June 3, 1958 F. L. MURDOCK, SR 2,837,213

SEPARATOR FOR OIL, GAS AND WATER

Filed May 7, 1956 2 Sheets-Sheet 1

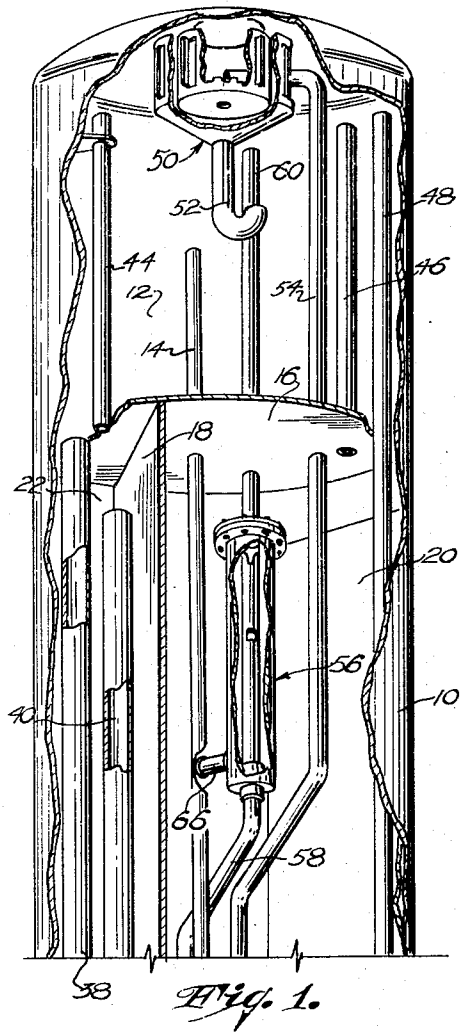


Fig. 1.

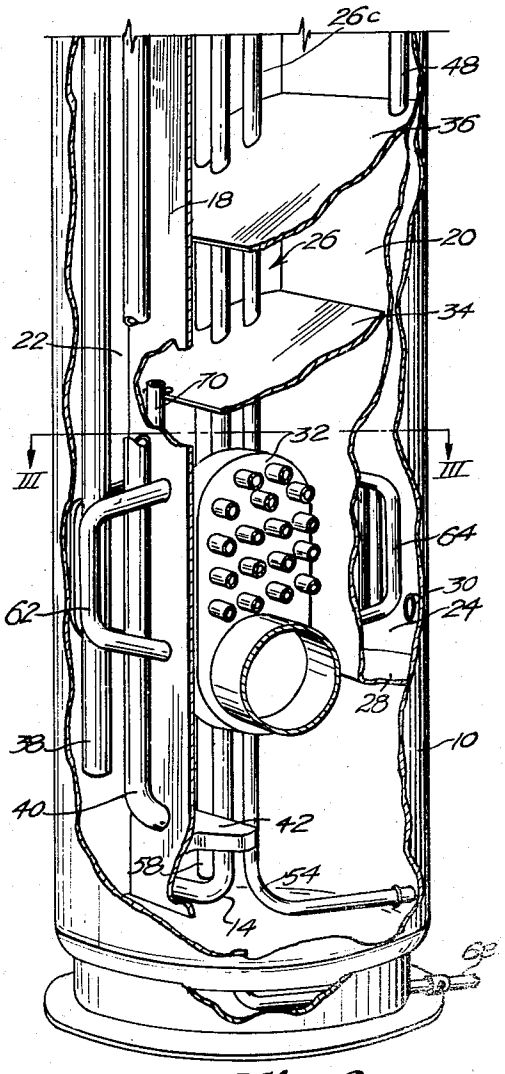


Fig. 2.

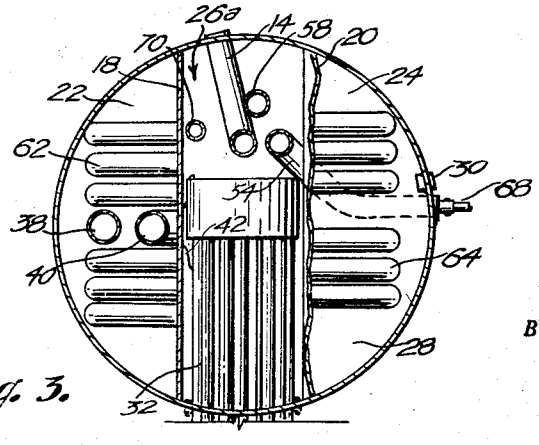


Fig. 3.

INVENTOR.
Forrest Lee. Murdock Sr.
BY
ATTORNEY

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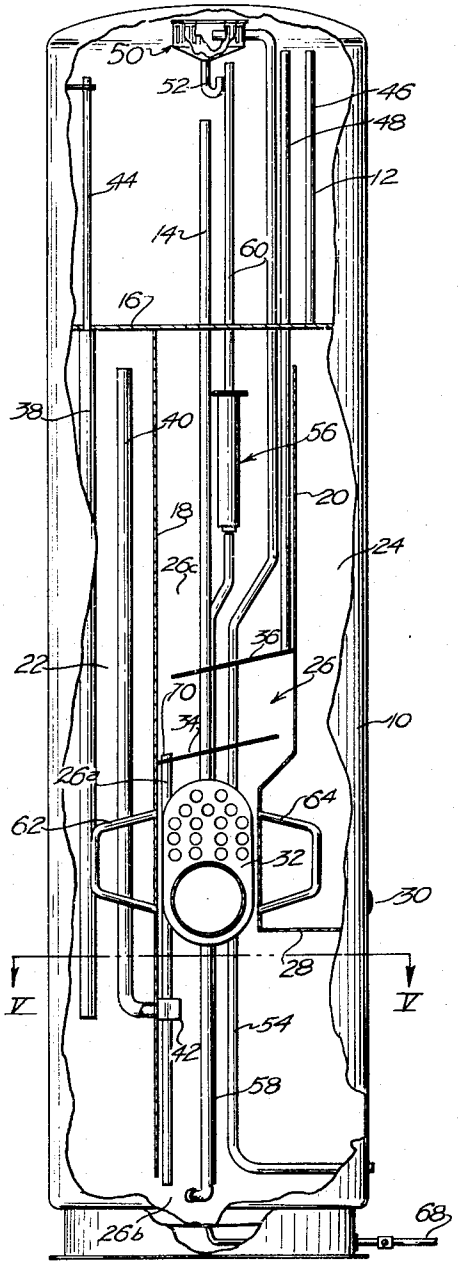


Fig. 4.

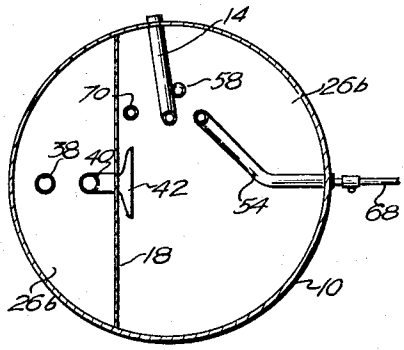


Fig. 5.

INVENTOR.
Forrest Lee. Murdock Sr.

BY

ATTORNEY

United States Patent Office

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SEPARATOR FOR OIL, GAS AND WATER

Forrest Lee Murdock, Sr., Tulsa, Okla.

Application May 7, 1956, Serial No. 583,202

7 Claims. (Cl. 210—187)

This invention relates to improvements in emulsion treaters and has for its primary object to improve upon the principles disclosed in my copending application Serial No. 527,012, filed August 8, 1955, now Patent No. 2,785,-766, this being a continuation-in-part of said copending application.

It is the most important object of the present invention to increase the efficiency of separators for oil, gas and water as well as to reduce the fuel cost of operation thereof by the provision of novel circulation of the water removed from the emulsion automatically through utilization of heat exchangers disposed not only within the cold emulsion itself as it enters a free water knockout chamber forming a part of the treater, but disposed within a receiver for hot oil forming a part of the treater, to the end that the circulating hot water serves not only to pre-heat the emulsion but is itself heated by the hot oil as the latter flows from the said receiver.

Another important object of the instant invention is the provision of a treater having recirculating apparatus as just above set forth operable on the principle of a natural flow of hot water, thereby eliminating the cost and expense incident to installation and operation of power driven recirculating mechanism.

Another important object of the instant invention is the provision of a treater embodying the aforementioned advantageous features together with an arrangement of parts for rendering the treater self-contained whereby the same is more efficient for cold weather use.

Other objects include important details of construction to be made clear as the following specification progresses.

In the drawings:

Figure 1 is a perspective view of the uppermost portion of a separator for oil, gas and water made pursuant to my present invention, parts being broken away and in section to reveal details of construction.

Fig. 2 is a view similar to Fig. 1 showing the lower portion of said separator.

Fig. 3 is a transverse cross-sectional view taken on line III—III of Fig. 2.

Fig. 4 is a side elevational view of the separator, parts being broken away and in section for clearness; and

Fig. 5 is a transverse cross-sectional view taken on line V—V of Fig. 4.

Emulsion to be treated is pumped into shell **10** and particularly into an emulsion receiving space **12** of shell **10** by means of an upstanding pipe **14** entering near the bottom of the shell **10** and extending upwardly to a point adjacent the uppermost end of the shell **10** within the receiver **12** as seen in Figs. 1 and 4 of the drawings.

Receiver **12** is set off by a horizontal partition **16** within the shell **10** through which the pipe **14** extends. A pair of vertical partitions **18** and **20** below the horizontal partition **16** define a chamber **22** on one side of the partition **18**, an oil receiver **24** on one side of the partition **20**, and a compartment **26** between the partitions **18** and **20**. The partition **18** depends from the horizontal partition **16** and terminates in spaced relationship to the lowermost end of the shell **10**, whereas the partition **20** is spaced below partition **16** as well as above the lower end of shell **10**. A horizontal partition **28** closes the lowermost end of the oil receiver **24** and an oil outlet **30** within the shell **10** above partition **28** is provided to drain the clean oil from the treater and conveyance to stock tanks or the like.

A heater **32** is disposed within the compartment **26** between partitions **18** and **20** below a pair of inclined baffles **34** and **36**, the baffle **34** joining with the partition **18** but being spaced away from the partition **20**, and the baffle **36** attaching to the partition **20** but being spaced away from the partition **18**. There is presented in the compartment **26**, therefore, a wash area **26***a* adjacent to and around the heater **32**, a water collection area **26***b* below the area **26***a* and which extends entirely across the shell **10** into chamber **22** and immediately below partition **28**, and a settling area **26***c* within the compartment **26** above the wash area **26***a*. The baffles **34** and **36** retard upward surge of the emulsion from the wash area **26***a* and tend to quiet the turbulence which would otherwise impede settling of the water from the emulsion within the area **26***c*.

The emulsion is fed from the receiver **12** into the chamber **22** and particularly into the water area **26***b* by a pipe **38** within the chamber **22** and which extends through and depends from the horizontal partition **16**. Substantially all free water is knocked out of the emulsion within the chamber **22** and the oil, together with water emulsified therein is conveyed from the chamber **22** to the compartment **26** and particularly to the water area **26***b* by a downcomer **40** that is open at its uppermost end which terminates adjacent to and immediately below the horizontal partition **16**. The downcomer **40** extends through the partition **18** and terminates in a diffuser **42** within the compartment **26** below the heater **32**.

Gas equalization tubes **44** and **46** within the receiver **12** extend through the partition **16**, the tube **44** communicating with the chamber **22** and the tube **46** being in communication with the compartment **26** and receiver **24**. Similarly, gas trapped beneath the uppermost baffle **36** is conveyed to the receiver **12** by a tube **48** that extends through the partition **16**, downwardly within the compartment **26** and through the baffle **36** adjacent the uppermost end of the latter and in close proximity to the vertical partition **20**.

Liquid is removed from the loose gas ends by a separator **50** within the shell **10** at the uppermost end of emulsion receiver **12**, the removed liquid being returned to the receiver **12** by a drain pipe **52**. A gas outlet pipe **54** communicating with the separator **50** extends downwardly through the partition **16**, thence through the baffles **36** and **34** within compartment **26**, and thereupon laterally through the side of the shell **10** below the partition **28** as is clear in Figs. 2 and 4 of the drawings. Water siphoning means broadly designated by the numeral **56** is also disposed within the compartment **26** and is provided with a water receiving pipe **58** having a lowermost open end disposed within the water collection area **26***b*, together with a gas equalization pipe **60** extending through the partition **16** and terminating in an uppermost open end within the emulsion receiver **12**.

It is now seen that all of the parts of the treater are disposed within the shell **10** and in accordance with the present invention, water recirculating apparatus is also disposed within the chamber **22** and within the receiver **24** respectively.

Such water recirculating means within the chamber **22** consists of a series of substantially U-shaped pipes **62**, each of which is provided with an uppermost and a lowermost open end extending through the partition **18** and communicating with the wash area **26***a* adjacent the

heater 32. Similarly, a series of substantially U-shaped pipes 64 within the receiver 24 are each provided with open uppermost and lowermost ends extending through the partition 20 and communicating with the area 26*a* of compartment 26 adjacent the heater 32.

Water may alternately be drained from the area 26*b* by a short conduit 66 extending from the siphon means 56 through the shell 10, or by a drain pipe 68 communicating with the bottom of the shell 10, it being understood that any suitable means (not shown) accessible exteriorly of the shell 10, may be provided for regulating the siphon 56.

Water tending to settle at the lowermost end of the baffle 34 adjacent the partition 18 is drained to the collection area 26*b* by a conduit 70 extending through the baffle 34.

Operation

As the cold emulsion is conveyed to the receiver 12 by way of inlet pipe 14, such emulsion is partially heated by virtue of the fact that the pipe 14 is in heat relationship with the liquid in the compartment 26. Accordingly, the loose gas ends emanating from the emulsion in the receiver 12 will pass to the separator 50 and the liquid carried thereby will be separated therefrom and returned to the receiver 12 by way of pipe 52. Furthermore, such pre-heating of the emulsion causes separation of a substantial amount of the water from the emulsion and as the same flows into the chamber 22 by way of pipe 38, the water will settle into the area 26*b* as the emulsion emanates from the lowermost end of pipe 38.

Furthermore, it is to be noted that the partition 18 is in heat exchange relationship to the hot liquid within compartment 26 and a substantial amount of such heat is transferred into the liquid contained in chamber 22. Consequently the emulsion is again preheated as it descends along the pipe 38; accordingly, the emulsion rising in the chamber 22 from the lowermost end of the pipe 38 is free of a substantial amount of the free water. As the emulsion rises in the chamber 22 it is heated still further by virtue of the heat transfer from partition 18 and, prior to overflowing into the downcomer 40, virtually all of the free water is knocked out of the emulsion.

It can also be seen that hot liquid constantly flows from the compartment 26 into the uppermost open ends of the pipes 62 and back to the compartment 26 by way of the lowermost open ends of the pipes 62. This also enhances heating of the rising emulsion within the chamber 22 and still further contributes to the free water knockout process. The pre-heat chamber 22 is also advantageous because of the fact that the downcomer 40 is disposed therewithin, causing the liquid to be further heated prior to discharge into the compartment 26 by diffuser 42. Here, again, more water settles from the emulsion prior to its rise within the compartment 26 in impinging relationship to the heater 32.

Very little water remains in the emulsion as it rises into the settling area 26*c* but, by virtue of the baffles 34 and 36, the turbulence caused by the heating and flow of the material is reduced and virtually all of the water settles to the baffle 34 for flow to the area 26*b* by way of pipe 70 before the clean oil spills over the uppermost end of the partition 20 into the receiver 24.

It is now noted that by virtue of the disposition of the pipe 64 within the hot oil, liquid flows automatically within the pipes 64 from and to the compartment 26 in the same manner as the liquid flowing within the pipes 62.

Having thus described the invention what is claimed as new and desired to be secured by Letters Patent is:

1. In an emulsion treater, a hollow shell; a vertical pre-heat baffle in said shell terminating at its lowermost end above the bottom of the latter, presenting a water collection area at said bottom of the shell, a combination free water knockout and pre-heating chamber on one side of the baffle, and a heater compartment on the opposite side of the baffle, there being a hot water wash area in said compartment adjacent the bottom thereof and a settling area in said compartment above the wash area, said shell having an outlet for flow of oil from the settling area; a heater in the wash area; means for conveying emulsion downwardly within the chamber and discharging the same into the water collection area; means for receiving the emulsion near the top of the chamber, conveying the same downwardly within said chamber, and discharging the same into the water collection area below said heater; and continuous conduit means located within said chamber in heat exchange relationship with said emulsion and communicating at each end thereof with the wash area for removing water from the wash area and recirculating the same back to the wash area for discharge thereinto below the point of removal.

2. In an emulsion treater, a hollow shell; a vertical pre-heat baffle in said shell terminating at its lowermost end above the bottom of the latter, presenting a water collection area at said bottom of the shell, a combination free water knockout and pre-heating chamber on one side of the baffle, and a heater compartment on the opposite side of the baffle, there being a hot water wash area in said compartment adjacent the bottom thereof and a settling area in said compartment above the wash area; a second baffle in the shell presenting an oil receiver communicating with said settling area, said shell having an outlet for flow of oil from the receiver; a heater in the wash area; means for conveying emulsion downwardly within the chamber and discharging the same into the water collection area; means for receiving the emulsion near the top of the chamber, conveying the same downwardly within said chamber, and discharging the same into the water collection area below said heater; and continuous conduit means located within said receiver in heat exchange relationship with the oil and communicating at each end thereof with the wash area for removing water from the wash area and recirculating the same back to the wash area for discharge thereinto below the point of removal.

3. In an emulsion treater, a hollow shell; a vertical pre-heat baffle in said shell terminating at its lowermost end above the bottom of the latter, presenting a water collection area at said bottom of the shell, a combination free water knockout and pre-heating chamber on one side of the baffle, and a heater compartment on the opposite side of the baffle, there being a hot water wash area in said compartment adjacent the bottom thereof and a settling area in said compartment above the wash area; a second baffle in the shell presenting an oil receiver communicating with said settling area, said shell having an outlet for flow of oil from the receiver; a heater in the wash area; means for conveying emulsion downwardly within the chamber and discharging the same into the water collection area; means for receiving the emulsion near the top of the chamber, conveying the same downwardly within said chamber, and discharging the same into the water collection area below said heater; means in said receiver communicating with the wash area for removing water from the wash area and recirculating the same back to the wash area for discharge thereinto below the point of removal; and continuous conduit means located within said chamber in heat exchange relationship with said emulsion and communicating at each end thereof with the wash area for removing water from the wash area and recirculating the same back to the wash area for discharge thereinto below the point of removal.

4. In an emulsion treater, a hollow shell; a vertical pre-heat baffle in said shell terminating at its lowermost end above the bottom of the latter, presenting a water collection area at said bottom of the shell, a combination free water knockout and pre-heating chamber on one side of the baffle, and a heater compartment on the opposite

side of the baffle, there being a hot water wash area in said compartment adjacent the bottom thereof and a settling area in said compartment above the wash area, said shell having an outlet for flow of oil from the settling area; a heater in the wash area, said shell having an emulsion-receiving space above the chamber, the compartment and the baffle; means for conveying emulsion into the shell near the bottom thereof, through the compartment, and into said space; means for conveying emulsion downwardly within the chamber from said space, and discharging the same into the water collection area; means for receiving the emulsion near the top of the chamber, conveying the same downwardly within said chamber, and discharging the same into the water collection area below said heater; and continuous conduit means located within said chamber in heat exchange relationship with said emulsion and communicating at each end thereof with the wash area for removing water from the wash area and recirculating the same back to the wash area for discharge thereinto below the point of removal.

5. In an emulsion treater, a hollow shell provided with a compartment having a heater; means for directing emulsion into the compartment for upward flow therein past the heater; a baffle in the shell, presenting an oil receiver communicating with said compartment, said shell having an outlet for flow of oil from said receiver; and continuous conduit means located within said receiver in heat exchange relationship with the oil and communicating at each end thereof with said compartment for removing water emanating from the emulsion and recirculating the same back to the compartment for discharge thereinto below the point of removal.

6. In an emulsion treater, a hollow shell having a vertical partition, presenting a compartment on one side of the partition and a receiver on the opposite side of the partition, there being a horizontal partition in the shell closing the bottom of the receiver and an outlet in the shell for flow of oil from the receiver; heating means in the compartment; means for directing emulsion into the compartment below the heating means for upward flow to the uppermost end of the vertical partition and flow thereover of oil into the receiver as water settles in the compartment out of said emulsion; and continuous conduit means located within said receiver in heat exchange relationship with the oil and communicating at each end thereof with said compartment for removing water from the latter and recirculating the same back to the compartment for discharge thereinto below the point of removal.

7. In an emulsion treater, a hollow shell having therewithin, a first horizontal partition, presenting an emulsion receiver above the horizontal partition; a first vertical partition depending from the first horizontal partition and terminating above the bottom of the shell, presenting a chamber on one side of the first vertical partition; a second vertical partition spaced below the first horizontal partition and above the bottom of the shell, presenting an oil receiver on one side of the second vertical partition and a compartment between the vertical partitions; a second horizontal partition closing the bottom of the oil receiver; a heater in the compartment; means for conveying emulsion from the emulsion receiver to the lowermost end of the chamber; means for conveying emulsion from the upper end of the chamber to the lower end of the compartment for flow of oil from the latter over the upper end of the second vertical partition into the oil receiver as water settles out of the emulsion in the compartment; a first series of water pipes in the chamber, each having an upper end and a lower end extending through the first vertical partition adjacent the heater and communicating with the water in the compartment; and a second series of water pipes in the oil receiver, each having an upper end and a lower end extending through the second vertical partition adjacent the heater and communicating with the water in the compartment, said shell having an outlet for flow of oil from the lower end of the oil receiver.

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