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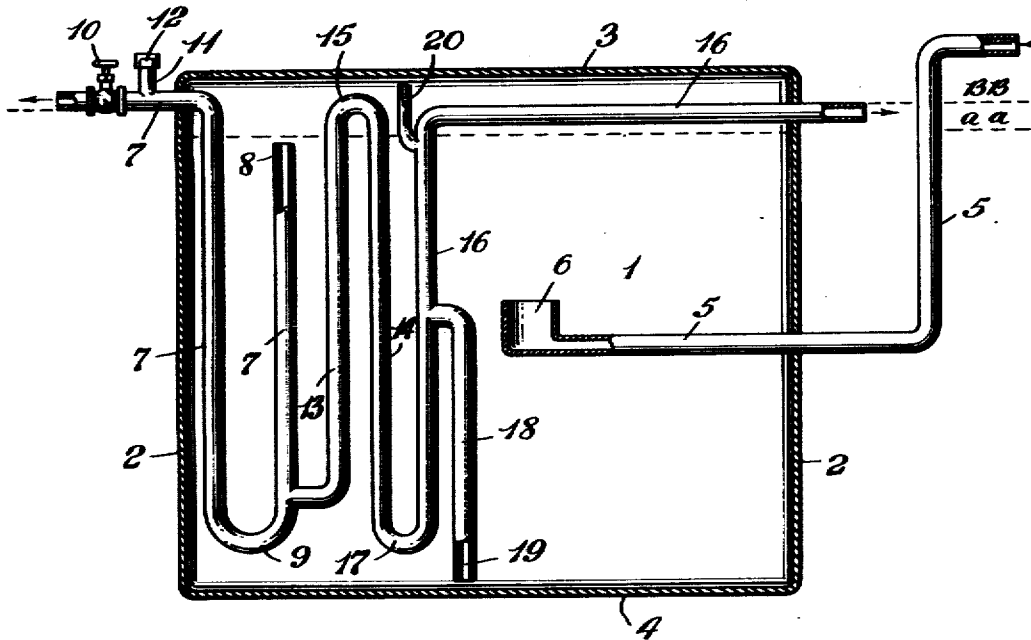
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POSITIVE AUTOMATIC MEANS AND METHOD OF CONTROLLING LIQUID
OR LIQUID MIXTURES IN THE PROCESS OF SEPARATION

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2 Sheets-Sheet 1

Fig. 1.



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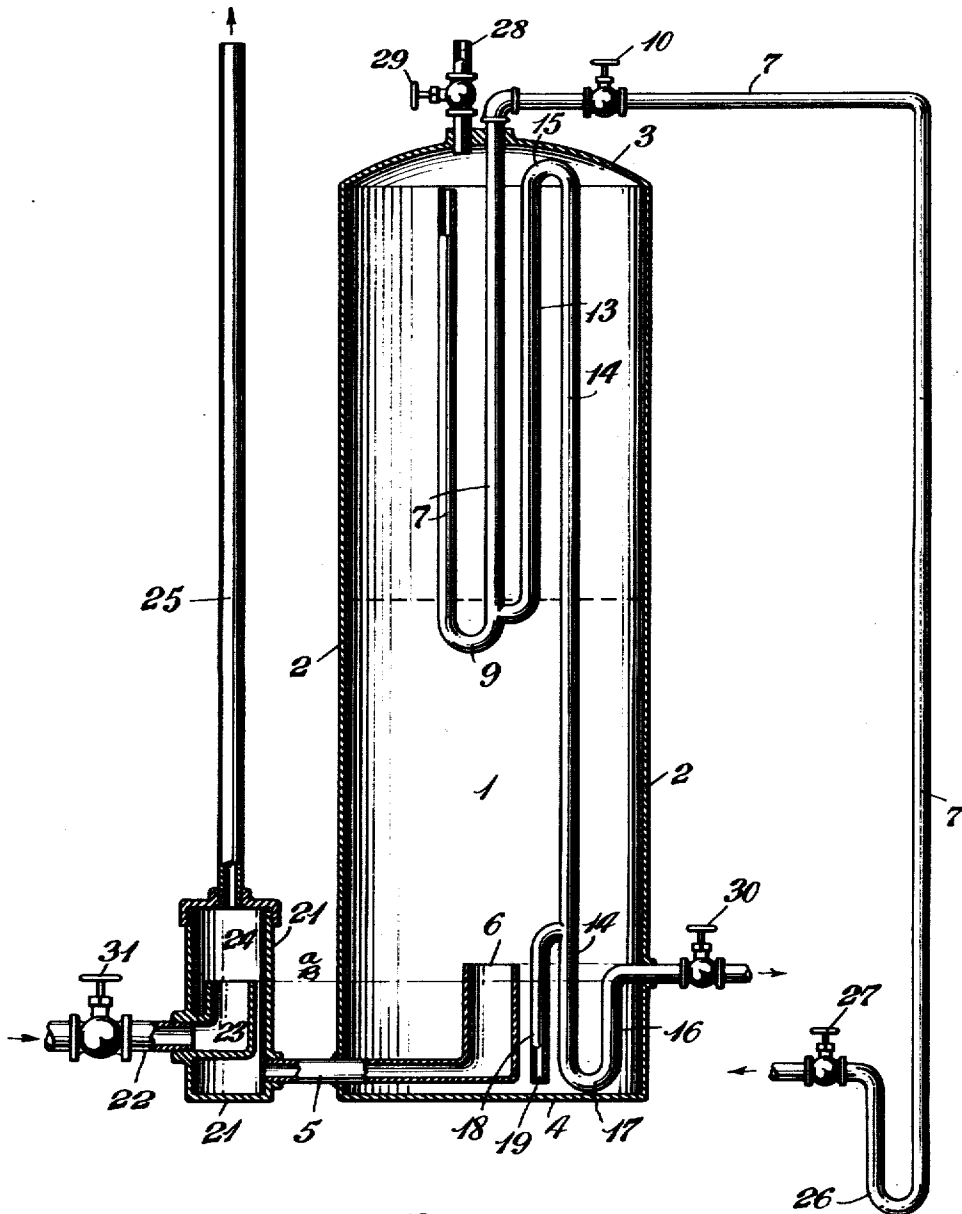
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POSITIVE AUTOMATIC MEANS AND METHOD OF CONTROLLING LIQUID OR LIQUID MIX- TURES IN THE PROCESS OF SEPARATION

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7 Claims. (Cl. 210—83)

This invention relates in general to the separation of liquid mixtures and more particularly to the removal of heavy impurities such as water, salt water, sulphur compounds, suspended sediment and other impurities from the crude petroleum.

It is therefore the primary object of the invention to provide a continuous automatically controlled negative pressure process to remove substantially all the impurities from crude petroleum and provide substantially one hundred percent pure petroleum thereby to increase the efficiency of the final refinery process.

Another object of the invention is to remove the impurities from crude petroleum prior to the time crude petroleum enters the pipeline, to not only increase the capacity of the pipeline but to remove the sulphur compounds and other impurities which are the major factor in the maintenance cost of the pipelines.

A still further object of the invention is to provide a positive means of controlling and discharging a lighter and a heavier liquid with relation to the total weight and volume of the lighter and heavier liquids to cause the automatic discharge of the lighter and heavier liquids from the top and bottom of a separating chamber substantially equal to the amount of each liquid separated from the mixture regardless of the percentage of each liquid admitted with the mixture.

A still further object of the invention is to provide a means and method for controlling the predetermined amount of each of the lighter and heavier liquids first under atmospheric pressure, second under positive or pressure above atmospheric pressure, third under negative or a pressure below atmospheric pressure and discharge the same automatically.

Other and further important objects of the invention will be apparent to those skilled in the art from the disclosures in the accompanying drawings and the following specification.

The invention (in preferred forms) is illustrated on the drawings and hereinafter more fully described.

The drawings:

Fig. 1 is a cross section through the vertical center showing in detail the arrangement of the parts in a high pressure operation.

Fig. 2 is a cross section through the vertical center showing in detail the arrangement of the parts in a low pressure operation.

I may prime a separating chamber with heavy liquids and use the said chamber to store the accumulated light liquids downward from the top of the said chamber by closing a valve on the light liquid discharge line and the said accumulated light liquids may be drawn off at intervals by opening the said light liquid discharge valve and passing a heavy liquid (water) through the separating chamber without closing the heavy liquid discharge line, all of which may be accomplished with liquids under all three pressures.

Referring to Fig. 1 of the drawings I have disclosed a primary separating chamber 1 formed in air-tight rela-

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tion by the walls 2 and the top 3 and bottom 4. A trapped supply line 5 leading from a supply source of liquids or liquid mixtures (not shown) terminates in the interior of the said separating chamber 1. The supply line 5 discharges into a cup 6 which acts to slow the velocity of the liquid or liquid mixture entering the said chamber. A light liquid discharge line 7 is open at the top as shown at 8 and is formed into a trap 9 near the bottom of chamber 1 and the opposite end passes out through the wall 2 in air-tight relation near the top of the said chamber 1. The out flow line 7 is equipped with a cut-off valve 10 and primer opening 11 closed by a cap 12 leading upward from the trapped light liquid discharge line 7 from near the bottom of the said trap 9. I have disclosed lines 13 and 14 forming an air trap 15 near the top of the said chamber 1. The said line 14 passes downward and in combination with line 16 forms a trap 17. A heavy liquid outflow line 18 is connected to the said discharge line 16 at one end and terminates near the bottom of the said chamber 1 and is open at the bottom as shown at 19. The final heavy liquid discharge line 16 passes out through the chamber wall 2 near the top of the said chamber 1. An air discharge line 20 leads downward from near the top of the said chamber 1 and connects in air-tight relation to the final heavy liquid discharge line 16 as shown and functions not only to release the entrained air or gases into discharge line 16, but establishes and maintains constant liquid level at the top of the said chamber 1 shown by the dotted line *aa*.

I will now describe the invention in operation.

Referring to Fig. 1 of the drawings, it will be observed that the light and heavy liquid discharge traps 9 and 17 formed at the initial priming of the apparatus, are controlled at the opposite sides respectively, by the air pressure trap 15. Both liquid traps 9 and 17 and the air trap 15 are formed simultaneously with the initial priming. The lighter and heavier liquid levels are formed at opposite sides of the air trap and balance against each other with relation to the weight of the vertical depth of the lighter and heavier liquid primed in the chamber 1. For example, heavy liquid (water) is admitted through the supply line 5 until the chamber 1 is filled to the top of the cup 6; the heavy liquid would rise in the tube 19 and fill the trap 17. The liquid level in the tubes 14 and 16 would be equal to the level of the liquid in the chamber 1. However, no liquid has yet entered the trap 7 or the line 13. Now if we admit light liquid (oil) through the supply line 5 the heavy liquid level in the lines 14 and 16 would rise correspondingly with the light liquid level relative to the difference in the weight. When the light liquid level in the chamber 1 reaches the top 8 of the open tube 7 the line 7 will fill with light liquid and the light liquid will rise in tube 13 and depress the heavy liquid level in the tube 14 and some of the heavy liquid would flow out to bottom of the open end of tube 18. Since the liquid level in the chamber 1 is not yet high enough to cause the liquid to flow out of the discharge lines the air is discharged from the top of the chamber 1 through the line 20 until the liquid level reaches the line shown at *aa*. This level is established and remains substantially constant due to air pressure, entrained air entering the chamber 1 through the supply line 5 would depress the level slightly and discharge the air through the trap 20 and the discharge tube 16. To maintain the liquid level *aa* light liquid or heavy liquid admitted separately or simultaneously would cause a corresponding amount of lighter or heavier liquid to discharge the lighter and heavier discharge lines 7 and 16. The cut-off valve 10 is open for continuous flow separation. However, where it is desirable to use the chamber 1 to store the separated

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light liquids the initial priming differs. The said chamber 1 is filled with water to a point just below the open end of the tube 7 shown at 8. The valve 10 is closed and the cap 12 is removed from the primer opening 11 and light liquid (oil) is primed into the chamber 1 through the trap line 7 until the water starts to flow from the discharge line 16. The primer line is now capped. The heavy liquid admitted separately or with the liquid mixture will discharge from the line 16 along with an amount of heavy liquid displaced by the lighter liquid separated and stored in the top of the chamber 1. The accumulated light liquid stored in the chamber 1 may be drawn by opening the valve 10 and passing water into the chamber 1 to replace the water displaced by the stored liquid. However, an amount of light liquid equal to the amount of light liquid originally primed will remain in the chamber 1. This is controlled by the air pressure in the trap 15 acting on the lighter and heavier liquid levels in the lines 13 and 14. When the original primed amount of lighter and heavier liquids is equal no more lighter liquid or heavier liquids will discharge unless they are admitted to the chamber 1. The valve 10 may now be closed to again accumulate the light liquid or it may be left open for continuous operation. However, for continuous or intermittent automatic operation a considerable amount of the lighter liquids should be carried in the process of separation. In the Fig. 2 apparatus the chamber 1 is a negative or low pressure chamber.

Referring to Fig. 2 of the drawings, I have disclosed a chamber 1 formed in air-tight relation by cylindrical wall 2 and the top and bottom 3 and 4. A trapped liquid or liquid mixture supply line 5 enters the said chamber 1 near the bottom through the wall 2 in air-tight relation and discharges into a cup 6. The said supply line 5 may lead directly from a supply source (not shown) where the air or gases are not likely to entrain with the liquid or liquid mixture. Where there is an entrained air or gas problem, the said line 5 may lead from the gas separating chamber 24 formed by the walls 21 and the liquid or liquid mixture line 22 may lead from a supply source (not shown) into the cup 23. The entrained air and gases are separated in the chamber 24 and pass out through the vent line 25. The trapped light liquid discharge line 7 passes out through the top walls 3 and returns downward and is trapped as shown at 26 below the bottom of the said chamber 1. A cut-off valve 10 is provided for priming the line 7 and a cut-off valve 27 is provided at lower discharge end of the line 7 for use where continuous discharge of the light liquid is not desired and the chamber 1 is used to store the accumulated light liquid.

Communicating with the said trapped light liquid discharge line 7, I have disclosed a tube 13 passing upward and in combination with the tube 14 leading downward forms air trap 15 located above the open end of the light liquid discharge line 7. The said lower end of the said line 14 passes downward to near the bottom of the said chamber 1 and in combination with the final discharge line 16 forms a trap 17. The said final discharge line 16 passes out through the wall 2 of the said chamber 1 in air-tight relation and is equipped with a cut-off valve 30. The heavy liquid discharge line 18 communicates with the said line 14 above the top of the trap 17 and passes downward to near the bottom of the said chamber 1 and is open, as shown at 19. An air discharge line 28 passes out through the top wall 3 of the chamber 1 and is equipped with a cut-off valve 30 for priming.

The operation is substantially as described with reference to the Fig. 1 apparatus except the trapped heavy liquid discharge line passes out near the bottom of the chamber 1 and the light liquid discharge line is trapped inside the chamber 1 and passes out through the top wall 3 of chamber 1 and leads downward and is exteriorly trapped below the bottom of the said chamber 1. The

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liquid trap discharge line for the light liquid in combination with the trapped heavy liquid discharge line forms an air trap between the said liquid traps. The supply line for the liquid mixtures passes near the bottom of the said chamber 1 and is provided with a gas or air separator which may be eliminated in some cases. However, I will describe it in combination with the gas separator. The air bleeder valve 29 is opened and the valve 30 is closed. The valves 10 and 27 are left open. Heavy liquid is admitted through the line 22 from the supply source (not shown) through the cup 23, the line 5 to the cup 6 into the chamber 1 which is filled to the point shown by the dotted line. Light liquid is now passed into the chamber 1 until the light liquid flows out the light liquid trapped discharge line 7. The valve 10 is now closed and when the liquid flows out the opening 28 the valve 29 is closed. The valve 30 is now opened and heavy liquid flows out to lower the liquid level in the air separating chamber 24 to the line shown at B. The valve 10 is now opened, the liquid in the chamber 1 is now under a negative or low pressure which graduates downward from the top of the chamber 1 to the static level line shown at B and the said neutral zone fluctuates between the lines a and B. The light and heavy liquid trap, and the air trap formed at the time of the initial priming all now function as described in Fig. 1 except that the function is in a negative or low pressure zone. The said low or negative pressure chamber may be primed for storage with a small amount of light liquid primer in the top of the chamber 1. However, the stored separated light liquid would be in a negative or low pressure zone. As the separator is now primed the liquid or liquid mixture passed into the chamber 1 through the cup 6 would separate and the amount of lighter and heavier liquid discharged from the respective discharge lines would be substantially equal to the amount of each liquid in the mixture.

I claim:

1. Apparatus for the purpose disclosed comprising a separating chamber structure sealed to the atmosphere, a line leading into the central region of the separating chamber, a discharge line for separated heavier liquids leading from the bottom of the chamber, a trap in the discharge line within the bottom region of the chamber, a discharge line for the lighter liquids leading from the top of the separating chamber, a trap in the light liquid discharge line within the upper region of the chamber and an inverted air trap within the chamber connecting the said discharge lines whereby the trapped air in the air trap will exert a positive discharging pressure simultaneously on both the lighter and heavier liquids thereby to effect discharge of lighter and heavier liquids in amounts substantially equal to the respective amounts of lighter and heavier liquids in a liquid mixture passed into the apparatus through the first said line.

2. Apparatus for the purpose disclosed comprising a separating chamber structure sealed to the atmosphere, a trapped line leading into the bottom region of the separating chamber, a discharge line for separated heavier liquids leading from the bottom of the chamber, a trap within the bottom region of the chamber in the heavier liquid line, a discharge line for the lighter liquids leading from the top of the separating chamber, a trap within the chamber in said light liquid discharge line and an inverted trap formation within the chamber to form an air trap and connecting the said two discharge lines whereby the trapped air in the air trap will exert a positive discharging pressure simultaneously on both the lighter and heavier liquids thereby to effect simultaneous discharge of lighter and heavier liquids in amounts substantially equal to the respective amounts of lighter and heavier liquids in a liquid mixture passed into the apparatus through the first said line.

3. In a liquid separating apparatus a system of drawing off separated light and heavy gravity liquids which

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includes an atmospherically sealed tank, an inverted U-shaped air trap and a U-trap connected to each leg of the air trap structure, said atmospherically sealed tank housing the trap system, one of the connected traps having a leg open at the top region of the tank and the other connected trap having a leg open to the bottom region of the tank.

4. In an apparatus of the character described in atmospherically sealed tank, an inflow line leading into the tank, separate outflow lines leading out of the tank, a trap formation in each of said outflow lines disposed within the tank one leg of one formation being open to the top region of the tank and one leg of the other trap formation being open to the bottom region of the tank and an air trap structure in the top region of the tank and connected to a leg of each trap structure within the tank at points in the lower region of the tank.

5. Apparatus for the purpose disclosed comprising a separating chamber structure sealed to the atmosphere, an inflow line leading into the separating chamber, said inflow line having a riser located within the separating chamber, a discharge line for separated lighter liquids located near the top of the separating chamber, said discharge line having a goose neck trap formation with an open leg terminating in the top region of the separating chamber for the ingress of downwardly flowing separated lighter liquids, a discharge line for the separated heavier liquids leading from the bottom of the chamber with an opening adjacent the bottom of the separating chamber, an inverted U-shaped connection between the said two lines thereby to form an air trap whereby the air in the trap will exert a liquid discharging pressure simultaneously on both the lighter and heavier liquids thereby to effect discharge amounts of the lighter and the heavier liquids from said separating chamber, substantially equal respectively to the amounts of lighter and heavier liquids in a mixture passed into said chamber for separation.

6. The method of separating a mixture of liquids of different specific gravities which consists of: the establishing of a liquid separation main column consisting of separate layers of the liquids of the mixture while main-

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taining the column; establishing separate columns of lighter and heavier liquids by simultaneously balancing one separate column against the other separate column while the separate lighter and heavier liquid columns are in communication respectively with the top and the bottom of the main column and with each other; and thereafter admitting to the liquid separating main column the mixture to be separated whereby separated lighter and heavier liquids will be discharged automatically from the corresponding separate columns in volumes substantially equal to the respective volumes in the added mixture.

7. The method of separating a mixture of liquids of different specific gravities which consists of: the establishing of a liquid separating main column, formed of separate layers of the liquids of the mixture while maintaining the top of the column under less than atmospheric pressure; establishing separate columns of the lighter and heavier liquids by simultaneously balancing one separate column against the other separate column while the separate lighter and heavier liquid columns are in communication respectively with the top and the bottom of the main column; and thereafter admitting to the liquid separating main column and the mixture to be separated, whereby volumes of separated lighter and heavier liquids will be discharged automatically from the corresponding separate columns the total volume of which is substantially equal to the volume of the added mixture.

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