United States Patent

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[54] **PROCESS FOR THE DISTILLATION OF PETROLEUM CRUDE**
3 Claims, 1 Drawing Fig.

[52] U.S. Cl. **208/352,** 208/353, 208/355, 208/356
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[50] Field of Search 208/347, 356, 363, 365, 352, 361, 364, 255, 354

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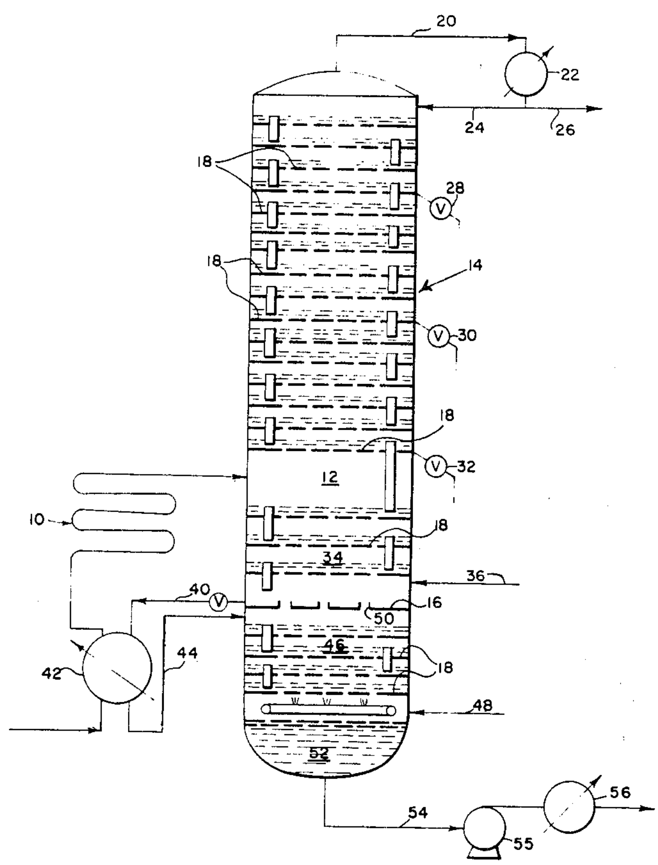
ABSTRACT: An improved process for the distillation of petroleum crude is provided in which hot bottoms liquid, remaining after flash distillation of crude in a fractionating tower, is withdrawn from the tower and passed to a cooling zone to cool the liquid to a temperature below its cracking temperature before it is returned to the stripping zone of the tower. Stripping the hot bottoms liquid at this reduced temperature, prevents cracking of the liquid in the stripping zone and avoids the formation of light ends thereby permitting bottoms product specifications to be more readily achieved.



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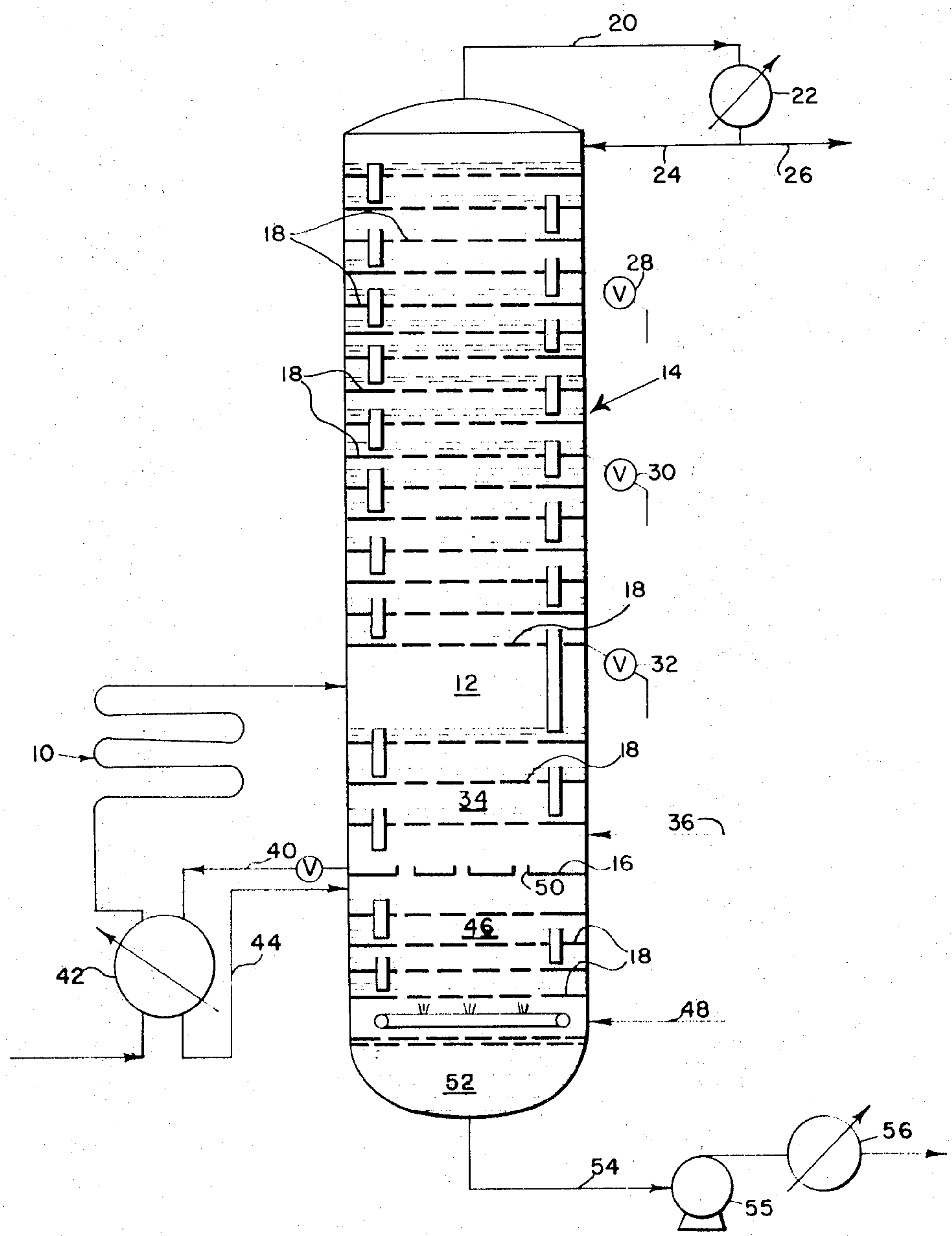

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PROCESS FOR THE DISTILLATION OF PETROLEUM CRUDE

This invention relates to an improved process for the distillation of petroleum crude and more particularly to an improved method for achieving bottoms product specifications in such a distillation process.

In the distillation of petroleum crude oil the crude is generally heated in a restricted stream to a temperature of around 700° to 725° F. It is then discharged into the vaporizing zone of a fractionating tower where it is flash distilled to separate the lower boiling fractions from the higher boiling fractions in the crude. The lighter, low-boiling fractions pass upwardly through the tower where they are fractionated into a number of refinery products and the heavier, high-boiling fractions are collected in the bottom of the tower as crude bottoms liquid.

Product specifications for refinery products set an upper limit on the amount of vapor that can be evolved from a product under specified conditions. For heavy materials, such as crude bottoms liquid from a fractional distillation process, product specifications require that only a very small percentage, generally around 25 p.p.m., of volatile hydrocarbons or light ends be present in the final bottoms product.

While a large portion of these light ends are removed by flash distillation in the fractionating tower, the bottoms liquid is never completely free of all light ends and must be subsequently steam stripped to meet product specifications. Stripping is conventionally accomplished by passing the hot bottoms liquid through a stripping column where the hot liquid descends through the column and steam is passed upwardly in contact with descending liquid.

Stripping columns, however, generally operate at a temperature around 650° to 750° F. which is above the normal cracking point of most crudes. Thermocracking of the hot bottoms liquid, therefore, can occur in the stripping zone of the column resulting in the formation of additional light ends. While most of these light ends are removed by stripping, further cracking can also occur downstream of the stripping zone, and particularly in the bottoms holdup portion of the column and in the lines leading to coolers for the final bottoms product. Thermocracking of the hot bottoms liquid in the stripping column therefore has made it extremely difficult to obtain a final bottoms product that meets required product specifications.

To alleviate the difficulty attempts have been made to recycle cooled bottoms product as a quench in the stripper column and, thereby, lower the temperature of the hot bottoms liquid below its cracking point. While this stops the cracking reaction in the stripping zone, recycle of cooled product reduces final product yield, lowers the efficiency of the stripping column and the bottoms coolers because the recycled product must be both restripped and recooled, and further results in a loss of high-level heat from the hot bottom liquid. Such a system, therefore, has not proven entirely satisfactory for use in a petroleum crude distillation process.

In accordance with the present invention, it has been found that an improved process for the distillation of petroleum crude and more particularly an improved method for achieving bottoms product specifications can be provided by collecting and withdrawing the hot bottoms liquid at the bottom of the vaporizing zone in a fractionating tower, cooling the hot bottoms liquid in a cooling zone to a temperature below its cracking point and thereafter introducing the cooled liquid into a stripping zone where it is stripped of dissolved light ends to meet required products specifications. By reducing the temperature of the hot bottoms liquid in a separate cooling zone, further cracking of the liquid in the stripping zone and particularly in regions downstream of the stripping zone is prevented, permitting the final bottoms product specifications to be achieved, in a simple, efficient, and economical manner.

Generally, the hot bottoms liquid withdrawn from the bottom of the vaporizing zone is at a temperature around 700° F. and this temperature is reduced, according to the process of the present invention, to below 600° F. and generally to about 550° F. to prevent further cracking of the liquid before it is passed to the stripping zone. Preferably, the heat value removed from the hot bottoms liquid is recovered and used to preheat the crude before it is heated to vaporization temperature, thus further increasing the efficiency of the present distillation process.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory but are not restrictive of the invention.

The accompanying drawing which is incorporated in and constitutes a part of this specification illustrates a preferred embodiment of the invention and together with the description serves to explain the principles of the invention.

The drawing is a schematic diagram showing an overall distillation process embodying the improvement of this invention.

As shown in the drawing crude petroleum is heated in a pipe still **10** to a temperature sufficient to vaporize all but the higher boiling fractions and generally to a temperature of around 725° F.

The heated crude is then fed into the vaporizing zone **12** of a fractionating tower **14**. The lighter, low-boiling fractions that immediately vaporize upon release of pressure rise through the tower while the heavier, high-boiling fractions collect as a liquid at the bottom of the tower on drawoff tray **16**.

The fractionating tower **14** is of conventional design and includes a plurality of gas-liquid contact elements such as perforated plates **18** that provide intimate contact between ascending vapors and condensed reflux liquid. From the top of tower **14** the lightest vapors of the crude are removed through line **20** where they flow through a condenser **22**. Generally a portion of this condensate is returned to tower **14** as reflux at **24** and a portion removed at **26** as a light gasoline product.

As further shown in the drawing, side streams can also be withdrawn at various places along the height of the tower. Gasoline, for example, can be withdrawn at **28** near the top of the tower, fuel oil at **30** and a lube oil at **32** immediately above vaporizing zone **12**. Additional plates **18** may also be provided below the vaporizing zone **12** for stripping the higher boiling liquid fraction in a high-temperature stripping zone **34** before the hot bottoms liquid is collected on drawoff tray **16**. Stripping gas, if required in high-temperature stripping zone **34**, can be added at **36** above drawoff tray **16**.

In accordance with the process of this invention the hot bottoms liquid collected on draw-off tray **16** and normally at a temperature of around 700° F. is withdrawn through line **40**, and passed through a heat exchanger **42** where the temperature of the bottoms liquid is reduced to below its cracking temperature, generally below 600° F., and preferably to about 550° F.

The cooled bottoms liquid is then introduced through line **44** into the top of a stripping zone **46**. Stripping zone **46** also includes a plurality of gas-liquid contact plates **18**. It may comprise a separate column but preferably, and as shown in the drawing, forms a part of the base of fractionating tower **14**. Zone **46** is separated from vaporizing zone **12** of the tower by drawoff plate **16**.

In stripping zone **46** the cooled bottoms liquid descends over the plates **18** while stripping gas, such as steam, introduced into the bottom of the zone through line **48**, rises in contact with the descending liquid. As the bottoms liquid flows downwardly through the stripping zone **46** the light ends dissolved in the liquid are revaporized, with the vapors and steam ascending through perforations **50** in drawoff plate **16** and into vaporizing zone **12** of tower **14**.

The stripped bottoms liquid which is primarily heavy lubricating oil that has been stripped of practically all light ends is collected in bottoms holdup section **52** at the bottom of stripping zone **46** and then withdrawn through line **54** and pumped at **55** to a cooler **56** where its temperature is reduced to about 250° F.

Reducing the temperature of the crude bottoms liquid in a cooling zone apart from the vaporizing zone in accordance with the present invention, and thereafter returning the cooled bottoms liquid to the stripping zone at reduced temperature, prevents cracking and the undesirable formation of light ends in the stripping zone. All the light ends remaining in the crude bottoms liquid after vaporization, therefore, can be completely stripped out in the stripping zone and no more light ends are formed downstream of the stripper, particularly in the bottoms holdup portion or coolers. This permits final bottoms product specifications to be more readily achieved. By the process of this invention color degradation of the volatile product, due to the formation of coke when cracking occurs in the stripping section, is also reduced since cracking has been substantially eliminated in the stripping zone.

Further, by cooling the hot bottoms liquid from the vaporizing zone in a separate cooling zone, high-level heat can be recovered from the hot bottoms liquid and used to further increase the efficiency of the distillation process.

In accordance with the preferred embodiment of this invention and as shown in the drawing, the hot bottoms liquid withdrawn from the bottom of fractionating tower **14** is passed in heat exchange relationship at **42** with the crude oil feed to fractionating tower **14** to simultaneously cool the hot bottoms liquid and preheat the feed before it is heated in pipe still **10**.

The invention thus provides an improved process for the distillation of petroleum crude in which final bottoms product specifications are more readily achieved by substantially preventing cracking and the formation of light ends in a stripping zone in a simple, economical and effective manner. The practice of the process of this invention not only prevents the formation of light ends in a stripping zone but also contributes to the overall efficiency of the process by reducing the amount of heat required to heat the crude oil prior to flash distillation

For a clearer understanding of this invention, a specific example of it is set forth below. This example, however, is merely illustrative and is not intended to limit the scope and underlying principles of this invention in any way.

EXAMPLE

Petroleum crude is withdrawn from a storage tank (not shown) at room temperature and pumped through heat exchanger **42** where it is heated to a temperature of about 150° F. by indirect heat exchange with hot bottoms liquid withdrawn from the bottom of a distillation tower. From heat exchanger **42** the crude passes to pipe still **10** where it is heated to a temperature of about 725° F.

The heated crude is discharged into the vaporizing zone **12** of the fractionating tower where it is flash distilled with the vapors rising through the tower while the hot bottoms liquid collects on a drawoff tray at the bottom of the tower. The hot bottoms liquid is then withdrawn from the tower at a temperature of about 700° F. and passed through a heat exchanger where it is reduced to a temperature of around 550° F.

After the hot bottoms liquid is cooled, it is returned to the stripping zone of the tower where it is steam stripped to remove dissolved, light ends. Following steam stripping the bottoms product is collected and withdrawn at the bottom of the stripping zone, generally at a temperature of about 530° F., and then cooled to a temperature of about 250° F.

Analysis of the final bottoms product, a heavy lubricating oil, shows that strict product specifications, setting a limit on the amount of dissolved light ends that can be present in the product have been met.

The invention in its broader aspects is not limited to the specific details shown and described and departures may be made from such details without departing from the principles of the invention and without sacrificing its chief advantages.

What is claimed is:

1. An improved process for the distillation of whole petroleum crude which comprises:
   heating said crude in a heating zone to a temperature sufficient to vaporize at least a proportion of the lower boiling fractions in said crude:
   discharging the heated crude into a vaporizing zone of a fractionating tower to flash distill the lower boiling fractions;
   passing the distilled vapors from the vaporizing zone through a rectifying zone;
   stripping the hot liquid which collects at the bottom of the vaporizing zone in a high-temperature stripping zone;
   collecting and withdrawing said stripped hot liquid from said high-temperature stripping zone;
   cooling said stripped hot liquid to a temperature below about 600° F. by passing said hot liquid in heat exchange relationship with the whole crude before it is heated in said heating zone;
   thereafter stripping the cooled bottoms liquid in a separate low-temperature stripping zone.

2. The process of claim **1** wherein the whole petroleum crude oil is heated to about 725° F. in a heating zone prior to discharging said crude into the vaporizing zone.

3. In a process for the distillation of whole petroleum crude wherein the crude is heated and flash distilled in a vaporizing zone to separate it into a lower boiling vapor fraction and a higher boiling liquid fraction, and wherein the liquid fraction is subsequently stripped in a high temperature stripping zone to remove dissolved lower boiling fractions therefrom, the improvement which comprises collecting and withdrawing the higher boiling liquid fraction from the high- temperature stripping zone, cooling the liquid fraction to a temperature below about 600° F. in a cooling zone by passing said liquid in heat exchange relationship with the whole crude before said crude is heated in said heating zone, and thereafter stripping the cooled liquid fraction in a separate low-temperature stripping zone.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,617,536 Dated November 2, 1971

Inventor(s) Lonnie S. Saylor and Arthur R. Campbell

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, Claim 1, line 20; "proportion" should read --portion--.

Line 20 should therefore read as follows:

"cient to vaporize at least a portion of the lower boiling"

Signed and sealed this 30th day of May 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents