through the operation of the pump 9,
 10 is forced in the form of a finely divided mist or stream downwardly through the chamber 7 to contact with the air passing in counter-current relation through the chamber 7 on its way to the vapor space of the tank. In addition, the pyro-
 15 gallic acid saturates the body of steel wool 14 arranged in the treating chamber 7 on the screen 8 whereby through the provision of this arrangement intimacy of contact between the air and the pyrogallic acid or other equivalent oxygen-
 20 removing medium is assured to the end that the gases drawn from the atmosphere and finally delivered to the interior of the tank are substantially free from objectionable quantities of oxygen. This results in placing an inert gas
 25 blanket over the liquid oils stored in the tank so that the gum-forming evils, due to oxidation, are greatly minimized or eliminated.

The oxygen-absorbing reagent may be either continuously circulated or intermittently circulated. For example, the vent may be provided
 30 with an automatic switch 15 which is responsive to the pressures in the tank 1 so that when the pressures within said tank fall sufficiently to permit of air flow through the vent into the tank, the switch 15 will function to close the circuit 16
 35 leading to the motor 10 in order to cause the forced circulation of the oxygen-absorbing reagent only when air is being drawn through the vent from the atmosphere. The pyrogallic acid may be withdrawn from the reservoir in the
 40 base of the treating chamber 7 and replenished from time-to-time by means of the valved pipe line 17.

In view of the foregoing it will be seen that
 45 the present invention provides for the maintenance of an inert gaseous atmosphere over a body of stored motor fuel oils and, furthermore, this atmosphere is maintained throughout fluctuations in the volume of oil stored in the tank as
 50 well as in response to variations in the internal pressures of the tank. The system functions automatically, requires little or no manual attention and is simple and inexpensive to install and operate. Gasolines so stored may be maintained
 55 in their original condition and without gum formation for extended periods of time, avoiding the necessity for re-running or re-treating fuels to remove gums or other expensive systems of purification or treatment. While the invention has
 60 been particularly described as being applicable to fuel storage tanks of the type used by refineries and storage depots, nevertheless, it will be appreciated that the invention may be employed in connection with any apparatus wherein cracked
 65 gasolines are either stored or contained.

What is claimed is:

1. In apparatus for storing motor fuel oils, a tank, a vent establishing communication between the upper interior portion of said tank and the
 70 atmosphere, and means for positively circulating a liquid medium through a localized portion of said vent in intimate contact with air drawn from the atmosphere through said vent.

2. In apparatus for storing cracked motor fuel
 75 oils, a tank, a vent establishing communication

between the upper interior portion of said tank and the atmosphere, said vent being provided with a treating chamber arranged intermediately of the length thereof, and means for circulating a liquid medium through said treating chamber to substantially deprive air passing through
 80 said chamber of its oxygen content prior to delivery thereof to said tank.

3. In apparatus for storing cracked hydrocarbon motor fuels, a tank formed for the reception of such fuels, there being a vapor space in said tank above the fuels, a vent establishing communication between said vapor space and the atmosphere, said vent intermediately of the length thereof being provided with a treating
 85 chamber, and means for passing a liquid reagent downwardly through said chamber in counter-current relationship to oxygen-containing gases passing upwardly through said chamber, whereby to substantially deprive said gases of the oxygen content thereof prior to their delivery to the vapor space in said tank.

4. In apparatus for storing cracked motor fuel oils, a tank formed for the reception of such oils, a vent communicating with the upper interior portion of said tank at one end and with the atmosphere at its other, said vent being provided intermediate of the ends thereof with a treating chamber, a permeable bed of treating material arranged in said treating chamber, and means for continuously supplying a liquid reagent to said treating material whereby to substantially deprive air passing through said vent from the atmosphere of the oxygen content thereof before the introduction thereof into said
 100 tank.

5. In apparatus for storing cracked motor fuel oils, a tank, a vent leading from the upper interior portion of said tank to the atmosphere, said vent being provided intermediate of its ends with a vertically disposed treating chamber, and means for positively passing a liquid reagent in a finely divided form downwardly through said treating chamber in contact with air drawn from the atmosphere and passing substantially upwardly through said chamber.

6. In apparatus for storing cracked motor fuel oils, a tank, a vent leading from the upper interior portion of said tank to the atmosphere, said vent being provided intermediate of its ends with a vertically disposed treating chamber, means for positively passing a liquid reagent in a finely divided form downwardly through said treating chamber in contact with air drawn from the atmosphere and passing substantially upwardly through said chamber, and a bed of solid material permeable to fluids disposed in said treating chamber in contact with the fluids passing therethrough.

7. In apparatus for storing cracked motor fuel oils, a tank formed for the reception of fluctuating bodies of said oils, a vent establishing communication between the vapor space formed in said tank above the oils therein and the atmosphere, said vent being provided between the ends thereof with a treating chamber, a liquid reagent receivable in the bottom of said chamber, and motor operated pump means for withdrawing the reagent from the bottom of said chamber and discharging the same in a finely divided form into the top of said chamber to intimately contact with gases passing through said vent from the atmosphere whereby to substantially deprive said gases of the oxygen content thereof.

8. In apparatus for storing cracked motor fuel
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oils, a tank formed for the reception of fluctuating bodies of said oils, a vent establishing communication between the vapor space formed in said tank above the oils therein and the atmosphere, said vent being provided between the ends thereof with a treating chamber, a liquid reagent receivable in the bottom of said chamber, motor operated pump means for withdrawing the reagent from the bottom of said chamber and discharging the same in a finely divided form into the top of said chamber to intimately contact with gases passing through said vent from the atmosphere whereby to substantially deprive said gases of the oxygen content thereof, and means automatically responsive to the internal pressures developed in said tank for controlling the operation of the pump mechanism employed in circulating said reagent.

9. The method of inhibiting gum formation in unsaturated hydrocarbon motor fuel oils during storage thereof, which consists in retaining a body of such oils in a confined storage zone having restricted vent communication with the atmosphere, and in maintaining in the vent region when the internal pressures of such storage zone are lower than surrounding atmospheric pressures a moving stream of a normally liquid oxygen-absorbing agent in extended surface form, whereby the oxygen of the atmosphere passing into the vent region is caused to unite substantially with said agent to admit of the introduction of substantially inert gases only into the storage zone for contact with the oils retained therein.

10. The method of inhibiting gum formation in unsaturated hydrocarbon motor fuel oils during storage thereof, which consists in retaining a fluctuating body of such oils in a confined storage zone, said zone having restricted vent communication with the atmosphere, and in estab-

lishing in said vent region when the internal pressures of such storage zone are lower than the surrounding atmospheric pressures a spray of a normally liquid oxygen absorbing agent, whereby the oxygen of the atmosphere passing into the vent region is caused to unite substantially with said agent to permit of the introduction of substantially inert atmospheric gases only into said storage zone.

11. The method of storing cracked motor fuel oils of the type which tend to form gums on exposure to air, which consists in retaining fluctuating quantities of such oils in a confined storage zone having restricted vent communication with the atmosphere, and in establishing at intervals in the vent region a forced circulation of a normally liquid oxygen absorbing agent maintained in extended surface form to combine with atmospheric oxygen drawn into the vent region, whereby to permit of the introduction of substantially inert atmospheric gases only into said storage zone.

12. The method of inhibiting gum formation in cracked unsaturated hydrocarbon motor fuel oils during storage thereof, which consists in retaining a body of such oils in a storage receiver having restricted vent communication with the atmosphere, and in maintaining in the vent region of said receiver, during such periods only when the internal pressures of said receiver are lower than the surrounding atmospheric pressures, a positively circulating stream of a normally liquid oxygen absorbing agent, whereby the oxygen of the atmosphere passing into the vent region of the receiver is caused substantially to unite with said agent to permit of the passage only of substantially inert atmospheric gases into the receiver.

AUDLEY E. HARNSBERGER.

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