

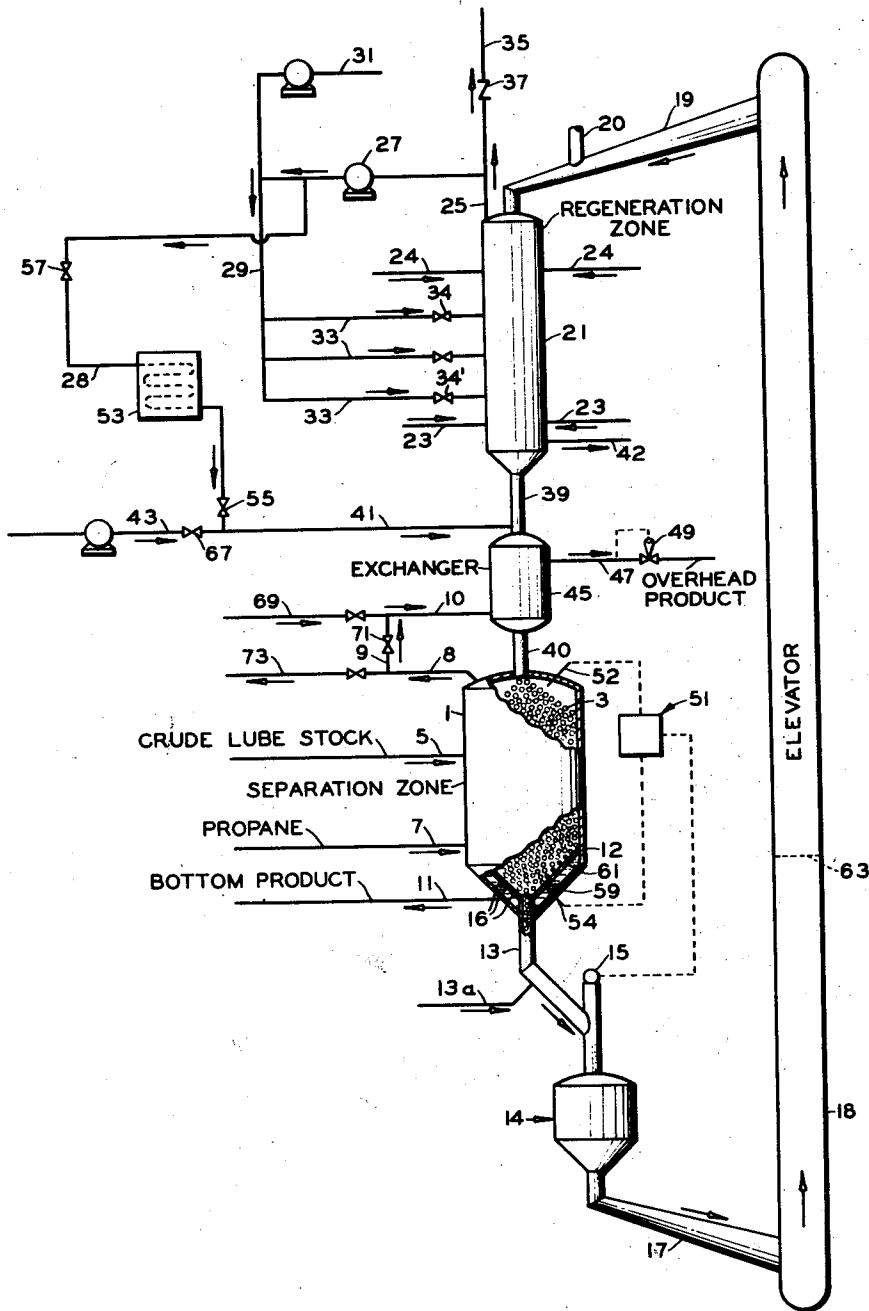
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PROPANE FRACTIONATION OF LUBRICATING OIL STOCKS

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PROPANE FRACTIONATION OF LUBRICATING OIL STOCKS

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This invention relates to propane fractionation of lubricating oil stocks. In one aspect, it relates to a method for the treatment of asphalt-containing lubricating oil stocks for the simultaneous separation of lubricating oil fractions and the removal of asphaltic material. In still a more specific aspect, it relates to a process for the separation and the recovery of lubricating oil fractions from crude lubricating oil stocks containing some asphaltic and resinous material by fractionation with propane wherein the asphaltic and resinous materials are precipitated and removed from the lubricating oil.

The asphalt content of a crude oil may conveniently be defined as the per cent of residue from the vacuum distillation of a crude oil, said residue having a maximum A. S. T. M. D243-36 penetration of 100 at 77° F. For Oklahoma City crude oils this asphaltic residue constitutes about 2 per cent by weight of the crude oil.

By the term "low-asphalt crude oil," I mean crude oils containing a maximum of about 5 per cent asphalt by weight as determined by the above-mentioned A. S. T. M. method. Such a low-asphalt-containing crude oil may be distinguished from conventional asphaltic crude oils such as California crudes which contain from 12 per cent to 65 per cent asphalt, and from Wyoming and Arkansas crude oils which contain about 30 per cent asphalt.

Deasphalting petroleum oils and more particularly reduced crude oils from which distillate lubricating oil fractions have been removed is old in the art. Such operations are usually carried out at temperatures between about 70° and 140° F. to take advantage of the precipitating action of propane on the heavy asphaltic constituents of the oil. It has also been recognized for many years that a fractionating effect can be obtained with propane-oil mixtures at temperatures ranging from about 140° F. up to the critical temperature of propane or higher. Utilizing the unique properties of liquid propane whereby increasing temperatures result in progressive rejection of hydrocarbons in such a manner that the higher molecular weight components and the more aromatic and naphthenic components are separated first and the lighter components and more paraffinic hydrocarbon last, a combination of low temperature distillation and solvent extraction is achieved. However, due to the difficulties involved in working at high pressures and in close proximity to the critical temperature of propane, commercial exploitation was unknown until quite recently.

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It has been found, however, that some low asphalt-content reduced crude lubricating oils may be fractionated continuously by liquid propane under high pressure and at a relatively high temperature, while other such crude oil stocks can be fractionated only for very short periods of time. In this latter case it has been found that the fractionating equipment became plugged with a deposit of asphaltic material. This asphaltic material has apparently been precipitated from the oil upon contact with the high temperature propane. It should be mentioned that the oils in question were low asphalt-containing oils and did not differ significantly from each other in total asphalt content, as conventionally determined. Why some caused plugging trouble and others did not is not clearly understood.

An object of my invention is to devise a process in which a low asphalt-containing reduced crude lubricating oil stock is fractionated for the separation and recovery of lubricating oil fractions.

Another object of my invention is to devise a process for the separation and removal of asphaltic resinous materials from crude oil stocks containing these materials and the simultaneous fractionation of the lubricating oil and constituents.

Still another object of my invention is to devise a process in which precipitated asphaltic and resinous materials may be removed from a propane lubricating oil fractionation process without precipitating of the asphaltic and resinous material in such a manner as to plug the treating apparatus.

Still other objects and advantages of my process will be obvious to those skilled in the art upon reading the following disclosure which taken with the attached drawing forms a part of this specification.

In preparing to apply the above-mentioned unique properties of liquid propane to actual commercial fractionation of certain grades of lubricating oils from residual stocks, a hitherto unrecognized problem was encountered. Upon fractionating some Mid-Continent reduced crude lubricating oil stocks with liquid propane in a countercurrent contacting tower at a propane-to-oil volume ratio of about 7:1 with temperatures ranging from about 195° F. at the top to about 175° F. at the bottom of the tower, an SAE 40 oil was continuously separated in the overhead product. On the other hand, when a very similar Mid-Continent reduced crude lubri-

cating oil stock was charged to the process under the same operating conditions a similar fraction of lubricating oil was initially obtained, but the column rapidly filled with a hard asphaltic material in the stripping section thereby making continuous operation impossible. In this second case, a third phase, that is, a semi-fluid asphaltic phase was apparently produced along with a propane-rich light oil fraction and an oil-rich solution of propane in heavy oil. Upon contacting the charge oil with liquid propane, this third phase when first formed was sufficiently fluid to flow nearly to the bottom of the column before the ascending propane had washed it sufficiently to cause it to set to a hard cake. Upon continued operation, this cake builds up in the column until complete closure of the column occurs. Why one low asphalt-containing oil should deposit its asphalt while another does not when the two oils contain similar amounts of asphalt is not definitely known.

In a study of three well-known Mid-Continent crude oils which have long been recognized as excellent sources of lubricating oil stocks, hard deposits were formed when treating two of these stocks with liquid propane while the third was fractionated with propane continuously and without difficulty. It has also been found that some West Texas low asphalt-content reduced crude oils can be continuously fractionated with propane while others cannot. It is therefore realized that propane fractionation cannot be universally applied to all so-called low asphalt-content reduced crude lubricating oil stocks.

In my improved process, I use a vertically disposed elongated separation zone filled with a downwardly moving bed of particulate material which may be used as packing for the separation zone. The particulate material is preferably spherical-shaped, although irregular shapes may be used, and has a diameter in the range of about $\frac{1}{4}$ " to 1". Hereinafter, this flowable particulate material will be called pebbles. These pebbles may be formed from refractory material such as alumina or silicon carbide, but in some instances, it will be found desirable to utilize an adsorptive material such as silica gel, activated charcoal, or adsorptive alumina.

In the drawing, the figure represents diagrammatically, partly in section, and partly in elevation, one form of apparatus in which the process of my invention may be practiced. Referring now to the drawing, a contacting vessel 1 is an elongated, cylindrical-shaped vessel having a conical-shaped bottom. This vessel is filled with pebbles 3 and these pebbles are held up some distance from the bottom by a conical filter member 12. From the apex of this conical member 12 a pipe 13 leads to a pebble flow controller apparatus 14. A source of power 15 is adapted to operate this pebble flow controller apparatus. Pebbles leaving the apparatus 14 flow through a line 17 into the bottom of a pebble elevator 18 which is adapted to elevate such particulate material from one point to a higher point. This elevator then can discharge the elevated material into a conduit 19 which in turn discharges the material into the top of a regeneration vessel 21.

The regeneration vessel 21 is equipped with numerous inlet and outlet pipe connections. Pipes 23 and 24 are intended for passage of gaseous combustible material from an outside source into the regeneration zone. Pipe 25 is for removal of combustion products from the top of this vessel. Combustion products not desired in

the process may be vented or otherwise disposed of by passage from pipe 25 through pipe 35 and the flow through pipe 35 is controlled by a damper or other suitable valve control means 37. Combustion gases to be used in the process flow from pipe 25 under the influence of a compressor or blower 27 into a pipe 29. From this pipe these gases may be passed into the regeneration zone through one or more inlet pipes 33. These inlet pipes 33 are provided with some valves 34 so that one or more of the pipes may be closed to the flow of gases. A pipe 31 is for passage of air or other combustion-supporting gas into the pipe 29. A by-pass line 28 connects with the discharge pipe of blower 27 for passage of combustion gas through a valve 57, cooler 53, a valve 55, and a line 41 into the bottom outlet pipe 39 to regeneration vessel 21. Under certain conditions of operation, steam or other cooling material may be desired to be passed through line 41 into the leg 39 so as to cool the pebbles and serve as seal between zones 1 and 21, and under such conditions, said steam or other cooling material is passed through a pipe 43 through a valve 67 into the pipe 41. Pipe 42 is connected with the body of the regeneration zone 21 at a point somewhat below the inlet pipes 23. This pipe 42 is intended for use in withdrawing a portion or all of the flue gas or steam introduced into the regeneration zone 21 through pipe 41 and leg 39.

To the bottom of the leg 39 is attached a heat exchanger apparatus 45 which in turn is connected by conduit 40 to the top of the separation vessel 1. This heat exchanger 45 may contain tubes through which a heat exchange fluid may pass in indirect heat exchange with the particulate material flowing by gravity through the spaces between the tubes. Pipe 8 is connected for passage of fluid from the separation vessel through a pipe 9, a valve 71, and a pipe 10 into the tubes of the exchanger. A pipe 47 which is equipped with a back pressure regulator 49 is intended for passage of cooling fluid from the tube section of the exchanger 45. In case fluid from the top of the separation zone 1 is not passed through the exchanger 45, a pipe 73 is provided for removal of this product from the system. In case extraneous cooling fluid is desired to be passed through the tube section of the exchanger 45, such cooling fluid is passed from pipe 69 through pipe 10 into the exchanger. When an extraneous cooling fluid is used at this point, the back pressure regulator 49 may or may not be used.

Apparatus 51 is a temperature differential controller recorder assembly having a connection leading to a thermocouple 52 in the top of the vessel 1, and a connection leading to a thermocouple 54 in the bottom of the vessel 1. This temperature differential controller regulates the power supplied to prime mover 15 and thus regulates the speed of the pebble flow controller.

In the operation of my process, the apparatus is filled with a desired particulate material such as $\frac{3}{8}$ " diameter alumina pebbles through a pebble makeup inlet line 20. Sufficient pebbles are added through the pipe 20 to fill the separation vessel 1, the heat exchanger 45, and the regeneration vessel 21. When these several vessel and connected conduits are filled with pebbles, the elevator 18 is started and the pebble flow controller apparatus 14 is also started so that pebbles may flow through conduit 13, flow controller 14, conduit 17, and fill the elevator 18. Additional pebbles will of course be added through pipe 20

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to fill the pebble-containing system with the desired amount of pebbles.

An inert gas, such as nitrogen, an oxygen-free flue gas, or steam, may be introduced into the system through pipe 43, valve 67, and pipe 41 to serve as sealing fluid between chambers 21 and 1 and a cooling medium for the pebbles.

Liquid propane is introduced into the separation vessel, through a propane inlet pipe 7. Sufficient propane is added that the level of the liquid propane will rise in the exchanger 45 to the point at which pipe 47 is connected and that the propane-to-oil feed stock ratio is between the limits of 4:1 to 14:1. The propane may also flow through the conduit 13, pebble flow controller 14, and through conduit 17 into the elevator column. In some cases, it may be desirable to inject a sealing fluid into conduit 13, 17, or elevator 18, to prevent or reduce the flow of hydrocarbon materials from the separation zone. Such a sealing fluid may be steam added through line 13a.

A combustible mixture of a gas and air may be injected into the regeneration zone through the pipes 24 for heating of the pebbles in the zone to a temperature such that when an excess of oxygen is added, the asphaltic material on the pebbles will burn. Additional gas and air are introduced into the regeneration zone through the pipes 23 for further heating of the pebbles. The gases of combustion then leave the regeneration zone through pipe 25 and are circulated by the blower 27 through pipes 28 and 29. That flue gas passing through pipe 28 passes on through valve 57, cooler 53, valve 55, and pipe 41 into the leg 39. In this leg 39 hot pebbles from the regeneration zone are flowing downward and the pebbles are then cooled by countercurrent contact with the upward flowing cool combustion gases. These gases after cooling the pebbles may be removed from the regeneration zone through pipe 42.

Heated pebbles pass from regeneration zone 21 through leg 39, thence through heat exchanger 45 wherein the temperature may be adjusted as found necessary so that the pebbles entering separation zone 1 will supply the desired amount of heat to this zone. Under certain conditions of operation, the temperature to be maintained in the top of this zone may be of the order of from 190°-200° F. Propane for continuous operation may then be introduced into the column through the propane inlet line 7. The entrance of the hot pebbles continuously into the top of the column then continuously heats the propane as it rises upward in the column, and the propane in the top of the column is maintained at about 190°-200° F. The warmed propane then leaves the column through line 8 and out through pipe 73 or through lines 9, 10, exchanger 45, and pipe 47. The asphalt-containing lubricating oil stock may be introduced through inlet line 5. When the lubricating oil contacts the propane in the column, the lower molecular weight oily hydrocarbons and the more paraffinic hydrocarbons dissolve in the propane as an oil-in-propane phase. Since the hot pebbles lose their heat progressively on descending in the column, the propane is heated progressively less and less at points successively nearer the bottom of the column. At the point of highest temperature in the column, the propane possesses the greatest precipitating tendency for the asphaltic and resinous material. However, at the point of inlet of the crude lubricating oil stock, the above-men-

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tioned third, or asphaltic phase usually precipitates upon contact with the propane at the temperature of the column at that point. In my process this asphaltic and resinous material precipitates upon the surface of the pebbles. In the lower portion of the column, which is operated at relatively lower temperatures, the propane is a better solvent for oil, and thus the ascending propane washes this more oily material from the surface of the pebbles. In like manner, at points higher up the column and at progressively higher temperatures, the precipitating action of the higher temperature propane tends to throw out of solution the less paraffinic and more aromatic resins and asphaltic materials. At least some of this precipitated material is retained on the surface of the pebbles and as they flow downward in the column is washed by the ascending propane.

In case only a small amount of asphaltic material is present in the oil stock, the layer, or coating of asphalt acquired by the pebbles is relatively small, and some of the asphaltic material may be retained in an oily solution insoluble in propane. This oil-rich liquid then flows downward in the column along with the pebbles. Upon reaching the conical member 12, this liquid then drains through perforations 16 in the cone 12 and accumulates in the vicinity of the apex of the vessel 1 as an oil-rich liquid phase. This oil-rich phase containing at least some propane in solution is withdrawn through a line 11 and is conducted to a propane recovery step, not shown, or to another propane fractionation step similar to that explained as occurring in column 1. In such a subsequent step, the temperature, pressure, and propane to oil ratio conditions will be varied in such a manner as to remove overhead a desired fraction of the bottoms product from line 11.

The pebbles with their asphalt coating flow from the bottom of the conical member 12 through the conduit 13, the pebble flow controlling apparatus 14, pipe 17, and into the elevator 18. The elevator raises or lifts the asphalt-coated pebbles and discharges them through conduit 19 into the top of the regeneration vessel 21.

In some cases, burning of combustible fuel from inlets 24 is desirable in order to raise the temperature of the pebbles to such a temperature that the free oxygen entering the vessel through one or more lines 33 will consume the asphaltic and resinous matter from the pebbles. In order that all of the combustion of the asphaltic and the resinous material will not occur at one point in the column, with possible overheating of the pebbles, several points of inlet of combustion-supporting gas 33 are provided. Gases of combustion leave the regeneration zone through the pipe 25 and at least a portion is transferred by blower 27 into line 29, in which some air through pipe 31 is introduced. The proportion of air added at this point is so controlled that the oxygen content is maintained at a sufficiently low level that overheating of the pebbles in the regeneration zone will not occur. If sufficient heat is generated in the upper portion of the regeneration zone and in the combustion section to maintain the pebbles at a combustion temperature relative to the oxygen content of the combustion-supporting gas entering through lines 33, the pebbles do not need to be heated further in the region of lines 23. Under such conditions, the combustible gas mixture may be introduced into this column through the

lines 23 only during such times as is required for the system to acquire an operational equilibrium and then, as mentioned, if combustion is complete at about the center of this column, the combustion gas mixtures from lines 23 may be closed off.

The bottom portion of the regeneration zone and the leg 39 are used as a pebble cooling section. Pebbles in this section may be cooled by an inert gas or by steam. Since the entire apparatus is maintained under a relatively high operating pressure, it may be preferable to pass a portion of the combustion gases from line 25 through pump 27, line 28, valve 57, cooler 53, valve 55, and on through pipe 41 into this cooling section. In case steam or cooling gas from an extraneous source is used as a cooling medium, valve 55 may be closed and the cooling medium may be introduced into the leg 39 through the pipe 43, valve 67, and the pipe 41. All or a portion of the steam or gases of combustion used for cooling, may be removed from the regenerator through the outlet 42. The regeneration operation taking place in the top of this vessel is not interfered with.

The cooling medium which enters through line 41 is of such temperature and volume that the pebbles are cooled to such an extent that the final cooling may be properly carried out in the exchanger 45. In case the overhead product from the separation zone 1 is to be separated into its propane and oil components, this material is passed through lines 8, 9, and 10 and into the heat exchanger 45. The heated overhead product then leaves the exchanger through line 47 and is passed through a back pressure regulator valve 49, and at this point the propane may be flashed from the oily material to effect the separation. The propane may be condensed and returned to the system, while the oil may be passed to storage or to a subsequent treating step, as desired.

The oil-rich phase is withdrawn from the bottom of the separation zone 1 at such a rate as to maintain therein a relatively low level of this material. This oil-rich phase is identified in the drawing by reference numeral 59. Reference numeral 61 identifies the propane phase containing dissolved oil which floats on top of the oil-rich phase 59. Some oil-rich phase from the bottom of the separation zone 1 fills the conduits 13 and 17, and the pebble flow control apparatus 14, and the lower portion of the elevator 18. Reference numeral 63 is intended to identify the level of the oil-rich phase in the elevator.

The temperature differential in the separation zone 1 may be controlled automatically at a predetermined value by means of a temperature differential controller recorder. For example, if a 30° temperature differential between the top and bottom is desired and this differential increases by a temperature increase in the top of the column occasioned by too hot pebbles, this recorder control apparatus operates to slow down the flow of pebbles. In like manner, if the differential decreases for some reason, this controller operates to increase the flow of pebbles so that more pebbles will be introduced into the top of the separation zone.

Example

As an illustration of the operation of my process, a topped crude oil containing some asphaltic material and from which the lighter lubricating oil fractions have been removed and which may have an initial boiling point of 75

about 800° F. is introduced into the separation zone through line 5. Liquid propane is introduced into this zone through line 7. The ratio of the liquid propane to the lubricating oil stock is between 6:1 and 7:1. The top of the column is maintained at a temperature between 190 and 200° F. while the bottom of the column is maintained at a temperature between 145° and 175° F. The temperature of the propane introduced into the column through pipe 7 is maintained at such a value that the bottom of the column will have the temperature between 145° and 175° F. and the charge oil is fed at such a temperature that the feed point may be maintained at a temperature between column top and bottom. Pressure on the entire system is maintained between 600 and 700 p. s. i. When operating under these conditions, an oil having the viscosity characteristics of an SAE 40-50 and dissolved in propane is taken off through line 47 as overhead product. This propane oil solution is flashed on passage through valve 49 and final traces of propane may be stripped from the oil if desired, to produce an oil having the above-mentioned SAE viscosity characteristics. Sufficient air or other free oxygen-containing gas is added to the gases of combustion through line 31 for regeneration purposes that the oxygen content of the gas entering the regeneration column through lines 33 is from 2-5 per cent.

The elevator 18 may be a conventional bucket elevator or any other type of elevator which may be entirely enclosed and is suitable under the required operating conditions. The pebble feeder or flow controller apparatus 14 may be any suitable type of apparatus desired.

While my process has been so far described with pebbles flowing downward by gravity contacting gases or liquids countercurrently and flowing upward, these directions of travel are not necessarily critical. For example, in the regeneration zone, the pebbles may flow downward by gravity, while the oxygen-containing combustion gas may pass through the pebble bed in a horizontal direction in the well-known cross-flow type of chamber.

Under some conditions, it may be desirable to remove the asphaltic deposit from the surface of the pebbles at as low a temperature as possible. Oxidation catalysts, such as vanadium pentoxide, may be incorporated in the pebble composition, and under such conditions the asphaltic and resinous material may be burned from the surface of the pebbles at a lower temperature than when such a catalyst is not used.

The apparatus shown on the drawing and described hereinabove comprises only a fractionation zone and a pebble regeneration zone, with interconnecting apparatus. However, when the crude lubricating oil feed contains an appreciable quantity of aromatic hydrocarbons, it may be highly advantageous to use an adsorptive type of pebble such as silica gel, to remove by adsorption at least a portion of the aromatic content of the feed as well as removing the resinous and asphaltic materials. By this means it is possible to increase the paraffinicity of the overhead product. When this modification is employed, a third chamber positioned below separation zone 1 is employed. In this third chamber the adsorbed aromatic materials may be stripped from the pebbles prior to their passage to the regeneration zone for removal of the asphaltic and resinous matter by oxidation.

It will be obvious to those skilled in the art

that my process is susceptible to many alterations and variations. Such variations or alterations may include variations of propane to oil stock ratio, top column and bottom column temperatures, as well as temperature differential and variations in regeneration zone conditions. The apparatus may be constructed for the most part from materials of commerce, readily available, since ordinarily no special corrosion problems exist. The material from which the pebbles are made must withstand relatively high temperatures with relatively rapid heating and cooling. The apparatus must be constructed to withstand safely an operating pressure of at least 600-700 p. s. i.

Having disclosed my invention, I claim:

1. In the propane fractionation of lubricating oil constituents from low asphalt-content reduced crude lubricating oil stocks with liquid propane wherein solid asphaltic material precipitates upon initial contact with the propane and adheres to and plugs the fractionating apparatus in the region adjacent and below the raw feed entry point, a process for continuously carrying out this fractionation operation without precipitating said asphalt and plugging said apparatus comprising maintaining a moving bed of particulate material in a first zone, said particulate matter being within the size range of $\frac{1}{4}$ inch to 1 inch in diameter, maintaining a body of liquid propane containing dissolved oil in said zone, maintaining a body of an oil-rich phase below said body of propane containing dissolved oil in said zone, said bodies meeting at a common interface, introducing a stream of liquid propane into said body of propane containing dissolved oil at a point near said common interface, introducing a stream of said low asphalt-content reduced crude lubricating oil stock into said body of propane containing dissolved oil at a point above said point of introduction of propane, maintaining the top of said body of propane containing dissolved oil at a higher temperature than that of the oil-rich phase, removing propane containing dissolved oil from and recovering the oil therefrom, removing the oil-rich phase from the bottom of said zone and removing particulate material containing adhering asphalt from the bottom of said zone.

2. In the process of claim 1 introducing the particulate material to the top of said bed at a temperature higher than the temperature of the stream of liquid propane introduced into said body of propane containing dissolved oil.

3. In the process of claim 2, maintaining the top of said body of propane containing dissolved oil at a temperature between the limits of 190° to 200° F. and the bottom thereof at a temperature between the limits of 145° to 175° F. at a pressure between the limits of 600 to 700 pounds per square inch.

4. In the process of claim 3, introducing the liquid propane and the lubricating oil stock into said propane containing dissolved oil in the ratio between the limits of 4 to 1 and 14 to 1 by volume.

5. In the process of claim 3 introducing the liquid propane and the lubricating oil stock into said propane containing dissolved oil in the ratio between the limits of 6 to 1 and 7 to 1 by volume.

6. In the propane fractionation of lubricating oil constituents from low asphalt-content reduced crude lubricating oil stocks with liquid propane wherein solid asphaltic material precipitates upon initial contact with the propane and adheres to and plugs the fractionating apparatus in the

region adjacent and below the raw feed entry point, a process for continuously carrying out this fractionation operation without precipitating said asphalt and plugging said apparatus comprising maintaining a downward-moving bed of particulate material in a treating zone, said particulate matter being within the size range of $\frac{1}{4}$ inch to 1 inch in diameter, maintaining a body of liquid propane containing dissolved oil in said zone, maintaining a body of an oil-rich phase below said body of propane containing dissolved oil in said zone, said bodies meeting at a common interface, introducing a stream of liquid propane into said body of propane containing dissolved oil at a point near said interface, introducing a stream of said low asphalt-content reduced crude lubricating oil stock into said body of propane containing dissolved oil at a point above said point of introduction of propane, maintaining the top of said body of propane containing dissolved oil at a temperature between the limits of 190° to 200° F. by the introduction of heated particulate material into the top of said body of propane containing dissolved oil, withdrawing particulate material with adhering asphalt from the bottom of said downward moving bed at a temperature between the limits of 145° to 175° F., removing propane containing dissolved oil from the top of said zone and recovering the oil, removing oil-rich phase from the bottom of said zone and recovering the oil; burning said adhering asphalt from said particulate material, cooling the hot particulate material and recycling as said heated particulate material.

7. In the process of claim 1, maintaining the volume ratio of propane to oil introduced into said zone between the limits of 4 to 1 and 14 to 1.

8. In the process of claim 7, maintaining the pressure in said first zone and in said asphalt burning operation between the limits of 600 to 700 pounds per square inch.

9. In the process of claim 8, stripping the hot particulate material of combustion-supporting gas prior to introduction of the hot particulate material into the top of said treating zone.

10. In the propane fractionation of lubricating oil constituents from low asphalt-content reduced crude lubricating oil stocks with liquid propane wherein solid asphaltic material precipitates upon initial contact with the propane and adheres to and plugs the fractionating apparatus in the region adjacent and below the raw feed entry point, a process for continuously carrying out this fractionation operation without precipitating said asphalt and plugging said apparatus comprising maintaining a downwardly moving stream of solid particulate material in a treating zone, said particulate matter being within the size range of $\frac{1}{4}$ inch to 1 inch in diameter, introducing liquid propane into the lower part of said zone and said low asphalt-content oil into a higher part of said zone, maintaining progressively lower temperatures from the top to the bottom of said zone, removing a liquid comprising propane containing dissolved oil from the top of said zone, withdrawing particulate material with adhering asphalt from the bottom of said treating zone, and separately removing a liquid oil-rich phase from the bottom of said zone.

11. The process of claim 3 wherein the particulate material is non-hydrocarbonaceous matter.

12. The process of claim 11 wherein the particulate material is refractory alumina.

13. The process of claim 11 wherein the particulate material is silicon carbide.

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14. The process of claim 9 wherein the particulate material is nonhydrocarbonaceous matter.

15. The process of claim 14 wherein the particulate material is alumina.

16. The process of claim 14 wherein the particulate material is silicon carbide.

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