Oct. 23, 1923. 1,471,705

H. P. PORTER

APPARATUS FOR TREATING FRESH PETROLEUM

Filed Oct. 3, 1917 2 Sheets-Sheet 1

Fig. 1.

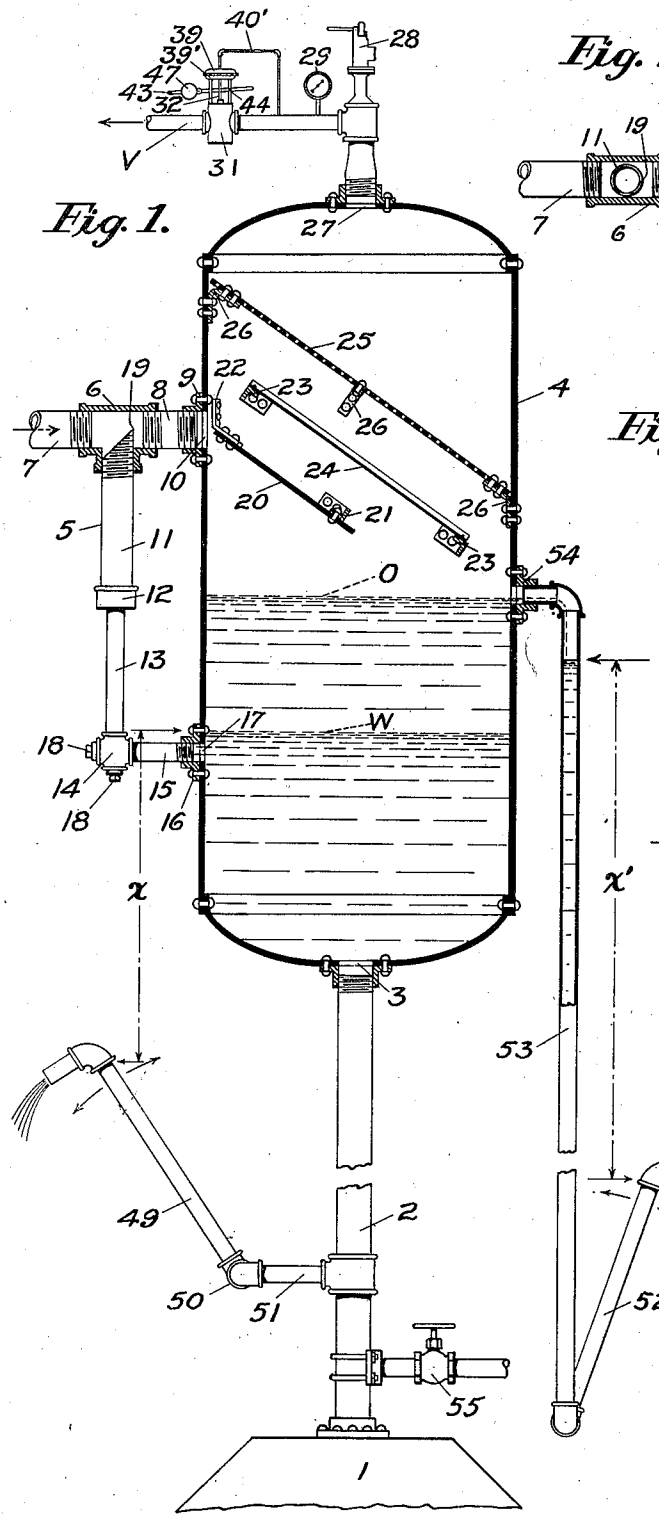


Fig. 2.

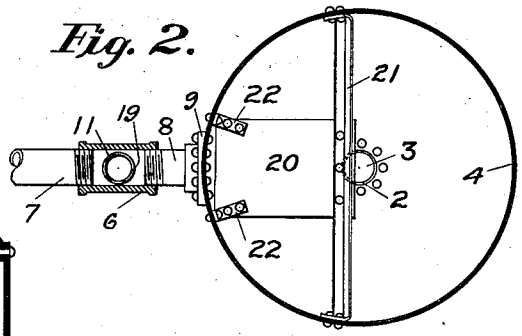


Fig. 3.

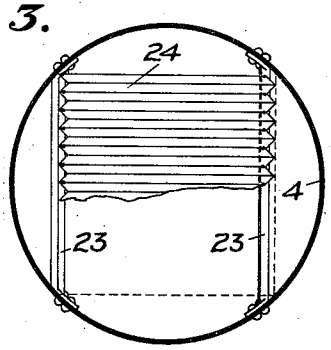
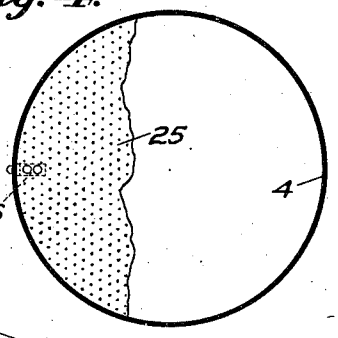


Fig. 4.



INVENTOR

Hollis P. Porter

BY

John F. Heine

ATTORNEY

Oct. 23, 1923. 1,471,705

H. P. PORTER

APPARATUS FOR TREATING FRESH PETROLEUM

Filed Oct. 3, 1917 2 Sheets-Sheet 2

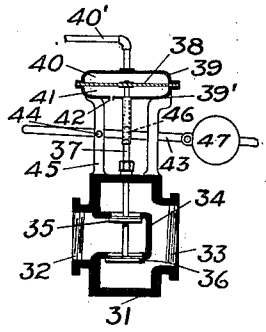


Fig. 6.

Fig. 5.

INVENTOR
Hollis P. Porter
BY
John T. Heinz
ATTORNEY

Patented Oct. 23, 1923. 1,471,705

UNITED STATES PATENT OFFICE.

HOLLIS P. PORTER, OF TULSA, OKLAHOMA.

APPARATUS FOR TREATING FRESH PETROLEUM.

Application filed October 3, 1917. Serial No. 194,508.

To all whom it may concern:

Be it known that HOLLIS P. PORTER, a citizen of the United States, residing at Tulsa, in the county of Tulsa and State of Oklahoma, has invented certain new and useful Improvements in Apparatus for Treating Fresh Petroleum, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to devices for handling or treating crude fresh petroleum as it issues from the well, or as it is being delivered into stock. In accordance with the customary practice, the fresh oil is pumped or otherwise caused or permitted to flow from the well into an open-topped vessel or so-called "flow-tank," wherein any water entrained in the oil is allowed to settle out and run into a wasteway, while the oil is discharged into a storage tank. Petroleum issuing from the well carries gases and certain light or volatile hydrocarbons, such as naphtha, gasoline, etc., which are necessarily wasted when the oil is treated in the ordinary flow-tank in the aforesaid customary manner. Furthermore, after the oil is freed from the entrained water and delivered into the large steel storage tanks, common to the oil-fields, further and great loss of oil is caused by solar radiation which effects a considerable temperature rise and consequent rapid evaporation of the lighter hydrocarbons carried by the petroleum stored in the tanks. According to actual tests the loss of oil by evaporation has been found to be as much as 5% during the first seven days the oil is held in storage.

The present invention, therefore, has for an object to provide a simple and efficient apparatus for treating crude petroleum as it issues from the well, or as it is being delivered into stock, to the end that the gases and volatile hydrocarbons carried by the fresh oil may be extracted and conserved for delivery to a gasoline plant, while the oil which is delivered into stock will be relieved of the more volatile hydrocarbons and consequently will not suffer a great loss by evaporation during the time the oil is held in storage.

A further object of the invention is to provide the apparatus in such form that it will function automatically without necessitating the use of heavy balanced or movable tanks which are difficult to erect and maintain in operative condition. Further objects of the invention will appear from the following description and claims.

According to the present invention, the fresh oil flowing or being pumped from the well, or from a series or system of wells, is first delivered into one or more conveniently situated vacuous chambers or elevated closed vessels or tanks stationarily supported at fixed elevations. A partial vacuum is maintained in said vessel or vessels by suitable connections with a vacuum system, including a vacuum pump, which serves to draw off the gases and vapors of the volatile hydrocarbons readily freed from the oil under the reduced pressure in said tanks, and deliver the said vapors and gases without dilution to the usual compressor at a central station or gasoline plant. In the present instance, delivery of the petroleum from the well into the vacuous chamber or chambers is effected without exposure or mixture of the natural petroleum to or with air or other extraneous matter, such as gases lean in hydro-carbons, which would serve as a diluent to the vapors or gases naturally accompanying the petroleum and thereby seriously interfere with the production of a maximum amount of gasoline therefrom. The relatively non-volatile liquids collect in the lower part of the vessel and may be discharged, preferably, by means of a barometric out-flow which permits the apparatus to function continuously without the attention of an operator.

In the accompanying drawings forming a part of this specifiction, Fig. 1 is a side elevation of one form of the apparatus adapted particularly for wells which are flowing; the gas and vapor conserver being shown in vertical section to reveal the baffle-plates disposed therein. Fig. 2 is a horizontal section through the conserver tank illustrated in Fig. 1, showing the position of the lower or plain baffle-plate. Fig. 3 is a similar view showing the position of the intermediate or corrugated baffle-plate. Fig. 4 is a similar view showing the position of the upper or perforated baffle-plate. Fig. 5 shows the tank illustrated in Fig. 1, but provided with a modified construction of barometric out-

flow and connected to a well which is pumping. Fig. 6 is a sectional view of the special vacuum pressure regulator employed in the apparatus illustrated in Fig. 1.

In the specific embodiment of the invention illustrated in Figs. 1 to 4, inclusive, 1 represents a suitable supporting base from which rises a supporting column or pipe 2, the upper end of which connects with the lower or water discharge orifice 3 of the gas separating and conserving tank 4 and rigidly supports said tank at a fixed elevation. Mounted on the side of the tank 4 is an auxiliary separator 5 made up of standard pipe fittings and comprising a T 6 in which is threaded the intake 7 which leads from the well and through which the fresh petroleum flows into the apparatus. Threaded into the opposite end of the horizontal portion of the T 6 is one end of a nipple 8 the opposite end of which is threaded into the flange 9 bolted to the tank 4 and embracing the intake orifice 10. Threaded into the vertical portion of the T 6 is the upper end of a vertically disposed short length of pipe 11 the lower end of which is reduced at 12 and connected to a vertically disposed pipe 13 of reduced size, the lower end of which is screwed into the upper orifice of a cross 14. One of the lateral orifices of the cross 14 is connected by a nipple 15 to the flange 16 embracing a second or liquid intake aperture 17 in the side wall of the tank 4. The two remaining orifices of the cross 14 are closed by plugs 18 which may be readily removed in case it is necessary to clean out the separator 5. The upper end of the pipe 11 is cut on an angle preferably of 45°, as shown in Fig. 1, and in the present instance is screwed into the T 6 to such an extent that the tip end 19 of the pipe 11 is disposed at substantially the center line of the intake 7 and nipple 8, while the upper orifice of said pipe is directed toward the intake 7 or opposite to the direction of flow of the petroleum.

Mounted within the tank 4 preferably at an angle of about 55° to the vertical is a rectangular, plain baffle-plate 20 of relatively small size, the lower end of which is bolted to a horizontally arranged angle-iron 21. The upper edge of the baffle-plate 20 is arranged at substantially the level of the center line of the intake orifice 10 and is spaced slightly from said orifice; the upper corners of the baffle-plate being secured to the tank 4 by suitable clip angles 22. The plain baffle 20 is intended to deflect only the main body of the oil-stream which may pass the separator 5; there being plenty of space around said baffle to allow the gas and coarse spray to pass around it.

Supported above and in parallelism with the plain baffle 20 by means of the angle irons 23 is a rectangular corrugated baffle-plate 24 of larger size; the corrugations extending in the direction of inclination of the baffle and providing a large surface upon which drops of petroleum collect and are exposed to the action of the vacuum for evaporation. The heavier oils gravitate to the lower end of each corrugation and fall to the main body of liquid below. The corrugated baffle 24, in the present instance, covers all the space its rectangular shape will permit; its four corners being in contact with the cylindrical side wall of the tank 4.

Disposed above and parallel to the plain and corrugated baffles is a perforated baffle 25 shaped as an ellipse and completely filling the area defined by the intersection of its plane with the cylindrical wall of the tank 4. The perforated baffle 25 is supported by means of suitable clip-angles 26 and, since it completely fills the cross-sectional area of the tank, all the vapors must pass through the numerous small perforations the walls of which serve to catch any spray or heavy oil particles and return them to the main body of liquid below.

The baffling means above described represents the preferred construction and arrangement of the plates. I do not, however, wish to be limited to the use of any particular number of baffle plates or to the use of plain, corrugated or perforated baffle plates. Broadly, the distinguishing characteristic of the baffling means of the present invention lies in the arrangement of such means in one or more planes inclined to the horizontal and adapted to receive the horizontally introduced oil stream and direct it downwardly while exposing a relatively large surface of oil to the action of the vacuum maintained in the tank.

When the intake 7 is connected to a flowing well, the flow of oil into the separator 5 may be very erratic; the oil at times being discharged from the well at high velocity and, at times, at medium or low velocity. During a high velocity discharge, the oil stream entering the intake 7 strikes the open upper end of the pipe 11 and is partially broken up into droplets resembling a coarse spray which is received by the corrugated baffle-plate 24; the main body of the oil stream passing the separator 5, through the nipple 8, being deflected downwardly by the plain baffle-plate 20. The breaking up of the petroleum into drops within the tank 4 exposes larger surfaces of petroleum and augments volatilization of the lighter hydrocarbons at the reduced pressure. Any water carried with the petroleum will find its way to the heavier liquid matter in the lower part of the tank where it will readily settle out and become separated from the petroleum. The open

upper end of the pipe 11 being situated in the lower part of the T 6 and being directed oppositely to the direction of flow of oil, will receive and divert a portion of the oil stream including any entrained water which may have settled below the oil in the intake 7. This diverted portion of the oil stream will carry most of the water and will enter the conserver tank 4 below the level of liquid therein. During a medium or low veolcity discharge of oil, the action of the upwardly projecting end on the pipe 11 in breaking up the oil stream into a coarse spray will be correspondingly reduced and the oil stream may, at times, be entirely taken care of or received by the pipe 11; the gases, only, passing through the nipple 8 and into the tank 4.

At the top of the tank is the vapor or gas outflow orifice 27 which is connected by suitable piping to the vacuum line or system V leading to a central gas pumping station where the conserved gases or vapors are converted into gasoline, naphtha, or the like. Connected to the line V in proximity to the conserver tank is a pressure relief valve 28 of common form, a vacuum pressure gauge 29 and a vacuum pressure regulating valve 31 shown in detail in Fig. 8.

The purpose of the valve 28 is to relieve the pressure within the tank as desired in case of an accidental excessive pressure, while the vacuum pressure regulating valve 31 may be adjusted to give any desired degree of vacuum within the tank 4, as will be understood from the following detailed description. Referring to Fig. 6, it will be seen that the body of the valve comprises a cylindrical casing having intake and outflow orifices 32 and 33, respectively. A U-shaped partition 34 divides the casing into two chambers and is formed with upper and lower circular valve seats to which are fitted the valves 35 and 36 carried by the valve rod 37 extending through the top of the casing and connected to a flexible diaphragm 38 preferably of rubberized fabric, which divides the space within the opposed upper and lower concave plates 39, 39′ into two chambers 40 and 41.—The chamber 40 is connected with the vacuum line V near the gas conserver by the pipe 40′ while the chamber 41 may communicate with the atmosphere through the vent 42. A lever 43 pivoted at 44 to the support 45 and connected at 46 to the rod 37, carries a weight 47 which tends to lower and open the valves 35 and 36 and permit the gas to flow from the tank 4 into the line V. It is obvious that if the vacuum in the tank 4 is reduced below a certain degree, determined by the position of adjustment of the weight 47, the atmospheric pressure will lift the diaphragm 38 and overcome the weight 47 thereby closing the valves and permitting the pressure to build up in the tank.

Any water carried into the conserver 4 with the oil or gas will settle to the bottom and assume a level such, for example, as W while the oil will float upon the water and assume a level such as O. In order that the water and oil may be automatically discharged from the vessel 4 while permitting the maintenance of a partial vacuum therein, I provide barometric out-flow means comprising in the present instance, a swingable water discharge pipe 49 connected through a pair of L's 50 to a horizontal nipple 51 connected in turn to the riser 2 leading to the bottom of the vessel 4. By swinging the water discharge pipe 49 about the double L connection the distance x can be regulated to suit the degree of vacuum maintained in the vessel 4.

A similarly adjustable oil discharge pipe 52 is connected to a riser 53 which leads from the oil discharge orifice 54, provided in the vessel 4 at the oil level O. The oil discharge pipe 52 may be swung to vary the distance x' to suit the degree of vacuum maintained. When adjusted, this barometric out-flow will permit the escape of the water and oil through separate pipes while permitting the maintenance of a partial vacuum in the vessel 4. Moreover the water level w will be maintained automatically at a safe distance below the orifice 54 and above the pipe 51. From the pipe 52 the oil may be conducted to a suitable storage tank. A valve 55 near the base of the column 2 may be used to draw off any heavy or solid matter deposited therein.

In Fig. 5 I have shown the vapor conserving tank 4 provided with a modified form of barometric out-flow and connected up to a well which is pumping. In Fig. 5, 56 represents the well casing within which is the usual flow-line 57 extending down into the well and terminating in the usual pumping barrel (not shown). The pump-rod 58 is operated by the usual pumping jack or walking beam (not shown). The oil is pumped through the flow-line 57 without exposure to air or mixture with extraneous matter, diluents, etc., into the intake 7 of the elevated gas-conserver 4. The well casing 56 is closed at the top and connected to the vacuum system V. The vertical pipe 59 leading downwardly from the bottom of the gas-conserver 4 may terminate in a T 60 within a lower settling chamber 61 supported by the usual derrick floor 61^x and wherein the water and oil automatically separate. An upper oil-discharge pipe 62 leads to a storage tank 63 having a vent 63′ while a lower water-discharge pipe having an adjustable section 64 permits escape of the water. No pressure regulating valve is shown in connection with this system as even a wide variation in pressure within the tank 4 is

not detrimental to the efficient action of the apparatus, since such variation will merely cause a fluctuation of the level of liquid in the pipe 59 or tank 4 and will have no effect upon the continuous and automatic action of the water and oil discharge means, connected to the lower setting chamber 61, which is of large capacity as compared to the capacity of the pipe 59. It is to be understood that the apparatus illustrated in Fig. 5 while shown connected to a well which is pumping is particularly adapted by virtue of the specific construction of the tank 4, for use in connection with a well which is flowing.

With a pumping well a gas conserver having the described separator 5 and system of baffles 20, 24 and 25 is not necessarily required, as the flow of oil is steady and not irregular or violent as is often the case with flowing wells.

While I have shown and described certain specific embodiments of the invention, I do not wish to be limited to said specific embodiments as it will be apparent to those skilled in the art that various changes, modifications, substitutions, omissions and additions may be made thereto without departure from the spirit and scope of the invention as defined in the appended claims.

Having thus set forth the nature of the invention, what I claim herein is:

1. Apparatus for conserving gas and vapors from fresh petroleum as it is produced at the well comprising, a closed vessel stationarily supported at a fixed elevation, an intake pipe connecting the well with said vessel and operating to deliver the fresh petroleum into said vessel without exposure to air or dilution with extraneous matter, said intake including means for breaking up the oil stream, a vacuum line connected to said vessel, one or more baffles mounted within said vessel in the path of the broken up oil stream for receiving oil particles and exposing them to the action of the vacuum, and barometric outflow means connected to said vessel whereby the liquid may escape automatically while permitting the maintenance of a partial vacuum therein.

2. Apparatus for conserving gas and vapors from fresh petroleum as it is produced at the well comprising, a closed vessel stationarily supported at a fixed elevation, an oil intake leading from the well and connected to said vessel intermediate its ends and including means for breaking up the oil stream into a coarse spray, a vacuum line connected to said vessel adjacent its upper end to draw off the conserved gases, and barometric out-flow means connected to said vessel whereby the liquid may automatically flow out under the influence of gravity while permitting the maintenance of a partial vacuum within said vessel.

3. Apparatus for conserving the volatile hydrocarbons in fresh petroleum comprising an elevated closed vessel, an intake connected to the side of said vessel between its upper and lower ends, a plain baffle-plate sustained at an inclination within said vessel and having its upper edge disposed substantially at the level of said intake, a corrugated baffle-plate sustained above said plain baffle-plate, a perforated baffle-plate sustained above said corrugated baffle-plate and substantially filling the sectional area of the vessel in the plane of said perforated plate, a vacuum line connected to said vessel above said perforated plate, and barometric out-flow means leading from said vessel at a point below the space occupied by said baffle-plates.

4. Apparatus for conserving the gases and vapors of the lighter hydrocarbons in fresh petroleum as it issues from the well, comprising, a closed vessel stationarily supported at a fixed elevation, an intake connected with the well and discharging horizontally into said vessel intermediate the upper and lower extremities of the latter, baffling means arranged in one or more planes inclined to the horizontal and adapted to receive the oil stream and direct it downwardly a vacuum line connected to said vessel above said baffles, and a barometric outflow leading from said vessel at a level below the space occupied by said baffles.

5. Apparatus for conserving the gases and vapors of the lighter hydrocarbons in fresh petroleum as it is produced at the well comprising, a closed vessel, an auxiliary separator connected to the well and discharging the partially separated gas and liquid constituents of the flow into said vessel at different levels, a vacuum line connected to the upper portion of said vessel for drawing off the gases, and outflow means for drawing off the liquids.

6. Apparatus for conserving the gases and vapors of the lighter hydrocarbons in fresh petroleum as it is produced at the well comprising, a closed vessel, an intake pipe discharging horizontally into said vessel, an upright pipe leading downwardly from said intake pipe and discharging into said vessel at an elevation below said intake pipe, a vacuum line connected to said vessel above the level of said intake pipe for drawing off the gases and outflow means for drawing off the liquids.

7. Apparatus for conserving the gases and vapors of the lighter hydrocarbons in fresh petroleum as it is produced at the well comprising, a closed vessel, an intake conduit discharging horizontally into said

vessel, an upright conduit connected to said vessel below the level of said intake and projecting into the latter, said upright conduit having an opening within the intake conduit directed oppositely to the direction of flow of petroleum and operating to separate a portion of the liquid constituents from the main oil stream, a vacuum line connected to said vessel above the level of said intake pipe for drawing off the gases, and outflow means for drawing off the liquids.

In testimony whereof, I have signed my name to this specification.

HOLLIS P. PORTER.