

PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in or relating to Process and Apparatus for the Distillation of Hydrocarbon Mixtures

We, N. V. DE BATAAFSCHE PETROLEUM MAATSCHAPPIJ, a company organised under the laws of The Netherlands, of 30 Carel van Bylandtlaan, The Hague, The Netherlands, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 This invention relates to a process and apparatus for the distillation of hydrocarbon mixtures at pressures below atmospheric.

It is known to distil at pressures below atmospheric hydrocarbon mixtures such as mineral oils and mixtures of vaporous and liquid hydrocarbons produced by heating these oils, especially the bottom product obtained in the distillation of crude oil at atmospheric or substantially atmospheric pressure. To this end the hydrocarbon mixture may be led into a distillation column at a high temperature.

25 The fraction of the feed which is vaporous at the inlet temperature is rectified in the part of the distillation column situated above the feed inlet line and withdrawn in two or more fractions as a side stream or top product, while the fraction which is liquid at the inlet temperature may be withdrawn directly for use as fuel or asphalt but may also be stripped with steam in a part of the column situated beneath the feed inlet line. On stripping, asphalt is obtained as bottom product; the top products of the stripper, comprising steam, vaporous hydrocarbons and liquid entrained thereby, enter the upper rectifying part of the column.

35 In order to improve the separation between the liquid and vaporous fractions of the feed, a vortex chamber may be arranged in the distillation column, and the feed passed into it tangentially. The vaporous fraction leaves the vortex chamber through the vapour overflow and the liquid fraction flows into the lower stripping part of the

column. A further improvement in the separation may be attained by arranging a plate, for example a disc, in the bottom portion of the cylindrical part of the rotation space of the vortex chamber. This plate is completely free of the construction situated above it and of the inner wall of the rotation space, and is arranged so that a free annular slot is present between the periphery of the disc and the inner wall of the rotation space.

50 Even with the use of these improvements it is, however, not possible to completely prevent liquid, carried over by the vaporous top products of the asphalt stripper, from finding its way with them through the vortex chamber into the rectifying part of the distillation column. The presence of this liquid in the rectifying part of the distillation column impairs the purity of the fractions obtained in the rectification. This is especially disadvantageous, when these incompletely pure fractions are used as feed for catalytic cracking processes, as there is then a danger of the catalyst rapidly becoming unusable.

70 It has now been discovered that this difficulty may be eliminated and that at the same time a number of practical advantages are obtained by stripping the liquid separated in the vortex chamber in a stripper separated from the vortex chamber and then leading the top products of the stripper, together with the feed, into the vortex chamber.

80 Accordingly, the present invention provides a process for the distillation of hydrocarbon mixtures at reduced pressure, wherein the hydrocarbon mixture to be distilled is passed tangentially into a vortex chamber wherein it is separated by centrifugal action into a vaporous fraction and a liquid fraction, the vaporous fraction of the feed leaving the vortex chamber through a vapour overflow is rectified, the liquid fraction separated in the vortex chamber is led

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off and stripped with steam in a stripper separated from the vortex chamber, and the top products of the stripper, together with the feed, are led into the vortex chamber.

- 5 The entrainment of liquid from the stripper to the rectifying part of the distillation column is thereby prevented and at the same time the partial pressure of the vaporous hydrocarbons in the feed to the vortex chamber is reduced by the presence of steam in the top products from the stripper, while the liquid entrained from the stripper is again separated from the vapours in the vortex chamber and returned to the asphalt stripper, so that there are no losses of asphalt.

- 10 There are two important embodiments of the present invention. In the first embodiment the rectification of the fraction leaving the vortex chamber through the vapour overflow on the one hand, and the stripping of the liquid separated in the vortex chamber on the other hand are effected in separate columns. This means that the height of the unit can be considerably reduced, involving definite constructional advantages. If desired, the stripper may be integral with stripper columns for the fractions derived from the rectifier.

- 30 The other important embodiment of the present process is that the liquid is stripped in a stripper which is constructionally integral with the vortex chamber and the rectifier, but is separated from the vortex chamber by a liquid seal through which no steam or other top products can find their way into the vortex chamber from the stripper. The necessary provisions may be easily made in existing columns.

- 40 The two embodiments are now further illustrated with reference to the accompanying schematic drawing.

- Referring to Figure 1, the lower portion of a vacuum-distillation column 1, has a vortex chamber 2, in the bottom part of which a plate 3 has been provided. Above the vortex chamber 2 in the column 1 are present a plurality of trays, a discharge at the top and various sidelines for withdrawing fractions, each of which may, if desired, be separately re-distilled or stripped, for example with steam. For the sake of simplicity this equipment is not shown in the drawing.

- 55 Feed to be distilled is passed through a line 4 into a furnace 5, where partial vapourisation takes place, and then passes at a high temperature, for example about 350-400°C, through a line 6 tangentially into the rotation space of the vortex chamber 2 wherein it is centrifugally separated into vapour and liquid fractions. The vapour fraction passes through the vapour overflow of the vortex chamber to the rectifying part of the column 1, while the liquid fraction

separated in the vortex chamber is led through a line 7 to the stripper 8, which contains a plurality of trays (not shown), for example between 5 and 8 trays. Steam is introduced into the bottom part of this stripper through a line 9. The stripped asphalt is withdrawn from the stripper through a line 10, while steam and other top products i.e. stripped volatiles are led from the stripper through a line 11 and through the line 6 into the vortex chamber 2, whence liquid entrained from the asphalt stripper, together with the liquid separated from the feed, is returned through the liquid discharge of the vortex chamber and the line 7 to the stripper. The temperature in the stripper 8 will generally be somewhat lower than that in the bottom part of the distillation column 1, while the pressure is usually higher than the pressure in the column 1.

Figure 2 shows a stripper 8a constructionally integral with a lower portion of a distillation column 1a. At the top of the stripper 8a there is a separating plate 12 provided with a central opening connected to a vertical riser 13 and surrounded by a bell-shaped element 14, of which a plate 3a forms the top.

The openings between the bell-shaped element 14 and the riser 13 as well as between the bell-shaped element 14 on the one hand, and the wall of the column and the separating plate 12 on the other hand, are such that a liquid seal may be formed by the liquid flowing downwards from the vortex chamber 2a, through which liquid seal no steam or other top products can find their way from the stripper into the vortex chamber. The steam and the other top products of the stripper enter the bell-shaped element 14 through the riser 13 whence they are led through line 15 to the feed inlet line 6a and on to the vortex chamber 2a. If desired, the top products from the stripper may alternatively be led through a line 16 (shown by a broken line) into the line 6a.

The invention is now further illustrated by way of example with reference to Figure 1 of the drawing.

Feed, which comprises a "Kuwait long residue" having a specific gravity 0.933 at 70/4°C and a kinematic viscosity 290 cS at 140°C and dirty wash oil obtained from a previous operation from the section of the distillation column above the vortex chamber, is fed at the rate of 5313 tons a day at a temperature of 300°C into the furnace 5 through line 4. The feed from the furnace passing through line 6 at a temperature of 400°C comprises 2542 tons/day liquid and 2771 tons/day of vapour. The pressure in the vortex chamber 2 is about 82 mm of Hg. The liquid separated in the vortex chamber has a penetration of 168 at 25°C and this liquid is passed through line 7 to the stripper

8 at a temperature of 385°C where it is contacted with low pressure stream (i.e. about 1 atmosphere) at 336°C. The pressure in the stripper is about 130 mm of Hg. The 5 vaporous top products from the stripper comprising hydrocarbons and steam pass through line 11 and are recycled to the vortex chamber, while an asphalt having a penetration of 91 at 25°C is withdrawn through 10 line 10.

WHAT WE CLAIM IS:—

1. A process for the distillation of hydrocarbon mixtures below atmospheric pressure, wherein the hydrocarbon mixture to 15 be distilled is passed tangentially into a vortex chamber wherein it is separated by centrifugal action into a vapourous fraction and a liquid fraction, the vapourous fraction of the feed leaving the vortex chamber through 20 a vapour overflow is rectified, the liquid fraction separated in the vortex chamber is led off and stripped with steam in a stripper separated from the vortex chamber and the top products from the stripper, together with 25 the feed, are led into the vortex chamber.

2. A process as claimed in claim 1, wherein the rectification of the vapourous fraction leaving the vortex chamber through the vapour overflow on the one hand, and 30 the stripping of the liquid fraction separated in the vortex chamber on the other hand, are effected in separate columns.

3. A process as claimed in claim 1, wherein the liquid fraction separated in the 35 vortex chamber is stripped in a stripper which is constructionally integral with the vortex chamber, but is separated from the vortex chamber by a liquid seal.

4. A process for the distillation of hydrocarbon mixtures at reduced pressure, substantially as hereinbefore described with 40 special reference to the accompanying drawings.

5. An apparatus for the distillation of 45 hydrocarbon mixtures by a process as claimed in claim 2, comprising a distillation column having a rectification section surmounting a vortex chamber provided with a tangential inlet and a discharge line for

liquid separated in the vortex chamber, in 50 which the discharge line for liquid separated in the vortex chamber leads to a stripper, while the discharge line for the top products of this stripper is connected to the inlet of the vortex chamber. 55

6. An apparatus as claimed in claim 5, wherein a plate is present in the bottom portion of the cylindrical part of the rotation space of the vortex chamber.

7. An apparatus for the distillation of 60 hydrocarbon mixtures at reduced pressure by a process as claimed in claim 3, comprising a column width, in order from top to bottom, a rectification section, a vortex chamber provided with a tangential inlet, 65 and a stripping section, in which at the top of the stripper a separating plate is provided having a central opening connected to a vertical riser which is surrounded by a bell-shaped element, the arrangement being such 70 that between the wall of the column, the separating plate, the riser and the bell-shaped element a liquid seal may be formed by liquid flowing from the vortex chamber, and in which above the upper edge of the riser 75 the bell-shaped element is provided with an opening to which is connected a line in communication with the inlet of the vortex chamber.

8. An apparatus as claimed in claim 7, 80 wherein a plate is present in the bottom portion of the cylindrical part of the rotation space of the vortex chamber.

9. An apparatus as claimed in claim 8, wherein the upper plate of the bell-shaped 85 element forms part of the plate present in the bottom portion of the vortex chamber.

10. An apparatus for the distillation of hydrocarbon mixtures at reduced pressure substantially as hereinbefore described 90 with special reference to the accompanying drawings.

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 25 the feed, are led into the vortex chamber.

2. A process as claimed in claim 1, wherein the rectification of the vaporous fraction leaving the vortex chamber through the vapour overflow on the one hand, and the stripping of the liquid fraction separated
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 70 that between the wall of the column, the separating plate, the riser and the bell-shaped element a liquid seal may be formed by liquid flowing from the vortex chamber, and in which above the upper edge of the riser
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