

May 21, 1946.

W. B. RHEES

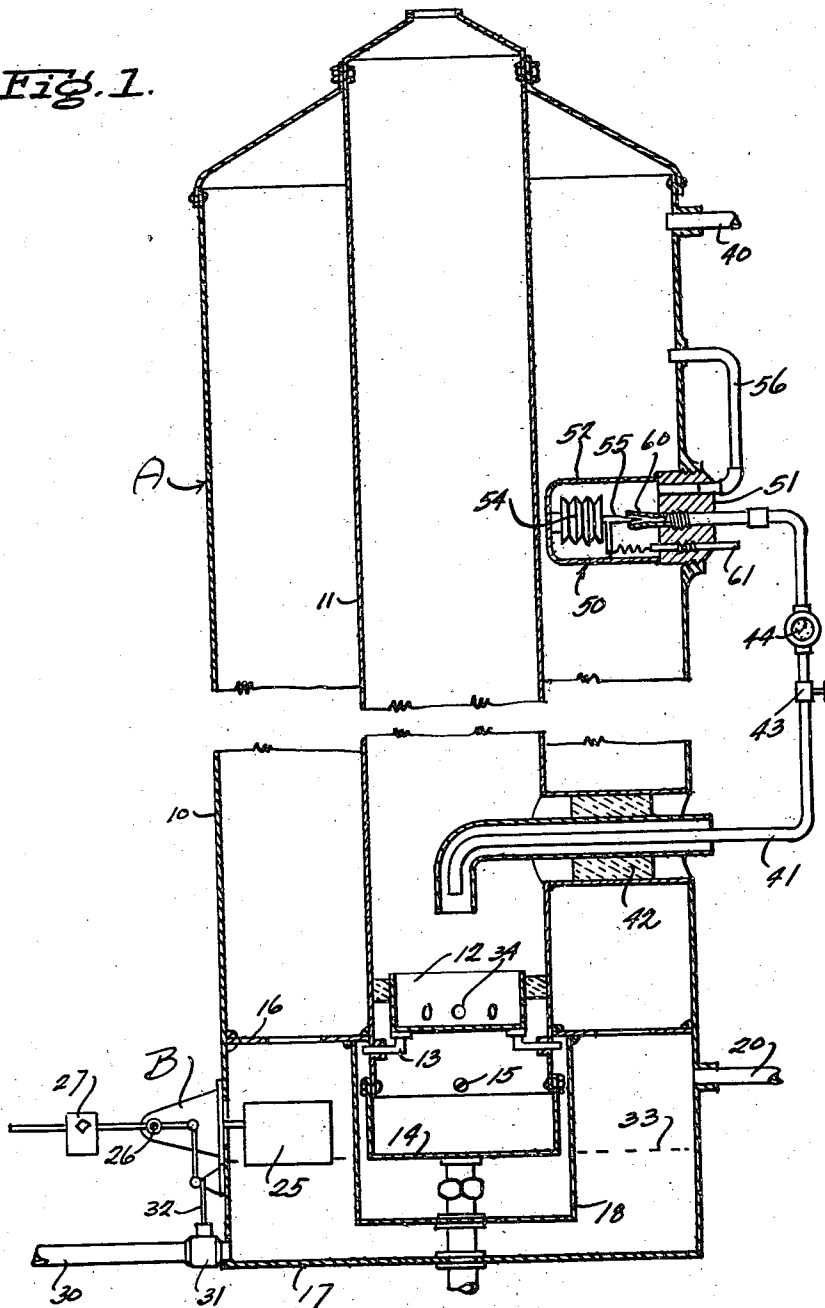
2,400,713

PROCESS AND APPARATUS FOR THE DEMULSIFICATION OF HYDROCARBONS

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2 Sheets-Sheet 1

Fig. 1.



INVENTOR.

William B. Rhees.

BY

Lawrence A. Rummel
ATTORNEYS.

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W. B. RHEES

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2 Sheets-Sheet 2

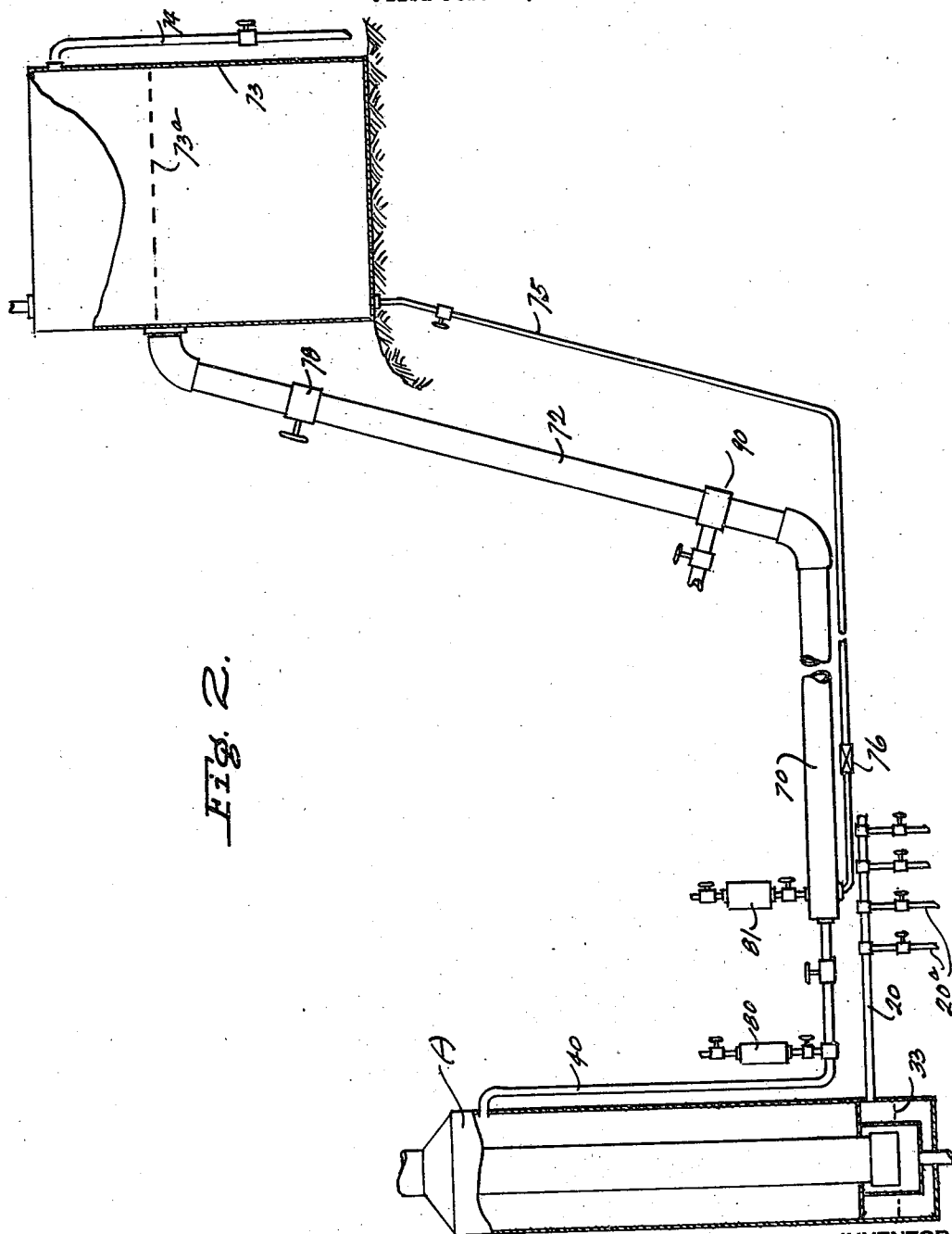


Fig. 2.

William B. Rhees.

BY *Lancaster, Allison & Forman*
ATTORNEYS.

UNITED STATES PATENT OFFICE

2,400,713

PROCESS AND APPARATUS FOR THE
DEMULSIFICATION OF HYDROCAR-
BONS

William B. Rhees, Augusta, Kans.

Application February 15, 1943, Serial No. 476,029

8 Claims. (Cl. 252—328)

This invention relates to an improved process for the separation of demulsified oil and water.

A further object of this invention is the provision of a process for the demulsification of oil and water under conditions which will render the oil equal to or better than present day processes of treating such oils before removal from the well, such as set forth in the John D. Brady U. S. Patent 1,531,173; the present process being carried out at a central location and above ground, and at which location the emulsified products of a plurality of wells may be treated.

A further object of this invention is the provision of an improved process for demulsifying oil and water as it comes from the oil well in a relatively economical and continuous manner for the production of a high grade usable oil.

Other objects and advantages of this invention will be apparent during the course of the following detailed description.

In the accompanying drawings, forming a part of this specification, and wherein similar reference characters designate corresponding parts throughout the several views,

Figure 1 is a vertical sectional view taken thru a heater tank; the same being a part of the apparatus, and which has been more specifically illustrated, described and claimed in my co-pending application Serial Number 408,252, filed August 25, 1941, which has now matured into Patent No. 2,386,061, granted October 2, 1945.

Figure 2 is a somewhat diagrammatic view, with some of the parts in section, showing an improved apparatus by means of which the improved process can be carried out.

In the drawings, wherein for the purpose of illustration is shown only a preferred embodiment of the invention, the letter A may generally designate the heating receptacle or tank in which the emulsified oil is heated. It consists of the receptacle casing 10 having a main heat flue 11 extending therethru. A burner pot 12 is supported in the lower end of the flue by detachable means 13, and the lower end of the flue is preferably provided with a removable drip receptacle 14 which can be detachably connected as at 15 to the lower end of the flue. The casing 10 may be provided with an apertured wall 16 spaced a desired distance from the bottom wall 17 of the casing, and in the space between these walls is disposed a housing 18 similar to that shown in my application Serial Number 408,252 above referred to, to sub-divide the oil compartment from the flue. The emulsified oil of course fills the casing 10 externally of the flue 11 and the casing

18. A line 20 is connected to the lower end of the casing 10, thru which the emulsified oil from the wells enters the tank.

A displacement float control for maintaining a constant level of water in the heater casing 10 is provided at B, and has been made the subject matter of my co-pending application Serial Number 432,351, filed February 25, 1942. It includes a float 25 pivoted at 26 and counter-balanced at 27. A water draw off line 30 is provided, having a valve 31 connected as at 32 with the leverage of the arm carrying the float 25. As the level of the water in the lower part of the tank rises, due to the difference in the specific gravities of the oil and water, the float 25 will cause an opening of the valve 31 and water will draw off from the tank.

In Figure 1, at 33, is designated the preferred level of the water, and thereabove the tank is filled with the emulsified oil.

It should be noted that the burner box 12 is located in the flue above the normal level of settled water. This burner box is provided with openings designated at 34 thru which oil can drop to the drip pan 14. This prevents coking of the burner pot.

The casing 10 at the top thereof is provided with an oil draw off line 40 thru which the heated oil flows into the apparatus shown in Figure 2, where it is further processed as will be hereinafter set forth.

I prefer to feed oil as fuel to the burner pot 12 taken from the upper part of the casing 10. To that end I provide a line 41 mounted as at 42 in the tank and thru which the oil drips into the burner pot. In this line 41 is located a shut-off valve 43 and a reading gauge 44.

I prefer to provide thermostatic means 50 for controlling the flow of oil to the burner pot, according to the temperature of the heated oil in the tank. This thermostatic means 50 preferably consists of a removable plug 51 detachably mounted in the casing 10, the inner end of which has a receptacle 52 detachably secured thereto. Within the chamber of this receptacle 52 is a thermostatic bellows 54 which controls movement of the feed needle 55. A line 56 withdraws oil from the upper part of the tank A whence it flows into the chamber 52. The line 41 has a tapered entrance 60 in the chamber 52 within which the needle 55 cooperates for the regulated feeding of oil thru the line 41.

A manually adjustable screw 61 controls the sensitiveness of the needle 55.

Referring to Figure 2, the heated oil flows

from the tank A thru the line 40 into a horizontally disposed receptacle 70, preferably of tubular formation, the internal diameter of which is at least several times larger than the internal diameter of the pipe 40 and within which the oil and water are subjected to a combined cooling and pressure treatment, and also a wash treatment for purposes to be subsequently described. The difference in size of conduits 40 and 70 reduces the velocity of flow thru conduit 70 so as to provide sufficient time for contact of the oil and water with the wash liquid, so as to enable the latter to coalesce with the droplets of water in the oil. This reduction of velocity also eliminates agitation of the oil during flow thru the receptacles 70 and 72. The oil and water are then forced vertically thru an elongated tubular receptacle 72, preferably of an internal diameter the same as the conduit 70, which connects at its upper end with a tank 73. The latter may be classified as a settling tank and the numeral 73^a designates the division of the oil and settled water. The oil in the upper part of the tank 73 is withdrawn thru line 74 to storage. A small diametered conduit 75 draws water from the bottom of the tank. This water enters the end of the conduit or receptacle 70 remote from the settling tank. The water fed from this line enters the conduits 70 and 72 for the purpose of coalescing water which has been separated from the oil. The conduit 75 is preferably smaller in internal diameter than the lines 40, 70 and 72 and a check valve 76 may be provided therein to prevent back pressure of water in the event the pressure in the system is built up too high. The conduit 72 may have a shut-off valve 78 in the upper end thereof near the settling tank.

As shown in Figure 2, the oil entrance line 20 may have a plurality of laterals 20^a which lead to various wells supplying roily oil to the tank A for treatment.

A feeder mechanism 80 may be placed in the line 40 adjacent to the conduit 70 for supply of an oil soluble chemical to the emulsified oil and water. Another feeder 81 may be placed at the inlet end of the conduit or receptacle 70 for supplying a water soluble chemical as an accelerant for the purpose of coalescing the water particles more easily during travel thru the horizontal conduit.

Referring to the step cycle of the process, the emulsified oil enters the lower end of the tank A thru the line 20 and free water settles at the level 33 and is withdrawn from the bottom of the tank A by the equipment B above described. The oil in the tank A is maintained at constant pressure and temperature. The rate of velocity flow thru the tank is very low and while the process is continuous and oil continually drawn off from the top of the tank thru the line 40, it takes the oil substantially one hour to flow thru the casing 10. In the tank A the temperature is maintained below boiling, preferably at 160° F. but not above 190°, and the pressure therein may be maintained at 10 lbs. superatmospheric but not above 50 lbs. Since the heat is maintained below the boiling point, there will be no effervescence in the tank A and the emulsion will be broken. There is no vapor escape. The treatment in the tank A breaks the emulsion into oil, free water and fine water particles. The fine water particles are held in suspension so that they can readily coalesce and combine with the wash water in the treatment of the oil and

water in the conduits 70 and 72 of the apparatus. While the pressure in the tank A is superatmospheric, it must be above the vapor pressure of the particular oil used. In this connection it should be stated that the temperature and pressure may be varied to suit the particular roily oil which is to be demulsified.

The heated oil under pressure has a very slow flow thru tank A and therefrom it enters the line 40 and flows into the inlet end of the enlarged conduit or horizontal receptacle 70. The oil flow thru the receptacles 70 and 72 which contains wash water is slower than in line 40 and is cooled. It is maintained under pressure for the purpose of retaining the stability of the oil. If the treatment is carried out in a horizontal conduit such as 70 and directly therefrom flows into a settling tank, mechanical pressure can be resorted to for the purpose of maintaining pressure during the cooling and washing of the oil. However, as shown in Figure 2, the oil and water may be maintained under a hydrostatic pressure by causing the same to flow thru a vertically disposed or inclined conduit 72. Such use is only practical where a settling tank, such as 73, can be maintained at a level considerably above the heater tank A. The oil during the treatment in the conduits 70 and 72 is cooled while being maintained under superatmospheric pressure. It is preferably not cooled lower than 100° F., but it must be cooled below 110° F. This cooling, while under pressure, is effected so that when the oil is lowered to atmospheric pressure, it will remain stable.

Flow of oil thru the conduits 70 and 72 is caused by pressure action upon the oil and partly thru thermosyphonic action. The wash water of course flows thru the line 75 by thermosyphonic action thereof.

The wash water fed into conduits 70 and 72 from the line 75 picks up and coalesces the particles of water held in suspension in the oil as the same flows thru the conduits 70 and 72. This wash water is preferably salt water and may be combined with the chemical or chemicals from the feeders 80 and 81. It is not otherwise diluted. It does not pass into the tank A or the line 40 above the horizontal. It is heated by the oil flowing thru lines 70 and 72 in a heat exchange relation.

As above stated the oil may be treated with a water soluble chemical as it enters the conduit 70, such as "Tretolite." This is a water softener which accelerates the separation of oil and water and coalescing of the water with the wash water thruout the treatment. The treatment may also consist in the addition of a water softener, such as sodium hydroxide or ammonium hydroxide in order to speed the coalescing of water particles. It must be remembered that the conduits 70 and 72 are many hundreds of feet in length, and to give some idea of their comparative diameters, the pipes 40, 70 and 75 may be respectively three inches, six inches and two inches. This proportion may be varied, as desired.

The chemical of course enters the settling tank 73 and is deposited in the salt water used for washing purposes and of course it is used over and over again until the solution becomes so weak that more of the water softener or chemical must be added from the feeders 80 and 81.

It is to be noted that the feeder 80 is located in the line 40. It feeds an oil soluble chemical to the oil after it leaves the tank A. Such a chemical must be used under certain circum-

stances for various oils, according to their chemical make-up, and I contemplate that under some conditions, both the oil soluble and water soluble chemicals may be used, altho under normal conditions the water softening chemical is the only one used in the process.

The oil withdrawn from the settling tank thru line 74 has less than 1% B. S. It is within the contemplation of this invention to provide other heat exchanging apparatus than the conduits 70 and 72, for the purpose of cooling the oil while under pressure.

If desired, I may provide a suitable mechanism for feeding natural gas into the conduit 72 at the lower end thereof, thru mechanism shown at 90, for the purpose of causing proper circulation and flow of the oil and water thru the system and into the settling tank.

The element of pressure in the treatment of oil thruout the system is important. In the tank A pressure keeps the oil from boiling and effervescing and of course there are no losses of volatile constituents. Pressure treatment maintains the oil at the desired gravity, and it is important to bear in mind that this pressure is maintained thruout the treatment, including the step of cooling the same up to the time that the same enters the settling tank. If found necessary, pressure regulating valves may be placed at the top of the conduit 72 and upon the conduit 74.

Various changes in the steps of the process and in the equipment necessary to carry out the process may be made to the form of invention herein shown and described, without departing from the spirit of the same or the scope of the claims.

I claim:

1. The process of demulsifying oil and water which consists in heat treating the oil and water at a temperature below the boiling point of water while under superatmospheric pressure, subsequently cooling the oil and water to a normal temperature while maintaining the same under superatmospheric pressure and during the pressure cooling of the oil and water treating the same with a wash solution for the purpose of coalescing the water of oil demulsification, and during the last mentioned step additionally treating the oil and water with a water softening chemical of a nature to accelerate water coalescence, and subsequently separating the oil and water.

2. The process of treating emulsified hydrocarbon and water out of the well which consists in heat treating the same while under superatmospheric pressure for the purpose of a preliminary breaking of the emulsion, withdrawing whatever free water there is, subsequently treating the remaining hydrocarbon and water with a water wash solution while maintaining the hydrocarbon under superatmospheric pressure to the point where the same is cooled to a normal temperature, and subsequently separating the oil and water.

3. The steps in the process of demulsifying hydrocarbon and water emulsions, which consist

in a preliminary heat and pressure treatment of the same for causing a break down of the emulsion, and while the resultant product is heated causing the same to flow under hydrostatic head pressure to a point where the same is cooled to a normal temperature and during such cooling treatment causing the particles of water to coalesce thru a water wash treatment, and subsequently causing the water to settle from the oil, the said wash water being the product of settling of the water from the oil treated.

4. In apparatus for the treatment of hydrocarbon emulsions, the combination of a container, means for admitting to the lower part of the container the hydrocarbon emulsions to be treated, means for withdrawing free water from the lower part of the tank to a predetermined level, and burner means for heating the oil in the tank located above the said level of free water in the tank.

5. The process of demulsifying hydrocarbon and water emulsions which consists in heat treating the emulsions for the purpose of breaking said emulsions, subsequently water washing the oil and any suspended water particles therein by causing the same to travel together with the water washing solution along a relatively long substantially horizontal path under superatmospheric pressure, and subsequently separating the oil and water.

6. The process of demulsifying hydrocarbon and water emulsions which consists in heat treating the hydrocarbon emulsions for the purpose of breaking down the emulsions, subsequently causing the oil and water particles suspended therein to travel thru a relatively long conduit under hydrostatic pressure together with a water wash solution for the purpose of coalescing the water particles with said wash solution, and subsequently separating the oil and water.

7. The process of demulsifying hydrocarbon and water emulsions which consists in heat treatment of the emulsions to initially break the same, subsequently causing the oil and water suspended therein to travel a relatively long horizontal path together with a washing solution under pressure greater than atmospheric for the purpose of coalescing the water particles with the wash solution, and subsequently separating the oil and water.

8. The process of demulsifying hydrocarbon and water emulsions and the like which consists in heat treating the oil and water for the purpose of initially breaking the emulsions, subsequently causing the oil and water particles suspended therein to travel a relatively long substantially horizontal path and then thru an upwardly disposed path under hydrostatic pressure and during the travel of the oil and water particles along the horizontal and upwardly disposed paths causing a wash solution to act upon said oil and water particles for the purpose of coalescing the water particles with said wash solution, and subsequently separating the oil and water.

WILLIAM B. RHEES.