June 24, 1947. J. H. WIGGINS 2,422,869

GAGING AND SAMPLING APPARATUS FOR LIQUID STORAGE TANKS

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FIG. 1.

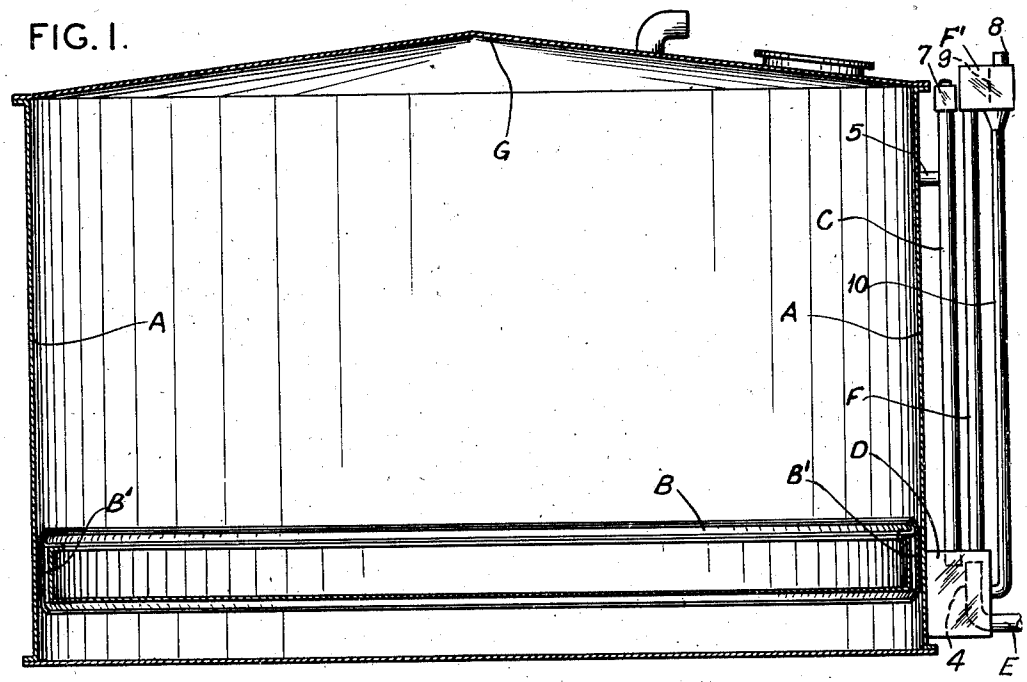


FIG. 2.

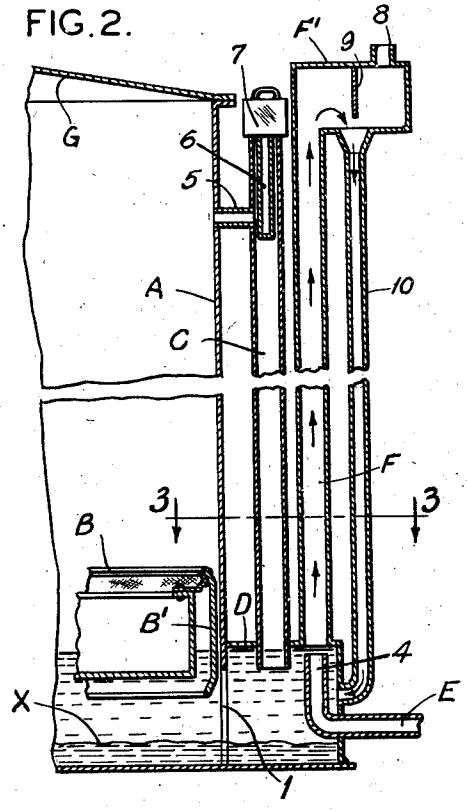
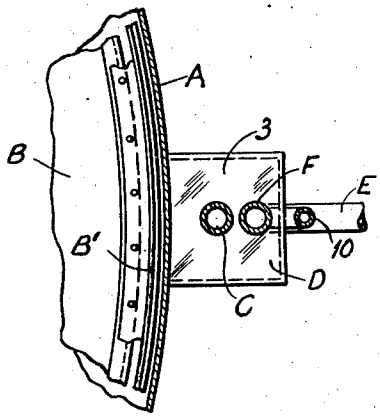


FIG. 3.



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GAGING AND SAMPLING APPARATUS FOR LIQUID STORAGE TANKS

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3 Claims. (Cl. 137—21)

1

This invention relates to a novel gaging and sampling apparatus for liquid storage tanks.

One object of the invention is to provide a gaging and sampling apparatus for liquid storage tanks that overcomes the necessity of forming a gage hatch in the roof of the tank.

Another object is to provide a gaging and sampling apparatus, which is of such design or construction, that when it is used with a liquid storage tank equipped with a floating roof, it overcomes the necessity of employing a ladder which the gager must use during the operation, in the event the floating roof is located at a point considerably below the top edge of the side wall of the tank.

Another object is to provide a novel means for preventing gases that may be mixed with oil from entering a storage tank during the operation of pumping oil into the tank.

Another object is to provide a novel means for preventing bottom settlings, commonly referred to as "B. S.," from escaping or being pulled out of an oil storage tank, during the operation of emptying the tank.

And still another object is to provide an inexpensive and efficient overflow mechanism for a storage tank equipped with a floating roof that eliminates the possibility of the roof rising above a certain level, and which does not interfere with the side wall sealing means of the floating roof. Other objects and desirable features of my invention will be hereinafter pointed out.

Figure 1 of the drawings is a vertical, transverse sectional view of a floating roof liquid storage tank, equipped with a gaging and sampling constructed in accordance with my invention.

Figure 2 is an enlarged, vertical sectional view of said gaging and sampling apparatus; and

Figure 3 is a horizontal, sectional view, taken on the line 3—3 of Figure 2, looking in the direction indicated by the arrows.

My improved gaging and sampling apparatus is particularly adapted for use with liquid storage tanks in which the roof of the tank floats upon or is supported by the liquid confined in the tank. However, it is not limited to floating roof tanks, but is capable of use with other types and kinds of liquid storage tanks.

In the accompanying drawings, which illustrate the preferred form of my invention, A designates the vertical side wall of an oil storage tank, that is equipped with a floating roof B, of conventional construction, said roof being provided at its peripheral edge with a side wall sealing

2

means, designated as an entirety by the reference character B'. Instead of equipping said roof with a conventional gage hatch, through which an operator can introduce an instrument into the oil confined in the tank, for the purpose of gaging the tank, or taking a sample of the oil, I have provided the tank with a gaging and sampling apparatus, comprising a gage and sample well C, constructed and arranged so that when the tank A contains liquid, the well C will also contain liquid, whose level always remains the same as the level of the liquid in the tank A. The well C is open at its upper end and the method of using the apparatus is for a gager to introduce a "thief" or conventional gaging device into the well C, through the open upper end of same, in the same way that a tank is usually gaged through a hatch in the roof. In the particular form of my invention herein illustrated, the gage and sample well C is formed by a vertically-disposed, tubular member arranged on the exterior of the tank in parallel relation with the tank side wall, the lower end of said member communicating with a reservoir D, that is located on the exterior of the tank adjacent the bottom of the tank. The reservoir D communicates with the interior of the tank through an opening 1 in the tank side wall, and the tubular member which constitutes the well C, extends upwardly to a point at least as high as the top of the highest oil level in the tank A. The reservoir D is large enough circumferentially so that "B. S." will accumulate in said reservoir at the same level or depth as the "B. S." which accumulates in the tank A, as indicated by the reference character X. As shown in Figures 2 and 3, the reservoir D is provided with a top 3 that is disposed slightly above the top edge of the opening 1 in the tank side wall which connects the reservoir D with the interior of the tank, and the vertically-disposed, tubular member that constitutes the gage and sample well C, projects downwardly through the top 3 of the reservoir, and terminates at a point approximately flush with the top edge of the previously mentioned opening 1 in the tank side wall.

The liquid stored in the tank A is admitted to and discharged from said tank through a horizontal eduction and supply pipe E, provided with a vertically-disposed, upturned end portion 4 that terminates inside of the reservoir D, at a level above the extreme lower end of the tubular member which constitutes the gage and sampling well C. Near the upper end of the tank A, an overflow tube 5 projects laterally from the tank

side wall and connects with the upper end portion of the gage and sampling well C. Normally, the overflow pipe 5 is closed by a float or buoyant closure 6, in the well C, and the upper end of the well C is normally closed by a removable closure 7 of any suitable or preferred kind. In the particular form of my invention herein shown, the closure 7 is attached to the buoyant valve 6 for the overflow 5. When the liquid in said well C rises to a certain height, the buoyant closure or valve 6 for the overflow 5 will move upwardly, thus opening said overflow and also unseating the closure 7 at the upper end of the gage and sampling well C, thereby permitting liquid to escape from the upper end of said well.

My improved gaging and sampling apparatus preferably has combined with same a novel means for preventing gases from entering the tank A, or the gage and sampling well C, during the operation of pumping oil into the tank. In the form of my invention herein illustrated, said means comprises a vertically-disposed, liquid-gas mixture eduction pipe F attached to the top wall 3 of the reservoir D, flush with the underside of said top wall, and leading upwardly from same to a liquid-gas separating chamber F', that is provided with a gas outlet 8, and a vertically-disposed baffle 9 arranged between said gas outlet and the upper end of the eduction pipe F. A vertically-disposed liquid return pipe 10 leads downwardly from the bottom of the liquid-gas separating chamber F' to the reservoir D, said return pipe 10 entering the side wall of said reservoir, at a level below the terminal end of the upturned portion 4 of the combined supply and eduction pipe E. Gases that may be mixed with the oil that is pumped into the tank through the pipe E, are released upon emerging from the upper end of the upturned portion 4 of the pipe E, and find their way into the gas space in the upper portion of the reservoir D, that is produced by locating the opening 1 in the tank side wall at a point below the top wall 3 of the reservoir D. From said gas space the released gases flow upwardly through the pipe F, into the separating chamber F'. If there are any particles of liquid or oil entrained in the gases flowing upwardly through the pipe F, as indicated by the arrows in Figure 2, such oil or liquid particles will be separated from the gases upon coming in contact with the baffle 9 in the separating chamber F', the gases escaping from said chamber through the gas outlet 8, and the separated liquid flowing downwardly through the return pipe 10, back to the reservoir D. In order to insure that the gaging and sampling well C will, at all times, contain an average sample of the oil that has been supplied to the tank A by the pipe E, the terminal or discharge end of the upturned portion of said pipe is disposed in such relationship with the lower end of the tubular member that constitutes the gage and sampling well C, that the inflowing oil will be sure to travel across the lower end of said tubular member, on its way to the opening 1 leading to the interior of the tank A. To further insure this, and at the same time, prevent a difference in temperature in the well C and in the tank A from causing a gaging error, the tank is provided with the previously mentioned overflow tube 5 that leads from the upper portion of the tank into the upper portion of the well C. Additional connections similar to the overflow tube 5 may be made between the tank and the well C, if operating conditions require it.

When the tank A is being emptied, the oil withdrawal stops exactly at the terminal end of the upturned portion 4 of the pipe E, due to the fact that the vacuum which otherwise would be set up, is broken by the air that enters the upper end portion of the reservoir D, through the liquid-gas mixture eduction pipe F. This is desirable

(1) In that it eliminates the possibility of any "B. S." being pulled out of the tank with the escaping oil; and

(2) It insures the floating roof coming to rest automatically in a predetermined low position.

When the tank is being filled, the floating roof rises until the liquid in the tank reaches a predetermined level that is controlled by the float valve 6 for the overflow 5, or by the closure 7 for the upper end of the well C. In an apparatus of the construction herein illustrated, before the tank is altogether full, the float valve 6 moves upwardly and opens the closure 7 of the well C, thus causing said well to act as an emergency overflow.

The structure above described is capable of use in storage tanks of any diameter, equipped with a floating roof. It is particularly adapted for use, however, on a tank whose diameter is small enough, say, from 10 ft. to 30 ft., to make it preferable, from an operational or structural standpoint, to equip the tank with a floating roof, and also with a weather roof. Accordingly, I have shown the tank A as being provided with a weather roof or stationary roof G. My invention is particularly applicable to storage tanks that are equipped with a floating roof and also with a weather roof, for various reasons:

It eliminates the gage and sampling hatch usually employed on floating roofs. Such hatch normally must be opened by a rope from the top of the tank to whatever depth the floating roof may be. It is a difficult operation to close said hatch, and experience has shown that they are generally left open, when handled in this manner. Thus, a gage hatch on a floating roof increases the evaporation losses, and on small tanks, this is a high percentage of the total loss by evaporation. The other alternative is to have the gager climb down on to the floating roof on a ladder leading from the tank side wall, and gage the tank while standing on the floating roof. Some companies insist upon this manner of gaging, notwithstanding the fact that it necessitates the use of a folding ladder or a rolling ladder, which is expensive. Thus, the above described method of gaging necessitates the use of rather expensive equipment. By eliminating the gage hatch on the floating roof, I decrease the evaporation losses. I also overcome the necessity of equipping the roof with an expensive ladder.

Another operational difficulty, especially where an oil storage tank is equipped with a floating roof and with a weather roof, is the separation of oil and gas that might be pumped into the tank. If the floating roof is used as an oil separator, in the normal manner, then it is certain that there will be an explosive mixture much of the time throughout all or part of the space between the floating roof and the weather roof. This creates a fire hazard, which it is desirable to eliminate. My invention eliminates any possibility of gas being pumped under the floating roof, and it prevents any gas which accompanies the oil from getting into the space between the floating roof and the weather roof.

Still another operational difficulty where a floating roof storage tank is provided with a weather roof, is the trouble that results from fill-

ing a tank too full. In such instances the floating roof is apt to rise too high, thereby striking the weather roof and wrecking same. In prior structures the tank side wall was provided with a safety overflow hole, located at the desired level, but the objection to such an overflow hole, is that it makes the floating roof side wall seal inefficient, with the result that the evaporation loss is increased enormously when the tank is full, or even 1 ft. to 3 ft. of full, depending upon the type of side wall seal that is used.

Briefly described, the gaging and sampling apparatus herein illustrated comprises a reservoir arranged on the exterior of a liquid storage tank at the lower end of same and connected with the interior of the tank by an opening or passageway, and a gage and sampling well joined to said reservoir and extending upwardly from same to the top of the highest liquid level in the tank, the upper end of said well having an opening through which a "thief" or similar gaging device can be inserted in the well. In addition, my improved apparatus is preferably so designed or constructed as to have one or more of the following elements, features or characteristics:

(1) A supply pipe arranged so that the liquid being pumped into the tank must first travel through the reservoir, above referred to;

(2) A supply pipe of the kind above mentioned, having an upturned end that terminates in said reservoir at a predetermined height above the bottom of the tank;

(3) A space in the upper portion of said reservoir equipped with a gas outlet, that prevents a considerable amount of gas from accumulating in said reservoir and eventually finding its way into the tank, or into the gage and sampling well;

(4) Means for causing liquid entrained in gases escaping from the upper portion of said reservoir, to be separated from the gases and returned to the reservoir;

(5) Means for supplying air to the reservoir when the tank is being emptied, so as to prevent accumulated "B. S." in the tank or in the reservoir from escaping with the outflowing liquid; and

(6) An opening or passageway between the tank and said reservoir, so proportioned and arranged that if sediment or "B. S." collects on the bottom of the tank, a layer of sediment of equal depth will collect on the bottom of the reservoir.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A liquid storage tank provided with a reservoir arranged on the exterior of the tank adjacent the bottom of the tank and provided with a top,

the tank side wall having an opening located below the top of said reservoir, that establishes communication between said reservoir and the tank, a gage and sampling well formed by a tubular member that projects downwardly through the top of said reservoir and terminates at a level below said top, and a pipe for supplying the liquid to the tank, provided with an upwardly-projecting discharge portion that terminates inside of the reservoir at a level higher than the lower end of the tubular member that constitutes the gage and sampling well.

2. An oil storage tank provided with a reservoir on the exterior of the tank located adjacent the bottom of same and connected with the interior of the tank by an opening in the tank side wall located at a level below the top wall of said reservoir, said reservoir being large enough circumferentially so that sediment or "B. S." will accumulate in said reservoir to substantially the same depth or thickness that sediment "B. S." accumulates in the tank, a combined liquid intake and discharge pipe that terminates inside of said reservoir at a level in close proximity to the underside of the top of said reservoir, a vertically-disposed, tubular member on the exterior of the tank constituting a gage and sampling well and having its lower end terminating inside of said reservoir at a level lower than the discharge end of said liquid supply pipe, and an overflow leading from the tank to the upper end portion of said tubular member.

3. An apparatus of the kind described in claim 2, provided with a closure for said overflow, adapted to be moved into its open position when the liquid in said tubular member rises above a certain level.

JOHN H. WIGGINS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,937,755	Ginger et al.	Dec. 5, 1933
1,358,355	Bewan	Nov. 9, 1920
2,237,461	Tokheim	Apr. 8, 1941
1,613,312	Conts	Jan. 4, 1927
723,832	Cook	Mar. 31, 1903
1,503,179	Whitson	July 29, 1924

FOREIGN PATENTS

Number	Country	Date
19,881	Great Britain	1894