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ART OF CRACKING HYDROCARBONS

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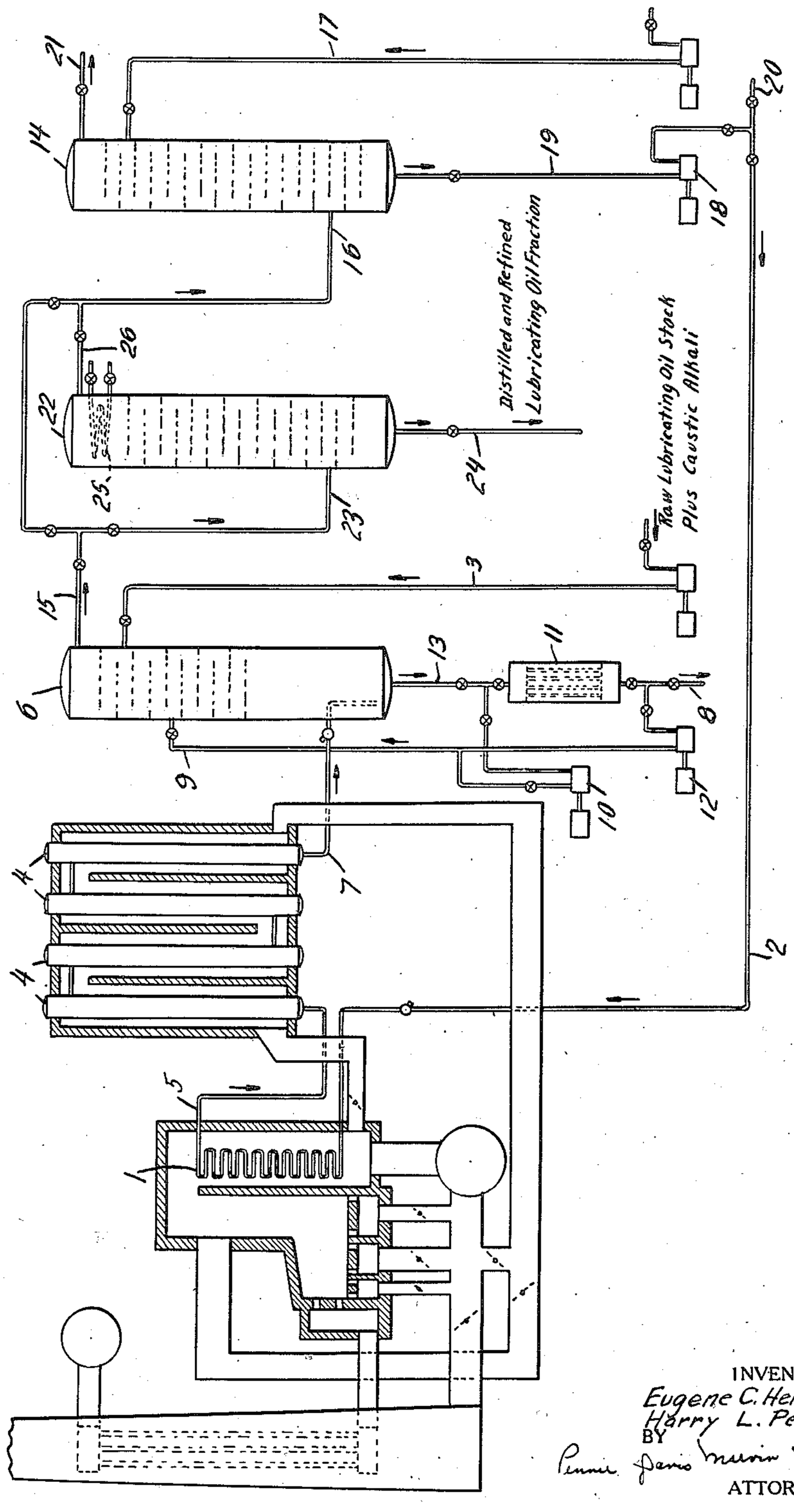

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UNITED STATES PATENT OFFICE

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ART OF CRACKING HYDROCARBONS

Application filed June 4, 1929. Serial No. 368,229.

This invention relates to improvements in the manufacture of distilled lubricating oil from raw lubricating oil containing stocks including raw crude stocks such as crude petroleums and reduced crude petroleums and distillate fractions containing lubricating oil components.

This invention provides an improved method of distilling refined, or partially refined, lubricating oils from raw stocks containing lubricating oil components. In the improved method of the invention, vaporization of the lubricating oil fraction from the raw lubricating oil containing stock is effected by direct heat exchange between this raw stock and the hot vapor products from a vapor phase cracking operation following regulation of the temperature of these hot vapor products to avoid decomposition of lubricating oil constituents. Objectionable decomposition of lubricating oil constituents is thus minimized; decomposition due to local overheating is avoided by the direct heat exchange, general overheating is avoided by regulation of the temperature of the hot vapor products from the vapor phase cracking operation, and the partial pressure of these hot vapor products is utilized to reduce the partial pressure of the vaporized lubricating oil constituents. Also, in the improved method of the invention, the raw lubricating oil containing stock is supplied to the operation as a mixture including a caustic alkali, such as quick lime or caustic soda, so that the lubricating oil constituents vaporized from this raw stock are maintained within the zone of activity of the caustic alkali until vaporized and consequently throughout the entire temperature range over which these constituents are heated up to the maximum temperature of this range. The vaporized lubricating oil constituents are condensed from the resulting vapor mixture including these constituents as well as vapors from the vapor phase cracking operation, by a suitable fractionating operation, and components of the then remaining vapor mixture higher boiling than suitable as components of the desired low boiling product of the vapor phase cracking operation are condensed, in a suitable refluxing operation, and supplied to the vapor phase cracking operation. This reflux condensate so supplied to the vapor phase cracking operation may include constituents of the raw lubricating oil containing stock supplied to the operation lower boiling than suitable as components of the desired lubricating oil product.

In carrying out the present invention, oil is subjected to a vapor phase cracking operation and the vapor mixture from this vapor phase cracking operation is subjected to a scrubbing operation for the separation of tar. The oil supplied to the vapor phase cracking operation may comprise the reflux condensate previously mentioned or a mixture of such condensate and raw oil. Regulation of the temperature of the hot vapor products from the vapor phase cracking operation and the direct heat exchange between these hot vapor products and the raw lubricating oil containing stock is effected in this scrubbing operation. Regulation of the temperature of the hot vapor products from the vapor phase cracking operation is advantageously effected by introducing the hot oil products from this operation into the scrubbing operation into and beneath the surface of a liquid body of oil therein and regulating the scrubbing operation to maintain this liquid body at the desired temperature. The raw lubricating oil containing stock is mixed with caustic alkali and this mixture is introduced into the vapors in the scrubbing operation and the lubricating oil components of this raw stock mixture are vaporized therein by heat exchange with these vapors. The resulting vapor mixture is then subjected, successively, to the fractionating operation and the refluxing operation previously mentioned. The lubricating oil product is discharged from the fractionating operation without being permitted to return to the vapor phase cracking operation. The tar separated in the scrubbing operation, including tar components from the vapor mixture from the vapor phase cracking operation and any residual components from the raw lubricating oil containing stock and any unconsumed caustic alkali and the solid or semi-solid re-

action products of the caustic alkali, is discharged without being permitted to return to the vapor phase cracking operation.

The invention will be further described in connection with the accompanying drawings which illustrate, diagrammatically and conventionally, in elevation and partly in section and with parts broken away, one form of apparatus adapted for carrying out the process of the invention. The particular apparatus shown is shown merely for purposes of illustration.

The apparatus illustrated includes a vapor phase cracking apparatus described in more detail in an application filed June 13, 1927, Serial No. 198,621.

Referring to the drawings, the oil supplied to the vapor phase cracking operation is supplied to the heating conduit 1 through connection 2, is heated and vaporized and the vapors superheated in the heating conduit, the vapors are passed to the digesting drums 4 through connection 5 and from the last digesting drum are discharged into the lower end of the scrubbing tower 6 through connection 7. For example, the temperature of the vapors passing from the heating conduit 1 to the digesting drums 4 may approximate 1050–1150° F., the temperature of the vapors passing from the digesting drums 4 to the scrubbing tower 6 may approximate 900–1100° F., the oil may be supplied to the heating conduit 1 under pressure just sufficient to force the oil and oil vapors through the apparatus, and the pressure in the scrubbing tower 6 may approximate 2-15″ of mercury.

The vapors discharged into the scrubbing tower 6 through connection 7 are discharged into and beneath the surface of a liquid body of oil maintained in the lower end of the scrubbing tower during normal operation. As the vapors pass through this liquid body of oil, entrained tar components, or most of them, are separated and the temperature of the vapors is reduced, for example, to a temperature in the neighborhood of 750–800° F. or lower. The raw lubricating oil containing stock is mixed with from ½ to 3 pounds per barrel, for example, of quick lime or caustic soda and this mixture is introduced into the upper end of the scrubbing tower 6 through connection 3. In the scrubbing tower, the lubricating oil components of this mixture are vaporized by direct heat exchange with the vapors from the vapor phase cracking operation, any residual components of this mixture and any unconsumed caustic alkali and the solid or semi-solid reaction products of the caustic alkali collect in the liquid body of oil maintained in the lower end of the tower together with the tar components separated from the vapors from the vapor phase cracking operation. This tar or tar mixture is discharged from the lower end of the scrubbing tower 6 through connection 13 without being permitted to return to the vapor phase cracking operation. The operation carried out in the scrubbing tower 6 may be controlled, or in part controlled, by regulation of the rate at which the raw lubricating oil containing stock-caustic alkali mixture is introduced through connection 3. This control may be supplemented by the regulated reintroduction of part of the tar discharged through connection 13 through connection 9 while hot by means of pump 10 or after cooling in cooler 11 by means of pump 12. For example, the temperature of the liquid body maintained in the lower end of tower 6 may approximate 725–775° F. and the temperature of the vapor mixture escaping from the upper end of the tower 6 may approximate 675–725° F.

The tar discharged through connections 13 and 8 may, for example, be subjected to coking distillation to separate oil components from alkali or alkali reaction products.

The vapor mixture escaping from the upper end of the scrubbing tower 6 through connection 15 is discharged into the lower end of fractionating tower 22 through connection 23. This vapor mixture includes the vaporized components of the raw lubricating oil containing stock introduced into the scrubbing tower 6 and the uncondensed components of the vapor mixture discharged from the vapor phase cracking operation into scrubbing tower 6. The vaporized lubricating oil components of this vapor mixture are condensed in the fractionating tower 22 and the resulting lubricating oil condensate is discharged from the lower end of fractionating tower 22 through connection 24. The operation of this fractionating tower may be controlled by regulated circulation of a cooling medium, water for example, through a cooling coil 25 arranged in the upper end of the tower. For example, the temperature of the vapor mixture escaping from the upper end of the tower 22 may approximate 500–575° F.

The vapor mixture escaping from the upper end of fractionating tower 22 through connection 26 is discharged into the lower end of reflux tower 14 through connection 16. In this tower, vapors higher boiling than suitable as components of the desired low boiling product of the vapor phase cracking operation but lower boiling than suitable as components of the lubricating oil condensate separated in tower 22 are condensed from this vapor mixture. The operation of this tower may be controlled by the regulated introduction, through connection 17, of raw oil to be supplied to the vapor phase cracking operation or of a fraction corresponding in character to the desired low boiling product. For example, the temperature of the vapor mixture escaping from the

upper end of the tower 14 may approximate 375–425° F. The condensate or condensate mixture from the reflux tower 14 is supplied to the heating conduit 1 of the vapor phase cracking apparatus through connections 19 and 2 by means of hot oil pump 18. This condensate stock may include components vaporized from the raw lubricating oil containing stock introduced into the scrubbing tower 6. For example, a reduced crude oil including gas oil components and lubricating oil components may be introduced into the scrubbing tower 6, the lubricating oil components separated in the fractionating tower 22 and the gas oil components separated in reflux tower 14 and supplied therefrom to the vapor phase cracking operation as fresh stock. Fresh stock may also be supplied to the vapor phase cracking operation through connection 20.

The vapor mixture escaping from the upper end of reflux tower 14 through connection 21 includes the desired low boiling product of the vapor phase cracking operation, gasoline for example. This vapor mixture is with advantage discharged through connection 21 directly to a condenser. It may, however, be subjected to further fractionating operations or refining operations.

The scrubbing tower 6, the fractionating tower 22 and the reflux tower 14 are with advantage of construction adapted to involve a minimum pressure drop therethrough in operation. The scrubbing tower 6 is with advantage lagged or thermally insulated. The fractionating tower 22 and the reflux tower 14 are with advantage lagged or thermally insulated where, as in the apparatus illustrated, condensation therein is effected by internal cooling.

We claim:

In the manufacture of lubricating oils, the improvement which comprises subjecting oil to a vapor phase cracking operation and subjecting the vapor mixture from the said vapor phase cracking operation to a scrubbing operation for the separation of tar, mixing caustic alkali with the raw lubricating oil-containing stock and introducing this caustic alkali-lubricating oil stock mixture into the vapors in the said scrubbing operation and thereby vaporizing the lubricating oil components of the raw lubricating oil-containing stock in the scrubbing operation, subjecting the resulting vapor mixture escaping from the said scrubbing operation including the uncondensed components of the vapor mixture from the vapor phase cracking operation and the vaporized components of the lubricating oil stock introduced into the scrubbing operation successively to a fractionating operation and to a refluxing operation, condensing the vaporized lubricating oil components from the vapor mixture in the said fractionating operation and discharging this lubricating oil condensate from the said fractionating operation without permitting this discharged lubricating oil condensate to return to the said vapor phase cracking operation, condensing in the said refluxing operation vapors higher boiling than suitable as components of the desired low boiling product of the said vapor phase cracking operation and lower boiling than suitable as components of the lubricating oil condensate condensed in the said fractionating operation and supplying this reflux condensate from the said refluxing operation to the said vapor phase cracking operation, and discharging tar including tar components separated from the vapor mixture from the said vapor phase cracking operation and any residual components separated from the raw lubricating oil-containing stock introduced into the scrubbing operation and including any unconsumed caustic alkali and the solid or semi-solid reaction products of the caustic alkali from the said scrubbing operation without permitting this discharged tar to return to the said vapor phase cracking operation.

In testimony whereof we affix our signatures.

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