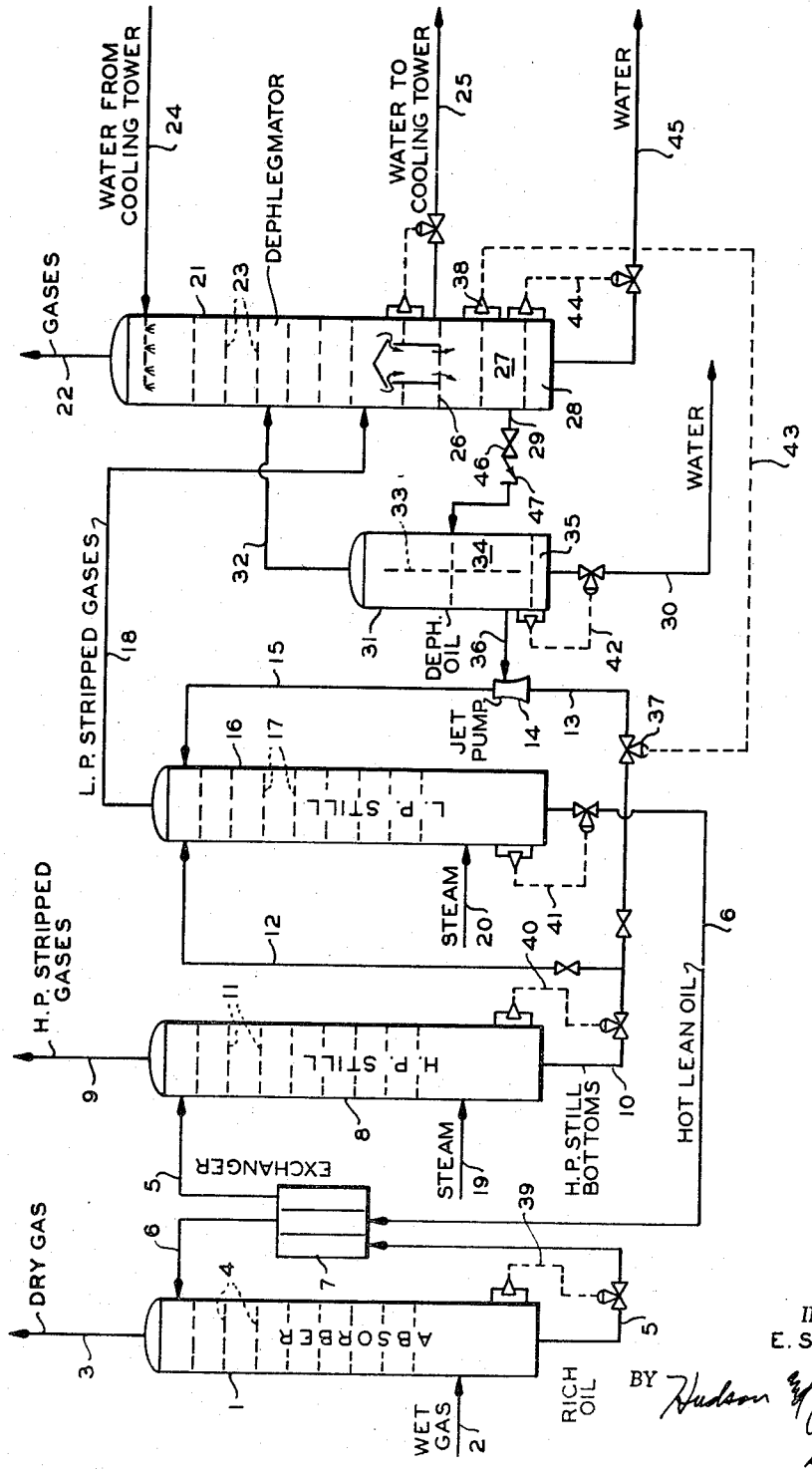
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STRIPPING STILL-DEPHLEGMATOR OPERATION

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STRIPPING STILL-DEPHLEGMATOR OPERATION

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This invention relates to absorber-stripping still-dephlegmator operation. In one aspect it relates to a low pressure still-dephlegmator operation. In another aspect it relates to means and a method for improving the efficiency of a pump, particularly a jet pump, for pumping hot dephlegmator oil to a low pressure still.

In the operation of jet pumping low pressure hot dephlegmator oil from the bottom of a dephlegmator to the top of a low pressure still by using drive oil from a high pressure still in a two-still distillation operation, it has been noted that the gasoline and water content in the dephlegmator oil affects the jet pump efficiency. The pressure reduction in the jet suction results in vaporization of volatile material in process and in flashing of water since the volatile material and water mixture is at a boiling point consistent with the pressure in the bottom of the dephlegmator. This vaporizing and flashing in the suction of the jet pump is further aggregated by the small pressure drop of the dephlegmator oil flowing through valved piping to the pump suction. There is a pressure drop even if this valved piping is short. In an operation employing a two-still system for recovering absorbed gasoline boiling range hydrocarbons from a rich absorption oil the volatile material in process is the gasoline boiling range hydrocarbons. Thus, in this case the flashed water and gasoline vapor reduce the capacity of the jet pump and this reduction in capacity over normal capacity, if no flashing occurred, approaches around 25 percent. In other words the actual capacity of the pump with the flashing is about 75 percent of the capacity if no flashing occurred.

To eliminate, or at least substantially minimize, this flashing in the suction of a jet pump, I provide a flash pot or a flash separator vessel in the suction line between the dephlegmator and the pump. In this flash vessel easily vaporized materials are flashed and removed from the liquid, and with removal of the most volatile constituents of the dephlegmator oil considerably less flashing in the suction of the jet pump occurs. Furthermore, I provide a pipe for returning the flashed vapors to the dephlegmator so that the flashed materials will not be lost to the operation. I also provide in the flash vessel means for removal of entrained water so as to reduce the content of water in the oil reaching the jet pump.

An object of my invention is to provide apparatus and a method for operation of a rich absorption oil stripping and dephlegmator system.

Another object of my invention is to provide an efficient apparatus and method for returning dephlegmator oil to the top of a low pressure still.

Still another object of my invention is to provide means and a method for increasing the efficiency of a jet pump utilizing available plant pressure for returning dephlegmator oil to the top of a low pressure still.

Still other objects and advantages of this invention will be realized upon reading the following description which, taken with the attached drawing, forms a part of this specification.

In the drawing the figure illustrates, in diagrammatic form, one arrangement of apparatus parts for carrying out the process of my invention.

Specifically, my invention includes a process comprising withdrawing hot dephlegmator oil from a low level or from a lower portion of a dephlegmation zone at a level higher than said low level and separating the withdrawn oil into a phase separation zone and therein separating a vapor phase from liquid oil, withdrawing separated liquid oil from said phase separation zone and transferring this withdrawn oil by jet action into the upper portion of a low pressure distillation zone. A high pressure still bottoms, which is normally fed to the low pressure still, is used as drive oil in the jet pump.

My invention further includes a distillation-dephlegmator system, in combination, a dephlegmator, a low pressure still, a high pressure still, a vapor-liquid separator, a first conduit communicating the normally liquid oil-containing portion of said dephlegmator with said vapor-liquid separator, a second conduit communicating the normally vapor-containing space of said separator with the upper portion of said dephlegmator, a third conduit communicating the lower portion of said high pressure still with the upper portion of said low pressure still, a jet pump in said third conduit, a fourth conduit communicating the normally liquid containing space of said vapor-liquid separator with the suction inlet of said jet pump, a fifth conduit communicating the upper portion of said low pressure still with the upper portion of said dephlegmator at a level below the level of communication of said second conduit with the upper portion of said dephlegmator, means for inlet of cooling water to and outlet of used cooling water from said dephlegmator, separate inlets for stripping steam to said stills and inlet for oil to be distilled to said high pressure still and outlets for off gases from said high pressure still and from said dephlegmator.

I will describe, as an example of the apparatus and process of my invention, the apparatus and process of an absorption-distillation operation for extracting normally liquid gasoline boiling range hydrocarbons from natural gases. In the drawing reference numeral 1 identifies an absorber column. A wet gas inlet 2, a dry gas outlet 3, a lean absorption oil inlet 6 and a rich absorption oil outlet 5 are provided with this absorber, as understood by those skilled in the art. This absorber column or vessel is provided with conventional vapor-liquid contacting apparatus 4, such as bubble cap trays. A high pressure still 8 is provided with a rich oil inlet 5, a stripped gas outlet 9, vapor-liquid contacting apparatus 11, and a bottoms oil removal outlet 10. A pipe 19 is provided for inlet of stripping steam to this still. A low pressure still 16 is provided with a conduit 12 for inlet of liquid to be distilled, a vapor outlet line 18, a lean oil outlet line 6, and a second line 15 for inlet of liquid to be distilled. Steam for operation of still is introduced through a pipe 20. This low pressure still is also provided with conventional vapor-liquid contact promoting apparatus 17. A heat exchanger 7 is provided for cooling the hot lean oil prior to its introduction into the absorber and for heating the rich absorption oil prior to its introduction into still 8. This heat exchanger 7 is intended to provide for interchange of heat between these just-mentioned oils and, in addition, is intended to include

further cooling of the hot lean oil with an extraneous cooling agent if needed. Additional heat for operation of still 8 is provided from the steam entering through pipe 19. Pipe 10 branches into pipe 12 and pipe 13. Pipe 13 is provided with a motor valve 37 and terminates in the power liquid inlet or drive liquid inlet of a jet pump 14. A pipe 36 communicates a flash separator tank 31 with the inlet to jet pump 14. A pipe 15 is provided for passage of liquid from jet pump 14 to the upper portion of low pressure still 16.

The vapor-liquid separator 31 is provided with a baffle plate 33, as illustrated. A pipe 32 communicates the normally vapor containing space of separator 31 with the upper portion of a dephlegmator vessel 21. A pipe 30 is provided for withdrawal of water from the lower portion of the separator 31.

The dephlegmator vessel 21 is provided in its upper portion with conventional vapor-liquid contacting apparatus 23 which can, if desired, be bubble cap trays or other suitable vapor-liquid contacting apparatus. A pipe 22 is provided at the top of the dephlegmator for removal of off gases. At an elevation well down the column 21 is a do-nut tray 26. This do-nut tray is provided for removal of water from the upper portion of the dephlegmator while allowing oil to flow through an opening in the center of the tray to the lower portion or normally kettle portion of the column 21. Such liquid take-off trays as do-nut tray 26 are well understood by those skilled in the fractionation art. A pipe 25 is provided for removal of water from this tray. A pipe 29 is provided for passage of oil, commonly called dephlegmator oil, from the lower portion of dephlegmator 21 to the vapor-liquid separator 31. A pipe 45 is for removal of water from the bottom part of the dephlegmator. A pipe 24 is provided for inlet of cooling water to the upper portion of dephlegmator 21.

In the operation of this apparatus a wet natural gas, that is, one containing extractable or condensable gasoline boiling range hydrocarbons, is introduced into absorber 1 through a pipe 2, the dry gases (free or substantially free from said condensable hydrocarbons) being removed therefrom through pipe 3. Lean absorption oil enters the column through pipe 6 and flows downward over packing apparatus 4 and is removed as a rich oil through pipe 5. The outlet of this rich oil is regulated by a float control apparatus 39. After passing through heat exchanger 7 for heating the rich oil, the heated rich oil is introduced into the upper portion of the high pressure still 8. This rich oil then flows downward over the vapor-liquid contact promoting apparatus 11 in countercurrent contact with steam introduced through pipe 19. The stripped gases leave this still through pipe 9. The partially denuded absorption oil leaves the high pressure still through pipe 10 and in one operation this partly denuded oil from the high pressure still, at substantially the pressure maintained in the still, is divided into two portions. One portion passes through pipe 12 directly into the upper part of the low pressure still for removal of the remainder of the absorbed hydrocarbons. The other portion flows on through pipe 13 and through the jet pump 14 and pipe 15 into still 16. This high pressure oil, on passing through jet pump 14, draws dephlegmator oil from the vapor-liquid separator 31 and transfers this withdrawn oil, along with this portion of the high pressure oil, through pipe 15 into the upper portion of the low pressure still 16.

A liquid level control assembly 39 and similar assemblies 40 and 41 are provided for regulating the removal of liquid bottoms from absorber 1, still 8 and still 16, respectively. A similar liquid level controller assembly 42 is provided in conjunction with vapor-liquid separator 31 for withdrawal of a water phase 35. A liquid level control assembly 44 is provided for withdrawal of water 28 from the bottom of the dephlegmator vessel.

A liquid level control apparatus 43, which includes a float apparatus 38, and a motor valve 37, is intended to regulate the rate of flow of drive oil from the high pressure still 8 in response to the level of the dephlegmator oil 27 in the dephlegmator 21. In this patricular operation the control assembly 43 is so arranged as to increase the rate of flow of drive oil through valve 37 upon an increase in the level of the dephlegmator oil above a predetermined level and to throttle valve 37 in case the level of the dephlegmator oil falls below the predetermined level. A valve 46 in pipe 29 is normally open and, of course, a check valve 47 in this line allows flow of dephlegmator oil only from the dephlegmator to the flash tank 31. Thus there is a free flow of dephlegmator oil from the dephlegmator to the flash vessel. Accordingly, when the jet is not transferring the dephlegmator oil sufficiently rapidly, the level of the dephlegmator oil in the dephlegmator rises and, under this condition, the float control apparatus 38 actuates the motor valve 37 to open same and allow the passage of more drive oil, and the greater the volume of drive oil flowing through jet 14 the more dephlegmator oil is removed from the dephlegmator through the flash tank 31. Under this condition, then, the level of the dephlegmator oil in the dephlegmator will fall and when it falls to a level below the predetermined normal operating level, the float apparatus 38 actuates valve 37 to throttle same and reduce the flow of drive oil through the pump 14. In this manner the rate of pumping of the dephlegmator oil is regulated. Provision is made in the flash tank 31 for a phase separation to take place between the entrained water and dephlegmator oil. Reference numeral 35 identifies water settlings in this separator vessel and reference numeral 34 identifies the larger volume of dephlegmator oil in this tank.

In one instance a high pressure absorber operating on a wet natural gas is operated at a pressure of from 250 to 1,000 p.s.i.g. (pounds per square inch gauge). The lean absorption oil flowing downward through this absorber is a conventional mineral seal oil and is maintained at a temperature as near atmospheric temperature as possible. The high pressure still is operated at a pressure ordinarily between about 235 and 250 p.s.i.g. The low pressure still is operated between pressures of about 45 and 60 p.s.i.g. The top still temperature of the low pressure still is, in this case, between the limits of about 380° and 400° F., that also being about the temperature of the bottoms oil from the high pressure still as it enters the upper portion of the low pressure still. On account of pressure loss of materials in process through piping, the pressure ordinarily maintained in the dephlegmator is about 3 to 5 pounds less than the pressure maintained in the low pressure still. For example, if the pressure in the low pressure still is maintained at 60 p.s.i.g., then the pressure in the dephlegmator is about from 55 to 57 p.s.i.g. The temperature of the water entering the top of the dephlegmator through pipe 24 is that which can be obtained from the cooling towers of the plant. The temperature of the gases leaving the top of the dephlegmator and the temperature in the top of the dephlegmator are within the limits of about 165 to 215° F. The temperature of the dephlegmator oil in the lower portion of this dephlegmator ranges from about 270° to about 283° F.

Throughout this specification and claims the term "upper portion of the dephlegmator" is intended to mean the portion of the dephlegmator above the do-nut tray 26. This portion, that is, the portion above do-nut tray 26, includes the vapor-liquid contact promoting apparatus 23. The term "lower portion of the dephlegmator" is intended to mean the portion of the dephlegmator below the do-nut tray 26 and this lower portion includes the portion normally corresponding to the kettle of a still. This lower portion includes the space in which liquid water 28 and the dephlegmator oil 27 separate.

By removing vapors or flash vapors from dephlegmator oil according to my invention the pumping rate of the

dephlegmator oil is increased between the limits of about 3 to 10 percent over the pumping rate when the vapor-liquid separator 31 is not employed. It is realized that the mechanical construction of pipe 29 and pipe 36, without the use of the vapor-liquid separator 31, has a considerable effect on the rate of pumping of the jet pump. That is, without the use of the vapor-liquid separator the size of the pipe, its length, and the number and type of valves disposed in this pipe leading from the dephlegmator to the suction of the pump have a considerable effect on the rate of pumping of the dephlegmator oil. With properly designed pipes leading from the dephlegmator to the separator and thence to the suction of the jet pump 14, and with the instalaltion of my vapor-liquid separator, the pumping rate of the pump is increased about, for example, 3 to 10 percent. With properly designed pipes (sufficiently large and with a minimum of valving) for transfer of dephlegmator oil from the dephlegmator to the suction of the jet pump, upon installation of the vapor-liquid separator, the pumping capacity of the pump may be increased as much as 10 percent. While an increase in pumping rate of from 3 to 10 percent may, at first sight, not appear to be very advantageous, yet when large volumes of liquid are transferred by such a pump, an increase in pumping rate of from 3 to 10 percent is a material increase in pumping rate.

While certain embodiments of the invention have been described for illustrative purposes, the invention obviously is not limited thereto.

I claim:

1. A process comprising withdrawing hot dephlegmator oil containing entrained water and other vaporizable material and at its boiling point from a lower portion of a dephlegmation zone, introducing this withdrawn hot oil into a phase separation zone and therein separating a vapor phase from a liquid oil phase, passing the separated vapor phase into the upper portion of said dephlegmation zone, withdrawing separated liquid oil from said phase separation zone and transferring this withdrawn liquid by jet action into the upper portion of a low pressure distillation zone.

2. A process for transferring hot dephlegmator oil from the lower portion of a dephlegmation zone into the upper portion of a low pressure distillation zone, comprising withdrawing hot dephlegmator oil containing entrained water and other vaporizable material and at its boiling point from the lower portion of said dephlegmation zone and passing same into a phase separation zone, separating a vapor phase from a hot liquid oil phase in this latter zone, venting the separated vapor from said phase separation zone into the upper portion of said dephlegmation zone, withdrawing hot bottoms oil from a high pressure distillation zone, passing this withdrawn hot bottoms oil through a jetting zone as drive oil, drawing the separated hot liquid oil phase into said jetting zone by the jetting action of said drive oil, and passing the drive oil and hot liquid oil phase into the upper portion of said low pressure distillation zone.

3. In the process of claim 2, regulating the rate of passage of said high pressure hot bottoms liquid through said jetting zone in response to the liquid level of said hot dephlegmator oil in the lower portion of said dephlegmation zone.

4. A distillation-dephlegmation operation comprising, withdrawing hot dephlegmator oil containing entrained water and other vaporizable material and at its boiling point from the lower portion of a dephlegmation zone and passing same into a phase separation zone, separating a vapor phase from a hot liquid oil phase in this latter zone, venting the separated vapor phase from said phase separation zone into the upper portion of said dephlegmation zone, withdrawing hot bottoms oil from a high pressure distillation zone, passing this withdrawn hot bottoms oil through a jetting zone as drive oil, drawing the separated hot liquid oil phase into said jetting zone by the jetting action of said drive oil, passing the drive oil and hot liquid oil phase into the upper portion of a low pressure distillation zone, introducing rich absorption oil feed and stripping steam into the upper and lower portions, respectively, of said high pressure distillation zone, introducing stripping steam into the lower portion of said low pressure distillation zone, maintaining said high pressure and said low pressure distillation zones under respectively high pressure and low pressure distillation conditions, removing off-gases from said high pressure and from said low pressure distillation zones, passing the off-gases from said low pressure distillation zone into the upper portion of said dephlegmation zone at a level below the level of entry of said separated vapor phase, maintaining said dephlegmation zone under dephlegmation conditions by introducing cooling water into the upper portion of said dephlegmation zone and therein directly contacting this introduced water with said vapor vented thereinto and with said off-gases from said low pressure distillation zone, and withdrawing used cooling water therefrom, withdrawing off-gases from the upper portion of said dephlegmation zone, and removing distilled oil bottoms from said low pressure distillation zone.

5. In the operation of claim 4, dividing the withdrawn hot bottoms oil from said high pressure distillation zone into two portions, passing one portion into said jetting zone as said drive oil and introducing the other portion directly into the upper portion of said low pressure distillation zone.

6. In the operation of claim 5, regulating the rate of flow of said one portion of said withdrawn hot bottoms oil into said jetting zone as said drive oil in response to the level of said dephlegmator oil in the lower portion of said dephlegmation zone.

7. In the operation of claim 4, maintaining said high pressure distillation zone under a pressure within about 235 to 250 p.s.i.g., the low pressure distillation zone within about 45 to 60 p.s.i.g., and the dephlegmation zone at a pressure from 3 to 5 p.s.i.g. less than the pressure maintained in said low pressure distillation zone.

8. In the operation of claim 4, maintaining the temperature of the dephlegmator oil in said dephlegmation zone within about 270° to 283° F.

9. A distillation-dephlegmator system comprising, in combination, a dephlegmator, vapor-liquid direct contact promoting means disposed operatively in said dephlegmator, a low pressure still, a high pressure still, a vapor-liquid separator, a first conduit communicating the lower portion of said dephlegmator with said vapor-liquid separator, a second conduit communicating the upper portion of said separator with the upper portion of said dephlegmator, a third conduit communicating the lower portion of said high pressure still with the upper portion of said low pressure still, a jet pump in said third conduit, a fourth conduit communicating the lower portion of said vapor-liquid separator with the suction inlet of said jet pump, a fifth conduit communicating the upper portion of said low pressure still with the upper portion of said dephlegmator at a level below the level of communication of said second conduit with the upper portion of said dephlegmator, means for inlet of cooling water to and outlet of used cooling water from said dephlegmator, separate inlets for stripping steam to said stills, an inlet for oil to be distilled to said high pressure still, an outlet for bottoms liquid from said low pressure still, and outlets for off gases from said high pressure still and from said dephlegmator.

10. In the apparatus of claim 9, a sixth conduit communicating said third conduit intermediate said high pressure still and said jet pump with the upper portion of said low pressure still.

11. In the apparatus of claim 10, a motor valve in said third conduit intermediate said jet pump and the point of communication of said sixth conduit with said third conduit, and a liquid level control means for regu-

lating liquid flow through said motor valve in response to level of liquid oil in the lower portion of said dephlegmator.

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