

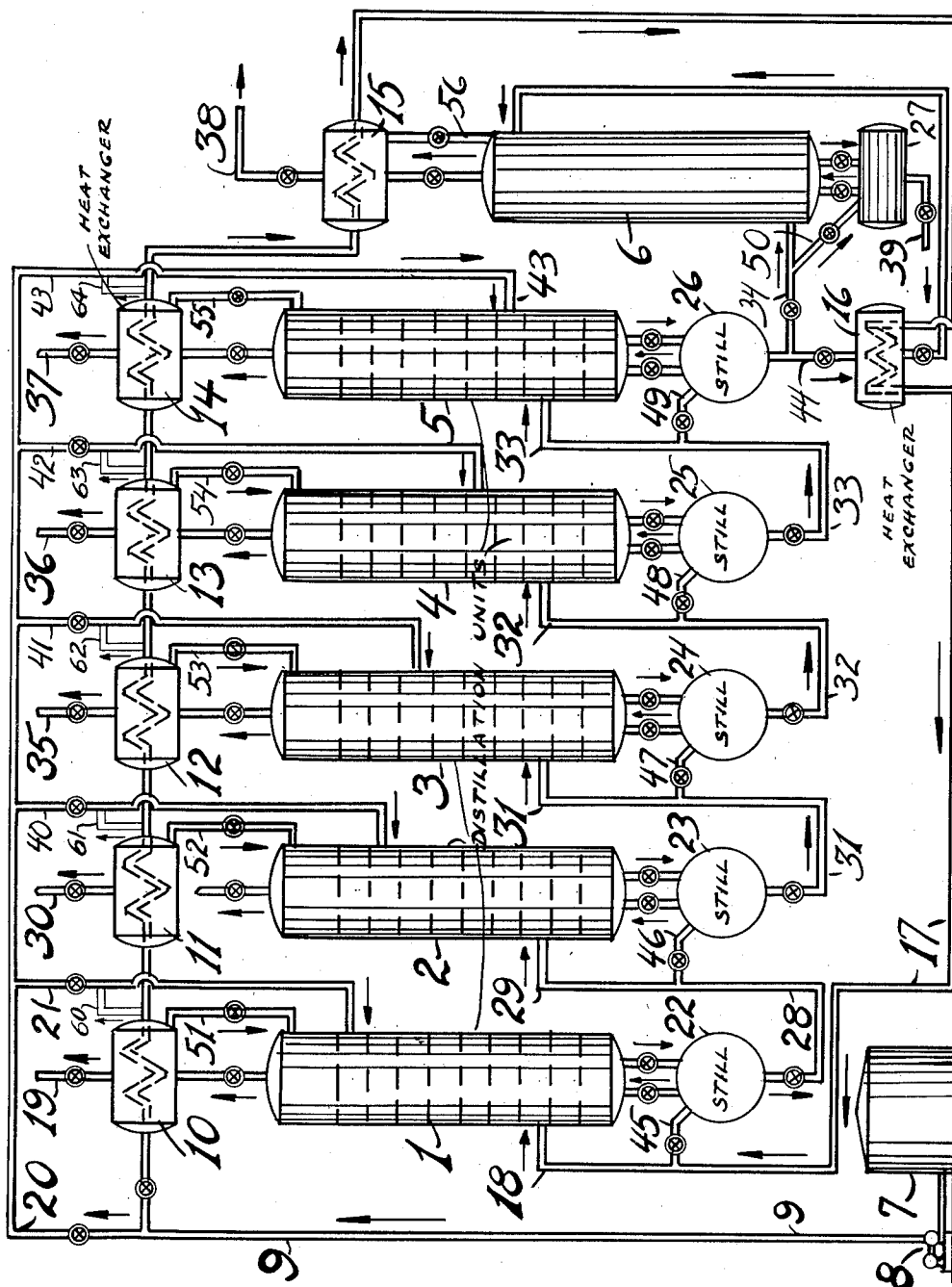
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REFINING MINERAL OILS

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REFINING MINERAL OILS

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The present invention relates to the refining of mineral oils. The invention is more particularly concerned with an improved distillation process by which a petroleum oil may be fractionated in a series of distillation units in an efficient and economical manner. In accordance with the present process, a petroleum oil is distilled into fractions in a series of distillation units in a manner in which the reflux and desired end point of the overhead product from the respective units is secured by the introduction of a relatively small portion of the feed at a point above the point at which the total feed is normally introduced.

It is well-known in the art to distill mineral oils, particularly petroleum oils, by various processes. In general these operations all are conducted in a manner to produce reflux by a suitable means. Usually the vaporous overhead products are cooled and condensed and a portion of the condensate returned to a top plate in the distillation zone. A process in which reflux is secured in this manner as well as similar processes of this character, are not particularly suitable for distillation operations employing a number of distillation units arranged in series especially in distillation operations in which crude petroleum oils containing constituents boiling over a relatively wide range are processed.

I have now discovered a method of controlling end points of overhead vaporous products and for securing maximum capacities in distillation operations, particularly in operations in which a number of units are utilized, which comprises introducing a portion of the feed oil at a point in the distillation unit above the point at which the total feed is usually introduced. My invention may be readily understood by reference to the attached drawing, illustrating modifications of the same.

For purposes of description it is assumed that the feed oil is a crude petroleum oil, and that the oil is distilled in a series of distillation units 1, 2, 3, 4, 5, and 6, which contain suitable distillation means, as for example bubble cap plates and the like. The feed oil is withdrawn from feed storage vessel 7 by means of pump 8 and passed serially by means of line 9 through heat exchangers 10, 11, 12, 13, 14, and 15 which for the purposes of illustration are shown as partial condensers maintained in the vapor lines of stills 1, 2, 3, 4, 5, and 6, respectively. Condensed reflux is returned to the respective stills by means of lines 51, 52, 53, 54, 55, and 56.

The feed oil is passed through heat exchanger 16 and introduced into distillation unit 1 by means of lines 17 and 18. Temperature and pressure conditions are maintained in distillation unit 1, adapted to remove overhead by means of line 19 a relatively low boiling petroleum oil fraction. In accordance with the present process, a portion of the feed oil withdrawn by means of line 9 by-passes heat exchanger 10 by means of line 20 and is introduced into the upper section of distillation unit 1 by means of line 21, preferably on the second bubble cap plate. The unvaporized portions of the feed oil flow downwardly into the bottom sections of the distillation tower and into shell still 22 which may be fired by any suitable means. For purposes of description it is assumed that the shell stills 22, 23, 24, 25, 26 and 27 are externally fired.

The unvaporized portions of the oil are withdrawn from shell still 22 by means of line 28 and passed to second distillation unit 2 by means of line 29. Temperature and pressure conditions are adapted to remove overhead by means of line 30 a petroleum oil fraction containing constituents boiling in the range above the boiling range of the fraction removed overhead from distillation unit 1. In a similar manner the unvaporized portions of the feed oil are passed successively to distillation units 3, 4, 5, and 6 by means of lines 31, 32, 33, and 34, respectively. Vaporized fractions containing progressively higher boiling constituents are removed overhead from stills 3, 4, and 5 by means of lines 35, 36, and 37, respectively, condensed and combined with the streams removed overhead by means of lines 19 and 30 to produce a finished petroleum oil product boiling in the motor fuel boiling range. A relatively high boiling vaporized fraction is removed from distillation unit 6 by means of line 38, condensed and blended to produce a petroleum fraction boiling in the heating oil boiling range. The unvaporized residue is removed from distillation unit 6 by means of line 39, and further refined, cracked or otherwise handled in any manner desirable. Reflux is provided in distillation units 2, 3, 4 and 5 in a manner similar to that described with respect to distillation unit 1. A portion of the feed oil is withdrawn by means of line 20, and introduced into the respective distillation units by means of lines 40, 41, 42 and 43.

The present process may be widely varied. In accordance with the preferred adaptation of the present invention, the reflux producing oil is in-

roduced at a progressively lower bubble cap plate in the respective stills in the direction in which the temperatures of the respective stills increase. A novel adaptation of the present invention when processing a crude oil for the production of a petroleum oil boiling in the motor fuel boiling range and for the production of a petroleum oil fraction boiling in the range above the boiling range of motor fuels is to segregate a relatively small portion of the unvaporized fractions from the still from which the highest boiling constituents which are blended with the motor fuel are removed overhead, and to pass the segregated unvaporized fractions in heat exchange with the fresh feed and then to introduce the relatively cool segregated stream of unvaporized fractions into the upper section of the distillation unit from which the petroleum oil fraction boiling in the range above the boiling range of motor fuels is removed overhead. This may be accomplished in the process illustrated in the drawing by segregating a portion of the bottoms in still 5 by means of line 44, passing the same in heat exchange with the feed in exchanger 46 and introducing the cooled segregated portion into the upper section of still 6.

Although it is preferred to introduce the feed oil into the respective stills in the manner described, under certain circumstances it may be desirable to introduce at least a portion of the feed oil by means of lines 45, 46, 47, 48, 49 and 50, respectively. The invention may be adapted to the processing of relatively narrow boiling fractions. However it is particularly applicable in the distillation of a feed oil boiling over a relatively wide range, as for example, a crude petroleum oil from which it is desired to segregate the relatively lower boiling petroleum fractions boiling in the motor fuel boiling range, the kerosene boiling range, the gas oil boiling range, and various heating oil boiling ranges. It is especially satisfactory in an operation in which a petroleum fraction boiling in the motor fuel boiling range and a petroleum oil fraction boiling in the kerosene boiling range are segregated from a crude petroleum oil. The number of distillation units may vary considerably and will depend, to a large extent, upon the feed oil being distilled and the particular fractions it is desired to segregate.

The amount of feed introduced in the manner described will depend upon general operating conditions and upon the character of the feed oil being distilled. In general the amount introduced as reflux should not exceed 10% of the normal feed to the particular distillation unit and preferably should be below 5%. A desirable operation, for example, is to decrease the ratio of feed introduced as reflux to normal feed in the successive distillation units as the temperatures in the units increase. Another preferred modification of the present invention is to withdraw the portions of feed utilized as reflux from the main feed stream as this stream is withdrawn from the partial condensers of the respective distillation units. This operation may be conducted by means of lines 60, 61, 62, 63, and 64. Thus the feed portions introduced into the successive distillation units are of a progressively higher temperature.

In order to more fully illustrate the invention the following examples are given, which should not be construed as limiting the same in any manner whatsoever.

EXAMPLE 1

A standard battery of crude stills processing a petroleum crude oil was operated under the following conditions:

Temperatures °F.

Still	Bottoms	Vapor lines	Feed	Feed reflux
1.....	340	190	250	100
2.....	400	200	340	120
3.....	430	240	400	140
4.....	510	290	430	180
5.....	580	350	510	180
6.....	630	410	580	300

The overhead streams from the first five stills were combined to produce a fraction boiling in the motor fuel boiling range, while the overhead from still 6 was condensed and utilized in a kerosene fraction.

In one operation the oil was distilled in the conventional manner, whereas in another operation feed oil reflux was employed in the manner described. The results and inspections on the final products were as follows:

	Conventional distillation	Present process
Gravity, ° A. P. I.....	60.0	70.8
Engler distillation:		
I. B. P..... ° F.....	126	88
Percent distilled at 257° F..... ° F.....	85	89.5
F. B. P..... ° F.....	318	293

EXAMPLE 2

In another similar series of operations the results and inspections on the final products were as follows:

	Conventional distillation	Present process
Gravity, ° A. P. I.....	46.6	55.0
Engler distillation:		
I. B. P..... ° F.....	208	139
Per cent distilled at 257° F..... ° F.....	7	27
F. B. P..... ° F.....	518	418

From the above it is apparent that an unexpected overall improvement in the distillation operation was secured.

The process of the present invention is not to be limited by any theory or mode of operation but only by the following claims in which it is desired to claim all novelty insofar as the prior art permits.

I claim:

1. Distillation process which comprises passing a petroleum crude oil through a series of distillation units operated at progressively higher temperatures, under conditions in which the feed oil is introduced into an intermediate section of the initial unit and in which unvaporized portions of the oil are withdrawn from the bottoms of the succeeding units and introduced as feed into an intermediate section of the next succeeding unit, withdrawing vaporous overhead fractions and a final residue, segregating relatively small portions of the feed oil and introducing said segregated portions directly into the upper sections of the respective distillation units at a progressively lower point intermediate the points of withdrawal of the vaporous overhead fractions and the points at which the feed is introduced, as the temperature of the respective stills increases.

2. Process in accordance with claim 1, in which the portions of feed oil introduced into the respective succeeding units are of a progressively higher temperature.

3. Distillation process for the segregation of a petroleum oil fraction boiling in the motor fuel boiling range and for the production of a vaporized fraction boiling above the motor fuel boiling range from a crude petroleum oil which comprises passing the oil through a series of distillation units operated at progressively higher temperatures, segregating and directly introducing portions of the feed oil into the upper sections of the respective stills, separating a bottoms from the still from which the highest boiling constituents boiling in the motor fuel boiling range are removed overhead, introducing a portion of said bottoms into a succeeding still adapted to remove overhead a petroleum oil fraction boiling in the kerosene boiling range, segregating the remainder of said bottoms withdrawn, passing it in heat exchange with the feed to the initial still, then introducing the relatively cool bottoms into

the upper section of said succeeding still, withdrawing and condensing the overhead fractions.

4. Process in accordance with claim 3 in which the segregated portions of feed oil introduced into the upper sections of the respective stills are introduced at a progressively lower point, intermediate the point of withdrawal of the vaporous overhead fraction and the point at which the feed is introduced, as the temperature of the respective stills increases.

5. Process in accordance with claim 3 in which the segregated portions of feed oil introduced into the upper sections of the respective stills are introduced at a progressively lower point, intermediate the point of withdrawal of the vaporous overhead fraction and the point at which the feed is introduced, as the temperature of the respective stills increases, and in which the ratio of feed introduced as reflux to normal feed to the respective distillation units decreases as the temperature of the respective stills increases.

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