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ART OF DISTILLING HYDROCARBON OILS

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Fig. 1.

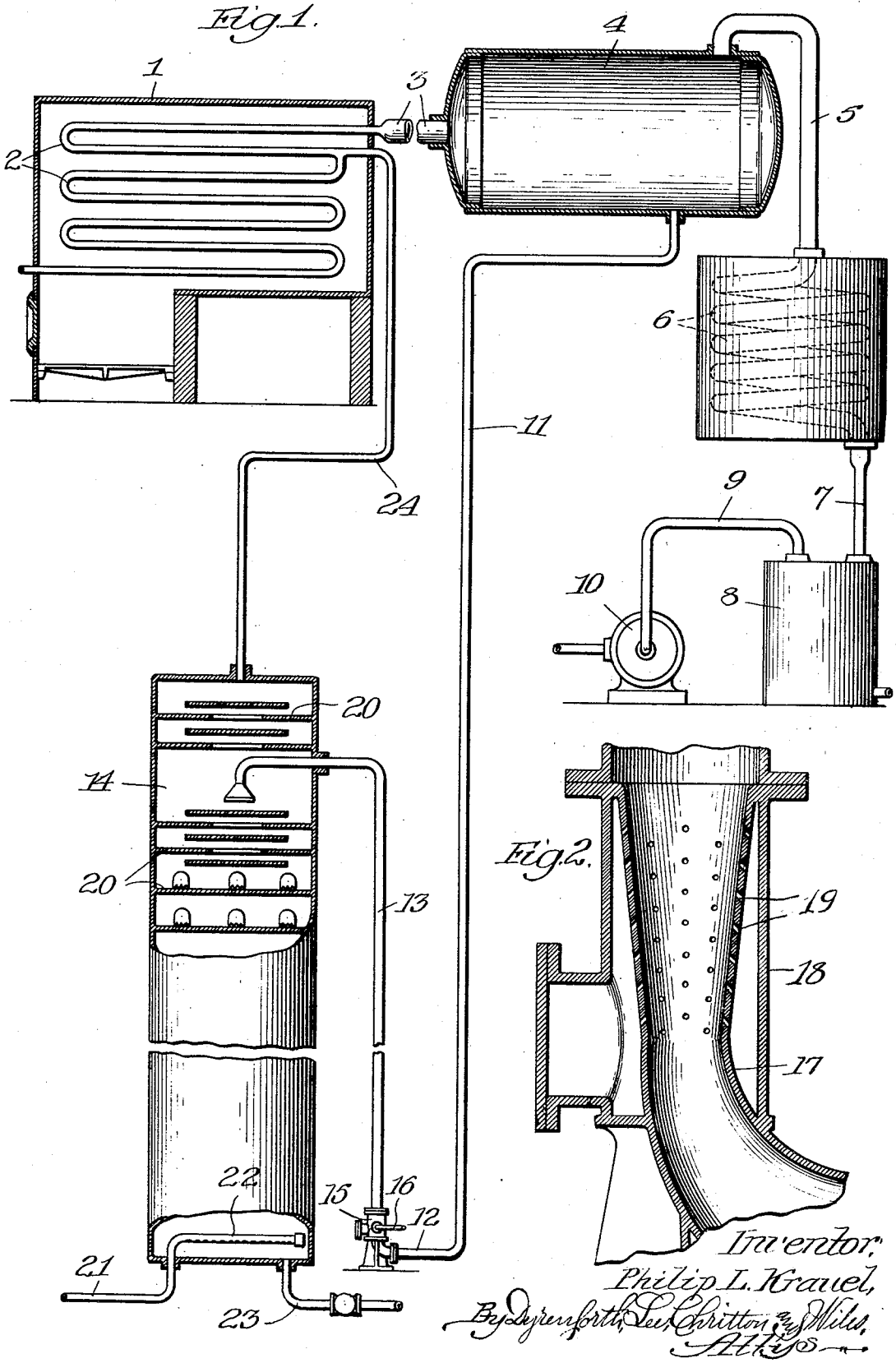

Fig. 2.

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ART OF DISTILLING HYDROCARBON OILS

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The present invention relates to improvements in methods of distilling hydrocarbon oils and more particularly for the distillation of lubricating fractions for the removal of their lighter constituents and the formation of a heavier lubricating fraction as a residuum.

It will be fully understood from the following description, illustrated by the accompanying drawing, in which:

Figure 1 is a diagrammatic sectional view of an apparatus suitable for carrying the invention into effect; and

Fig. 2 is a sectional detail.

Referring more particularly to the drawing, the numeral 1 indicates a furnace setting in which is provided a suitable coil 2 heated by any suitable means. The outlet of the coil 2 leads into a separating chamber or drum 4, and between the coil and drum may advantageously be provided an enlarged conduit 3. Vapors pass from drum 4 through a vapor line 5 to the condenser 6. Condensate flows from the condenser through line 7 to the receiver 8, the vapor space of which may be connected by the line 9 to the vacuum pump 10.

From the bottom of drum 4, a discharge line 11 extends downwardly and then upwardly to form a U-bend 12, the ascending limb 13 of which enters and terminates in the upper part of a column 14. The ascending limb 13 is provided with means for supplying steam to the oil therein so as to cause the oil to flow into the column 14. While any suitable steam lift or steam injector may be used for this purpose, it is preferred to employ the form of steam lift described in Watts' application Serial No. 45,618, filed July 23, 1925. The steam lift is designated 15 and the steam supply pipe 16. As shown in Fig. 2, the steam lift comprises an upwardly converging-diverging conduit 17 inserted in the ascending limb 13. Said conduit is surrounded by a housing 18 into which the steam supply pipe 16 leads. The upwardly diverging part of the conduit 17 is provided with orifices 19, which are inclined upwardly from the housing 18 to the interior of the conduit 17, so that steam is injected upwardly thereinto, in finely divided form. Thus the oil is caused to flow upwardly through limb 13 by the momentum of the injected steam and also by the air-lift effect due to the dispersion of steam bubbles in the oil. The column 14 may be provided, for example, with stripping plates 20, some of which may suitably be of the bubble plate type. A steam line 21 leads into the tower 14 and discharges through the perforated pipe 22 into the lower portion thereof. A discharge line 23 is provided for the removal of heavy oils from the tower or column 14. From the top of the column a vapor line 24 leads to a suitable point in the coil 2 preferably an intermediate point at or near its end, before it enters the conduit 3.

In carrying out the invention, the oil to be distilled is forced, by any suitable supply means, such as a pump (not shown), into and through the pipe coil 2, in which it is heated to the desired temperature. As pointed out hereinafter, steam and, in general some hydrocarbon vapors, are forced into the heated oil passing through the coil 2 from the pipe 24. The heated oil and steam pass out of the coil 2 into the enlarged conduit 3, which may be of any desired length, and into the vaporizing drum 4. The enlarged conduit 3 is of sufficient length to permit a substantial attainment of equilibrium between the heated oil and vapors present at the pressure prevailing. In the chamber 4 the separation of vapors and unvaporized oil takes place, the vapors passing off through the pipe 5 to the condenser 6 from which the resulting condensate flows into the receiver 8. From the chamber 4, the unvaporized oil descends through discharge line 11 and is forced by steam or other suitable inert gas such as flue gases or gases generated in the system. These gases are injected through orifices 19 and force the oil upwardly through limb 13 into the tower or column 14. It descends the column 14 in countercurrent to the rising steam entering through the pipe 21 and the perforated distributing pipe 22. The steam completes the removal of the light fractions from the oil, leaving as a residue the desired

vicous lubricating fractions, which are substantially cooled by their contact with the steam. The steam and vapors carried thereby are forced by the pressure in the column 14, through the pipe 24 and are admitted into the stream of heated oil before it enters the enlarged conduit, and where the pressure is relatively low, for example, near the exit end of coil 2, and there aid materially the removal of the lighter fractions of the oil. The steam supplied to the column 14 by pipes 16 and 21 is under pressure so that sufficient pressure is maintained in column 14 to ensure flow of steam and vapors there from into the coil 2 by pipe 24. The injection of steam through the orifices 19 in the limb 13 prevents vapors from the column 14 being forced back into the vaporizing chamber 4 by the pressure within the column 14.

If desired, the separating chamber 4 may be operated under vacuum, the vacuum pump 10 being connected by the line 9 to the vapor space of the receiver 8 for this purpose.

The process is particularly adapted to the production of residues, such as viscous lubricating oils, from reduced crude oils or from distillates. Thus, the feed stock may suitably be a paraffin distillate from Mid-continent crude of 30° A. P. L., with a viscosity of 60 sec. Saybolt at 100° F. and a flash point of about 150 to 175° F. It is brought in the coil 2 to a temperature of 650 to 675° F., the steam and vapors from the tower 14 being introduced into the stream of oil before it enters the enlarged conduit 3, where the pressure is comparatively lower. The residue from the separating chamber 4 reaches the tower 14 at a temperature substantially the same as that at which the oil leaves the heating coil. In the tower steam is injected in an amount to supply about 30% condensed water on distillate condensed in the condenser 8. A product is formed of about 23–24° Baumé, with a viscosity of 320–325 sec. Saybolt at 100° F. and a flash point of about 415 to 420° F. The conditions of operation may be varied as desired, according to the character of feed stock, the product desired, and the pressure under which the operation is carried out. Thus, with reduced pressure, materially lower temperature may be used.

The process may likewise be used in the distillation of other oils; for example, in the removal of lighter fractions from crude and reduced crude oils.

I claim:

1. The method of distilling hydrocarbon oils, which comprises passing the oil in a confined stream through a heating zone, discharging the stream of heated oil into an enlarged chamber, wherein separation of vaporized products takes place, removing unvaporized oil from said chamber and injecting inert gas into a stream of said unvaporized oil, thereby forcing it into a stripping zone, subjecting the oil to intimate contact with steam in said stripping zone thereby removing the lighter constituents thereof and forcing the steam and vapors carried thereby into the stream of heated oil at an intermediate point in the heating zone, and under the pressure of the stripping zone.

2. The method of distilling hydrocarbon oils, which comprises passing the oil in a confined stream through a heating zone, discharging the stream of heated oil into an enlarged chamber, wherein separation of vaporized products takes place, removing unvaporized oil from said chamber, maintaining a column of the withdrawn unvaporized oil, forcing oil from said column into a stripping zone by introducing an inert gas into said oil, subjecting said oil to direct contact with steam in said stripping zone thereby removing the lighter constituents thereof, and discharging the steam and vapors carried thereby into the stream of heated oil at an intermediate point in the heating zone and under the pressure of the stripping zone, the height of said column of oil being sufficient to prevent return of steam and vapors from the stripping zone to the separating chamber.

3. The method of distilling hydrocarbon oils, which comprises passing a confined stream of oil through a heated zone, passing the oil and steam through an elongated enlarged conduit into an enlarged chamber wherein separation into vaporized and unvaporized portions takes place, forcing unvaporized oil from said chamber to a stripping column by injecting steam thereinto, subjecting the oil to the stripping action of steam in said column and supplying said steam and the vapors stripped from said unvaporized oil portion directly into the stream of oil in said heating zone.

4. The method of distilling hydrocarbon oils, which comprises passing a confined stream of oil through a heated zone into an enlarged chamber wherein separation into vaporized and unvaporized portions takes place, passing the unvaporized oil in a confined U-shaped stream, injecting steam upwardly into the ascending limb portion of said U-shaped stream, thereby causing said oil to flow into the upper part of a stripping column at higher pressure than said enlarged chamber, subjecting the oil to the stripping action of steam in said stripping zone and supplying said steam and the stripped vapors under the pressure prevailing within the stripping zone to the stream of oil in the heated zone.

5. The method of distilling hydrocarbon oils, which comprises passing a confined stream of oil through a heated zone into an enlarged chamber wherein separation into vaporized and unvaporized portions takes place, passing the unvaporized oil downwardly and then upwardly into the upper

part of a stripping column at higher pressure than said enlarged chamber, passing fine jets of steam into the ascending stream of oil so that said stream is caused to ascend into said stripping column by the momentum of the injected steam and the bubbles of steam thus maintained in the oil, subjecting the oil to the stripping action of steam in said stripping zone and supplying said steam and the stripped vapors under the pressure prevailing within the stripping zone to the stream of oil in the heated zone.

6. In apparatus for the distillation of oil, a heated conduit, a drum into which said conduit discharges, a stripping tower, a discharge conduit from said drum leading to the stripping tower, means for injecting gas into said discharge conduit so as to force the unvaporized oil to the stripping tower and prevent back flow of steam and vapors through the discharge conduit, means for introducing steam into the lower portion of said stripping tower, and means for leading vapors from said stripping tower into the heating coil at an intermediate point thereof.

7. In apparatus for the distillation of oil, a heating conduit, means for applying heat thereto, an enlarged separating drum connected therewith, a stripping column, means for supplying steam thereto, means for conveying steam and vapors from the upper part of the stripping column to the heating conduit, a U-shaped conduit for conveying unvaporized oil from the separating drum to the upper part of the stripping column, and means for injecting a plurality of jets of gas upwardly into the oil in the ascending limb of said conduit for forcing unvaporized oil from said chamber to said stripping column.

8. The method of distilling hydrocarbon oils, which comprises passing a confined stream of oil through a heated zone, passing the oil into an enlarged chamber wherein separation into vaporized and unvaporized portions takes place, forcing unvaporized oil from said chamber to a stripping column by injecting steam thereinto, subjecting the oil to the stripping action of additional steam in said column and supplying said steam and the vapors stripped from said unvaporized oil portion directly into the stream of oil in said heating zone.

9. The method of distilling hydrocarbon oils, which comprises passing a confined stream of oil through a heated zone, passing the oil together with steam into an enlarged chamber wherein separation into vaporized and unvaporized portions takes place, forcing unvaporized oil from said chamber to a stripping column by injecting steam thereinto, subjecting the oil to the stripping action of additional steam in said column and supplying said steam and the vapors stripped from said unvaporized oil portion directly into the stream of oil in said heating zone, and under the pressure of the stripping zone.

10. The method of distilling hydrocarbon oils, which comprises passing a confined stream of oil through a heated zone, passing the oil into an enlarged chamber wherein separation into vaporized and unvaporized portions takes place, removing the unvaporized oil from said chamber in a confined stream, injecting steam into said confined stream thereby causing said oil to flow into a stripping zone of higher pressure than the pressure in said chamber, subjecting said oil in said stripping zone to the stripping action of additional steam and supplying said steam and the stripped vapors to the stream of oil in the heated zone.

11. The method of distilling hydrocarbon oils, which comprises passing the oil in a confined stream through a heating zone, discharging the stream of heated oil into an enlarged chamber, wherein separation of vaporized products takes place, removing unvaporized oil from said chamber and injecting steam into a stream of said unvaporized oil, thereby forcing it into a stripping zone, subjecting the oil to intimate contact with steam in said stripping zone thereby removing the lighter constituents thereof and forcing the steam and vapors carried thereby into the stream of heated oil at an intermediate point in the heating zone, and under the pressure of the stripping zone.

12. The method of distilling hydrocarbon oils, which comprises passing the oil in a confined stream through a heating zone, discharging the stream of heated oil into an enlarged chamber, wherein separation of vaporized products takes place, removing unvaporized oil from said chamber, maintaining a column of the withdrawn unvaporized oil, forcing oil from said column into a stripping zone by introducing steam into said oil, subjecting said oil to direct contact with steam in said stripping zone thereby removing the lighter constituents thereof, and discharging the steam and vapors carried thereby into the stream of heated oil at an intermediate point in the heating zone and under the pressure of the stripping zone, the height of said column of oil being sufficient to prevent return of steam and vapors from the stripping zone to the separating chamber.

13. The method of distilling hydrocarbon oils, which comprises passing a confined stream of oil through a heated zone, passing the oil into an enlarged unheated chamber wherein separation into vaporized and unvaporized portions takes place, removing the unvaporized oil from said chamber, injecting steam into said oil, thereby causing said oil to flow into a stripping zone of higher pressure than the pressure in said chamber, subjecting the unvaporized oil to intimate contact with steam in said stripping zone there-

by removing the lighter constituents thereof and supplying said steam and the stripped vapors to the stream of oil in the heating zone, whereby said oil in the heating zone and said steam and vapors flow into the said unheated chamber.

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