

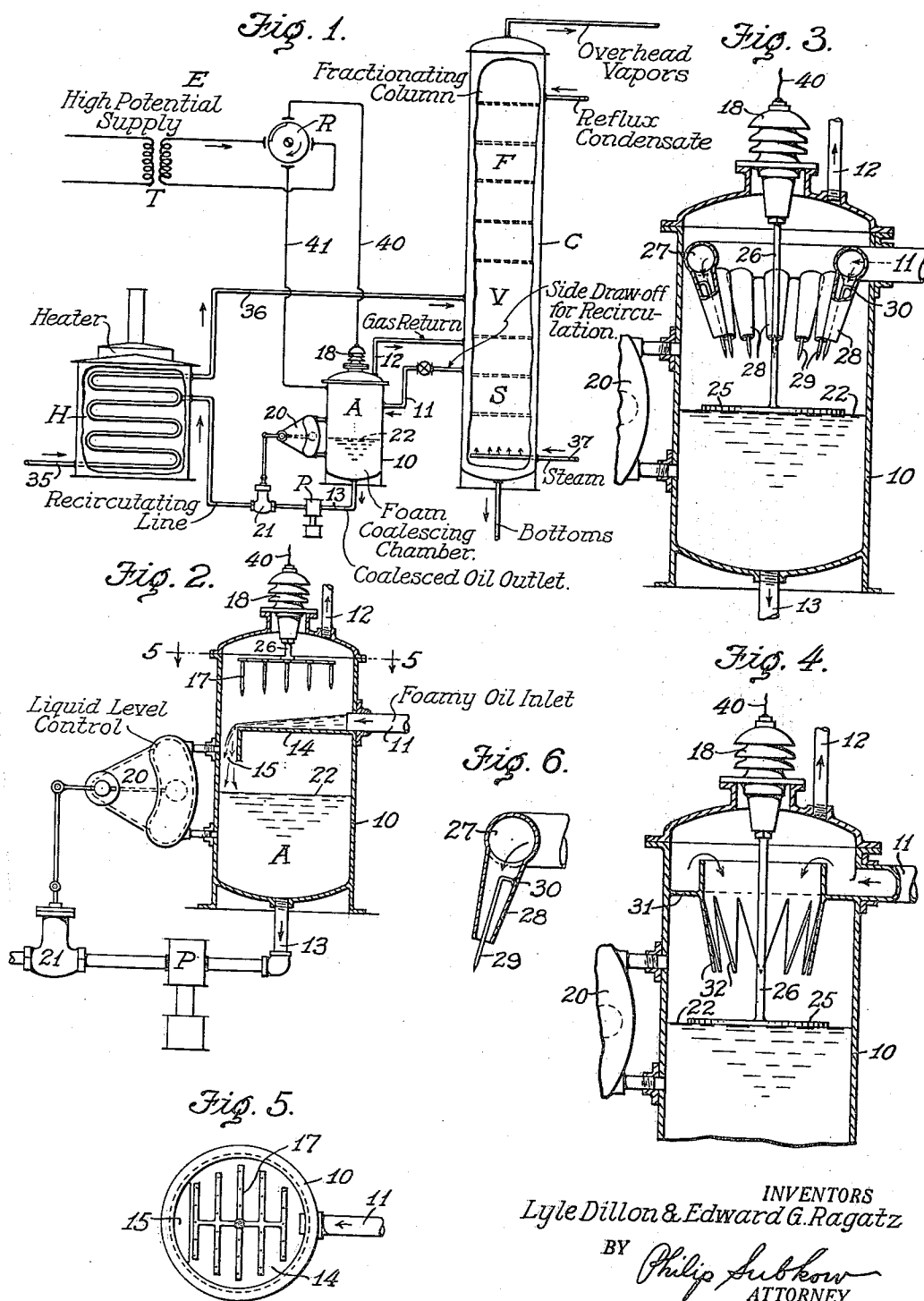
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APPARATUS FOR COALESCING FOAM

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APPARATUS FOR COALESCING FOAM

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This invention relates to foam coalescence and particularly to the coalescence of hot foamy oil to form a gas-free liquid.

Oil, such as a heavy residual petroleum oil fraction or the like, when heated as when it is introduced into a vaporizer or fractionating column where vaporization and agitation takes place, often forms a gassy foam which persists for long periods of time without coalescence. When it is necessary to transport such foamy oil rapidly and in large quantities from one point to another through pipe lines while hot, difficulties in the form of loss of suction on the pipe lines to the pump and hammering in the pumping system often are manifested, with attendant loss of pumping efficiency and damage to pumping equipment.

The object of this invention, therefore, is to eliminate the difficulties associated with pumping hot foamy oil or oil carrying entrained gas, by providing apparatus for rapidly coalescing the foam and freeing the gas.

It has been discovered that oil foam or froth can be rapidly coalesced by subjecting it to the influence of an intense electric field.

The invention accordingly resides in apparatus for coalescing foam whereby the foamy body is subjected to an intense electric field to break the foam and release the gas to form a relatively gas-free pumpable liquid body. The invention resides more specifically in apparatus for subjecting hot foamy oil to the influence of an intense ionizing electric field whereby the foam bubbles are rapidly broken, the gas released and the oil coalesced to form a gas-free liquid body which may be readily and efficiently pumped.

Other objects and novel features of the invention will be evident hereinafter.

In the accompanying drawing wherein preferred embodiments of the invention are disclosed by way of illustration:

Fig. 1 diagrammatically illustrates a general arrangement of the apparatus of the invention as associated with fractional distillation of hydrocarbon oil.

Fig. 2 is a sectional elevation of one embodiment of the invention.

Figs. 3 and 4 are sectional elevations of alternative embodiments of the invention.

Fig. 5 is a plan section taken on line 5—5 of Fig. 2.

Fig. 6 is an enlarged cross section of one of the electrode jets of Fig. 3.

The apparatus is as follows:

Fig. 1 diagrammatically illustrates a conven-

tional hydrocarbon oil fractional distillation system employing recirculation of bottoms or partially stripped material. The main units of this system are as follows:

H is a tubular heater adapted to heat the hydrocarbon oil feed prior to its introduction into the intermediate vaporizing zone of the fractionating column C. A is the foam coalescing chamber. P is a pump adapted to recirculate the coalesced oil from the coalescing chamber to the heater. E is a high potential electrical supply for the electrodes in the coalescing chamber comprising a high potential step up transformer T and a synchronous rectifier R.

Fig. 2 is a sectional elevation of the coalescing chamber A which comprises preferably a vertical gas-tight cylindrical tank 10 having a large foamy oil inlet pipe 11, gas outlet pipe 12 and a coalesced oil outlet pipe 13 at the bottom. At an intermediate section of the coalescing chamber cylinder a horizontal coalescing tray 14 is provided which partially divides the chamber into upper and lower sections which communicate with one another only through the opening 15 where the tray does not extend entirely across the cylindrical section. In the upper section of the coalescing chamber a plurality of vertical rod-shaped electrodes 17 are supported by means of the lead-in insulator bushing 18. These rod-shaped electrodes which are constructed of pointed wires or rods approximately $\frac{1}{8}$ " in diameter and approximately on 3" centers are suspended with their lower pointed ends directed toward the upper surface of the coalescing tray 14.

A liquid level operated float 20 is provided to operate the valve 21 to maintain the coalesced liquid level within the coalescing chamber approximately at the liquid level line as shown at 22. The liquid level operated float 20 thus operates the valve 21 to open it when the liquid level 22 rises above the line 22 to allow coalesced oil to flow out through the line 13 and to close the valve 21 when the liquid level falls below the line 22.

In Fig. 3, which is an alternative arrangement of the coalescing chamber, the apparatus is the same as that illustrated in Fig. 2 except for the electrode and the foamy oil inlet system. Here a disc electrode 25 is concentrically placed just upon the liquid level line 22 and partially closes the cylinder section at that point. This electrode 25 is supported by the rod 26 through the lead-in insulator bushing 18. The foamy oil inlet system comprises pipe 11 which leads to an internal cir-

cular distributing manifold 27 which carries from its lower surface a plurality of nozzles 28 adapted to direct the foamy oil downward in the form of relatively small streams or sprays which impinge upon the upper surface of the disc electrode 25.

Fig. 6 illustrates an enlarged sectional view of one of the distributing nozzles of Fig. 3. In each nozzle a rod electrode 29 is provided attached to the inside of the nozzle at 30 and extending coaxially through the orifices thereof to a distance of approximately 2 or 3 inches.

Fig. 4 illustrates another alternative arrangement of the foamy oil distributing system within the coalescing chamber. This system comprises a circular launder 31 supported from the walls of the upper section of the coalescing chamber. Along the lower inner edge of the launder is provided a plurality of pointed sheet metal electrodes 32 directed toward the upper surface of the disc electrode 25. The foamy oil inlet 11 makes connection with the inside of the launder 31.

The operation is as follows:

The hydrocarbon oil feed to be distilled is supplied to the heater H at the feed inlet 35 and after being heated to a vaporizing temperature is introduced into the intermediate vaporizing section V of the fractionating column C through the line 36. The unvaporized oil from the vaporizing section of the fractionating column passes downwardly through the stripping section S thereof in countercurrent contact with stripping steam introduced at the bottom at 37. The combined vapors from the oil feed and the stripping section of the column pass upward through the fractionating section F of the column in countercurrent contact with reflux condensate to produce overhead fractionated vapors in the conventional manner.

It is now common practice to withdraw unvaporized oil from the bottom or from an intermediate zone of the stripping section of the fractionating column and to recirculate this withdrawn oil to the heater to act as a heat storage medium to convey additional heat of vaporization for the feed material to the vaporizing section of the fractionating column. Heretofore, this withdrawn material has been pumped directly from the draw-off point below the vaporizing section of the column to the heater. This practice, however, has in many cases been unsatisfactory for the reason that the material withdrawn from the lower portion of the fractionating column, to be recirculated, contained a large proportion of entrained gas and foam, which resulted in a material reduction in the volumetric efficiency of the circulation pumps and in serious hammering due to the presence of the gaseous material in the pump cylinders. Since the rate of recirculation of this material is generally much in excess of the feed rate, the withdrawn foamy oil has no opportunity prior to its withdrawal from the column to coalesce into a gas-free liquid which could be readily and efficiently handled by the pumps. Moreover, the foam is found even upon standing to persist for long periods of time so that special means are necessary to effect its coalescence.

In the present invention, therefore, the withdrawn bottoms material from the lower portion of the fractionating column is introduced through a large line 39 into a coalescing chamber A. Here, as shown in Fig. 2, the foamy oil entering the coalescing chamber is distributed in a layer over the coalescing tray 14 where it is subjected to the intense ionizing electric field from the pointed

ends of the electrodes 17. The effect of this ionizing electric field is to cause a rapid coalescence of the foamy oil and freeing of gas so that the material passing from the top of the coalescing tray 14 and falling to the lower section of the coalescing chamber through the passageway 15 is a substantially gas-free liquid. That portion of the oil passing through the passageway 15 which still remains foamy is soon coalesced upon standing in the lower portion of the coalescing chamber. The gases thus freed from the oil are returned to the fractionating column through the gas return line 12.

The substantially gas-free oil is withdrawn from the lower section of the coalescing chamber through the oil outlet 13 and forced by means of pump P into the heater H where it commingles with the feed material passing through the heater tubes.

The liquid level float control 20, as described hereinbefore, operates the liquid level control valve 21 to maintain the liquid level within the coalescing chamber at approximately the line 22.

The electrodes 17 are individually adjusted in height so that the spacing between the lower ends thereof and the upper surface of the coalescing tray 14 which constitutes the electrode of opposite polarity will be just sufficient to prevent disruptive electrical discharges therebetween when the foamy oil is normally flowing thereacross. Potentials which have been found satisfactory are from 50,000 to 75,000 volts.

This high potential may be supplied from a high potential generator or any other suitable supply such as for example the high potential supply system E which comprises a high potential transformer T, the output of which is rectified by means of the mechanical rectifier R to produce high potential pulsating unidirectional current which is conducted through the lines 40 and 41 to the lead-in insulator connection to the electrodes 17 and to the coalescing chamber shell 10 respectively.

In Figs. 3 and 4 alternative arrangements of the electrodes and foamy oil distributors within the coalescing chamber are illustrated. In Fig. 3 the foamy oil enters the coalescing chamber through the supply line 11 into the circular distributor manifold 27. The foamy oil is projected from the manifold through the nozzles 28 in the forms of streams or sprays toward the upper surface of the disc electrode 25. As the foamy oil passes out of the nozzles over the rod electrodes 29 it is highly charged or ionized by the intense ionizing electric field formed around the lower point of the rod electrode 29. As the thus charged foamy oil impinges upon the electrode 25 the bubbles are rapidly broken and gas freed to form a coalesced, substantially gas-free oil which may be readily pumped from the bottom section of the coalescing chamber as described hereinbefore.

In Fig. 4 another alternative arrangement of the foamy oil distributor system is illustrated employing a circular launder 31 over which the foamy oil spills and falls in finely divided streams from the downwardly directed points of the electrodes 32 to the upper surface of the disc electrode 25.

While the apparatus of this invention for coalescing foamy oil has been shown in Fig. 1 by way of illustration, as applied to a conventional fractional distillation system employing recirculation of bottoms material, it is obviously applicable to any other system where the coalescence

of foam is advantageous. Moreover, the method and apparatus of the invention is not limited to the coalescence of foamy hydrocarbon oil but is equally applicable to the coalescence of animal and vegetable oil and any other similar material in which persistent foams may form for any reason.

The foregoing is merely illustrative of the apparatus of the invention and is not intended to be limiting. The invention includes any apparatus which accomplishes the same results within the scope of the claims.

We claim:

1. Apparatus for coalescing foamy liquid comprising a tank, a flat electrode in said tank, means to pass the foamy liquid onto said electrode to form a layer thereon, a second electrode in the

upper part of the tank adjacent to the surface of said flat electrode, means to charge said electrodes to a high electric potential difference, a settling chamber in the lower portion of the tank, and means to separately withdraw gas and coalesced liquid from said tank.

2. Apparatus for coalescing foamy liquid comprising a tank, a flat electrode in an intermediate portion of said tank, a pointed electrode in the upper portion of said tank, means to pass the foamy liquid over said flat electrode and under said pointed electrode, means to transfer foamy oil from said flat electrode to the lower portion of said tank and means to separately withdraw the gas and coalesced liquid from said tank.

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