Nov. 24, 1931. A. E. PEW, JR 1,833,691

PROCESS FOR PREPARING CRUDE OIL FOR DISTILLATION INTO LUBRICATING OILS

Filed Dec. 22, 1926 2 Sheets-Sheet 1

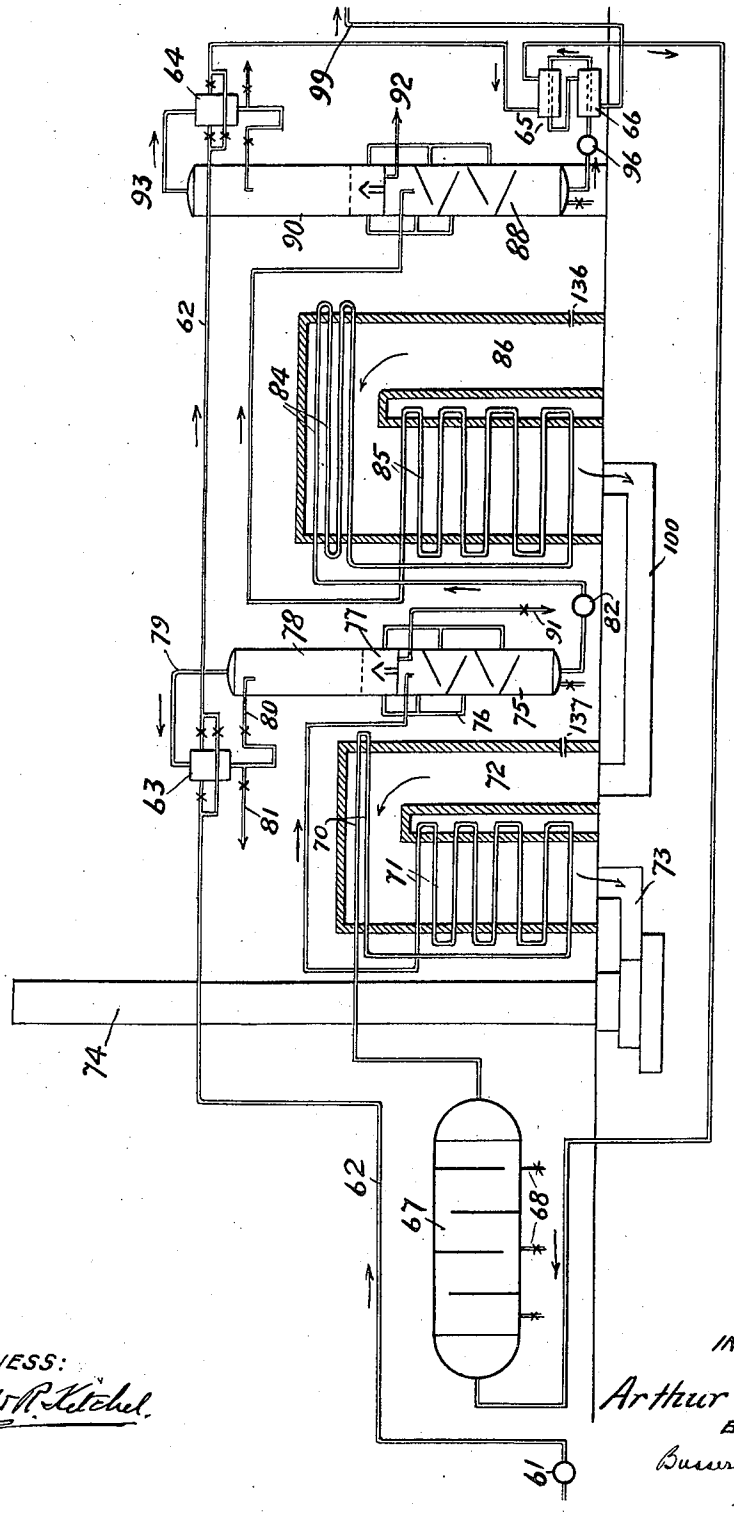


FIG. 1A.

WITNESS:
Robt R. Ketchel.

INVENTOR
Arthur E. Pew, Jr.
BY
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ATTORNEYS.

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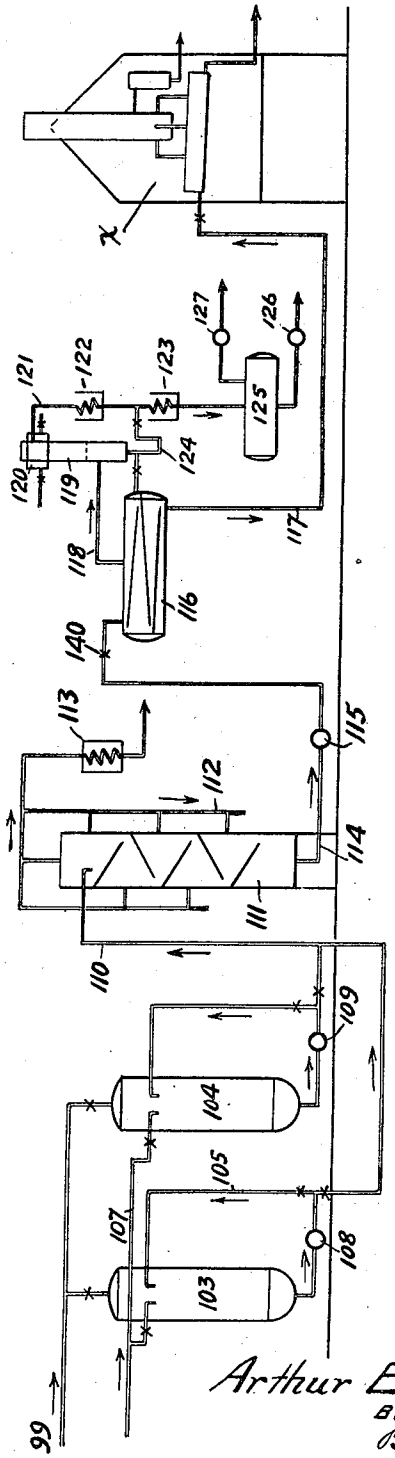


FIG. 1B.

WITNESS:
Robt. A. Kitchel.

INVENTOR
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Patented Nov. 24, 1931 1,833,691

UNITED STATES PATENT OFFICE

ARTHUR E. PEW, JR., OF BRYN MAWR, PENNSYLVANIA, ASSIGNOR TO SUN OIL COMPANY, OF PHILADELPHIA, PENNSYLVANIA, A CORPORATION OF NEW JERSEY

PROCESS FOR PREPARING CRUDE OIL FOR DISTILLATION INTO LUBRICATING OILS

Application filed December 22, 1926. Serial No. 156,287.

The object of this invention is to remove from crude oil its lighter fractions, principally gasoline and gas oil, in such manner as to adapt it for distillation into lubricating oils of the highest grade. A more specific object of the invention is to so "top" and otherwise treat crude oil that subsequent redistillation of the residual oil will not yield a fraction having a viscosity of less than 100 seconds Saybolt at 100° F. when such fraction is substantially more than three per cent. of the topped crude. Another object of the invention is to contribute to the accomplishment of the general object above mentioned by avoidance of cracking (this being essential to a subsequent maximum yield of high viscosity lubricating oils) and by avoidance of oxidation (this being necessary to the production of lubricating oils of good colors).

The objects are accomplished by the within process, which is characterized by topping at high velocities with short time intervals and at comparatively low temperatures (essential to avoidance of cracking) and under conditions that exclude the contact of air with the hot oil at any stage of the process; with such efficient fractionation and regulation and control of temperatures and pressures as enables the subsequent production, by distillation under proper conditions, of lubricating oils of high viscosities.

The within process is actually a part of a complete process of producing lubricating oils as set forth in an application filed January 8, 1927, Serial No. 159,754, which matured into Patent No. 1,761,153, on June 3, 1930; the production of lubricating oils of the very highest grade involving not merely novel features in the process of distilling the lubricating fractions, but also such pre-treatment and distillation of the crude oil as will provide a residual oil that is in the condition required for carrying on the lubricating oil distillation process. The complete process, as well as that part of the process which involves the distillation of the lubricating fractions, is claimed in said application; the present application being directed to only that part of the complete process which involves the topping and treatment of the crude oil preparatory to the production of lubricating oil.

It will, therefore, be understood that although the process herein claimed is adapted to the production of topped gasoline of high quality, the process is not primarily concerned with the production of gasoline or gas oil but with their separation from the crude oil in such manner as to produce a residual oil that is of very high grade and in the best possible condition for distillation into lubricating fractions. While it is believed that, in order to produce lubricating oils of the highest grade and of maximum yield, the residual oil produced by the process herein claimed must be processed in accordance with the lubricating oil distillation process set forth in said application, it will be understood that the residual oils produced by the process herein claimed may be subjected to any known distillation process and will result in the production of higher grade oils than will be produced by such known process applied to crude oils that have been topped by other processes than that herein described.

In order to facilitate a description of my improved process, I have designed an apparatus especially adapted to the carrying out of the process, the drawings (Fig. 1A and Fig. 1B) comprising a diagrammatic view thereof. The practice of the process is not dependent, however, on the employment of any particular apparatus. It should also be understood that many of the hereinafter described steps of the process are preferential merely.

Crude oil is pumped through pump 61 and line 62 through the tubes in reflux condenser 63. Here the crude is raised in temperature about 20° F. by heat exchange with the vapors from tower 78. The rise in tem-

perature will vary with the grade of crude and the amount of vapors coming off the towers. The heated crude, continuing its passage through line 62, goes to reflux condenser 64, where it is heated to (say) 140° F. by heat exchange with the vapors from tower 90. The crude then passes through heat exchanger 65, where it is in heat exchange relationship with residual oil, as hereafter described. Leaving this heat exchanger at a temperature of (say) 310° F., the crude then passes to a baffled tank 67 held under a pressure of (say) 100 pounds gauge. This tank is of such a size that the oil flows through at a velocity preferably not exceeding about 25 ft. per hour. At this velocity, and at the last mentioned temperature and pressure, the salt water contained in the crude, which may amount to about two per cent. or over, settles to the bottom of the tank, where it is drawn off through draw-off pipes 68. By removing the salt water, subsequent troubles due to salt deposit are eliminated, thus greatly simplifying the problem of continuously running the process with avoidance of frequent shutdowns for cleaning the tubes of the pipe stills. The removal of the salt also enables a better grade of asphalt (if the crude has an asphalt base) to be obtained at a final stage of the lubricating oil distillation process; such asphalt having superior solubility tests, i. e., containing a relatively small percentage of insoluble material.

The oil from tank 67 flows through the tubes 70 and 71 of a pipe still and thence into a vaporizer 75 at a temperature of (say) approximately 450° F. This pipe still may be of conventional design, fuel oil being burned through burner 137 in space 72, the products of combustion passing upwards over tubes 70, down over tubes 71, into flue 73, and thence up stack 74. In order to keep the gas temperature low in this furnace, the exhaust gases from pipe still 84—85 pass into the fire box 72 and are mixed with the products of combustion from burner 137. This results in great economy of operation, as it enables the hotter gases from pipe still 84—85 to give up their heat in pipe still 70—71. The flue gas temperatures in flue 73 are not above about 400° F.

The pressure in vaporizer 75 being substantially atmospheric, vapors are freed from the incoming oil as it travels down over the inclined plates. These vapors pass upwards through manifold 76, distributor section 77 and packed section 78, and out vapor line 79 into reflux condenser 63. In the latter, the vapors are condensed, the condensate being returned through line 80 to the tower, or through line 81 to storage, in such proportions as the operation of the tower requires; an increased amount being returned through line 80 when a lighter product through line 81 is desired and a decreased amount when a heavier product is desired. The reflux from section 78 is caught in section 77 and passes through line 91 to storage. The product through line 81 is light gasoline and the product through line 91 is an intermediate gasoline.

The residual or partially topped oil, which may be said to be a light mazout, leaving the bottom of vaporizer 75 passes through pump 82 and the tubes 84 and 85, where it is heated to approximately 590° F. At this temperature, it passes into vaporizing tower 88, which operates in a manner similar to vaporizer 75. The product from this vaporizer that leaves through line 93 is light gas oil, and that which escapes through line 92 is heavy gas oil.

The residual oil leaving the bottom of tower 88, which may be said to be an intermediate mazout, passes through pump 96 at a temperature of (say) 580° F. and through a heat exchanger 66, in which it is cooled to (say) 500° F. The mazout at this temperature then goes through heat exchanger 65, where it exchanges heat with crude oil as previously described. The mazout leaves this exchanger at about 360° F. and then goes through exchanger 66, wherein it is heated to about 480° F.

By this arrangement of exchangers, the mazout at its highest temperature does not directly heat the crude oil, but directly heats a more advanced part of the stream of mazout and then, at a reduced temperature (say 500° F.), heats the crude oil and becomes then, at a still further reduced temperature, the said more advanced part of the stream of mazout which is heated by the mazout at its highest temperature. The effect, from one viewpoint, is the same as if the hot mazout exchanged heat directly with the crude and thereby had its temperature reduced from (say) 580° F. to 480°; but the described more roundabout heat transfer avoids subjecting the crude to a temperature in excess of 500° F. I have found that if the crude is subjected to a temperature in excess of about 500° F., it so locally overheats the film of oil adjacent the heated surface of the passage through which the crude flows that a deposit of salt is formed in the exchanger on the crude oil side. By the indirect heat transfer described, this highly objectionable condition does not occur.

Leaving exchanger 66, the intermediate mazout passes through line 99 and into tank 103 or tank 104, in which tank it is mixed with approximately one per cent. of 38° Bé. soda. The soda is pumped into the tanks through line 107 and is therein thoroughly mixed with the oil by circulation through pumps 108 and 109. The provision of two tanks arranged as shown affords a convenient means of avoiding a break in the continuity of the process. The oil from line 99 is run

(say) into tank 103 until it is practically full, all the air in this tank having been expelled by steam. The soda is then admitted through line 107. A pressure of (say) 360 pounds gauge is immediately generated, due to the vapor pressure of the water in the soda at this temperature. Pump 108 is then started and the mixture of oil and soda circulated through line 105 back to the tank and through line 105 again. This operation should be continued for about ten minutes, or such other and usually longer time as may be required to give an intimate mixture of soda and oil and to enable the soda to neutralize any acidity that may be in the oil. As an excess amount of soda is preferentially used the mixture will be alkaline.

Having thus obtained the mixture, the valve on line 105 is shut and the mixture is pumped through line 110 to tower 111. The time of pumping out tank 103 is so arranged that the same time interval will enable a fresh charge to be treated in tank 104. Thereby a continuous feed may be obtained in line 110.

The mixture of soda and oil under pressure goes through line 110 to vaporizing tower 111, which is maintained at a substantially reduced—preferably atmospheric—pressure. Due to this reduction in pressure, enough specific heat is converted into latent heat to permit all the water which is in the soda that will boil at a temperature of 460° F. to be vaporized. It is desirable to remove this water to as great a degree as possible to enable a greater vacuum to be obtained in the subsequent distillation of the lubricating fractions. This object tower 111 successfully accomplishes.

It is difficult to get an intimate mixture between the oil and the soda when only a small proportion of the latter is added. However, in my process, I secure the advantage of a larger amount of liquid caustic soda, as it is mixed, in tanks 103 and 104, under such conditions of pressure and temperature that the water will not vaporize. Then, in tower 111, the water which would be highly objectionable at a later stage of the process is removed.

The steam generated in tower 111 passes upwards through manifolds 112 into condenser 113. The mazout and soda mixture passes out through line 114 and pump 115 through back-pressure valve 140 into tank 116, where the oil is flowed over vaporizing pans. This tank is maintained under a substantial vacuum, say of 28 inches. Due to the reduction in pressure from atmospheric, or about 15 pounds absolute, to about two pounds absolute, enough specific heat is converted into latent heat to enable all the gas oil left in the mazout from the topping process to be vaporized and pass out through line 118 into tower 119.

Due to the great velocities at which vapors form and leave the surface of the oil in the vaporizing pans of tank 116, some entrainment of heavier oil may occur. The reflux condenser 120 at the top of tower 119 permits, by temperature control, the lighter products to pass out through line 121 and throws the heavy products back down into trap 124, from which, should the entrainment be particularly objectionable, the heavier products flow back to the vaporizer; or, should the entrainment not be objectionable, such heavier products flow into a cooler 123, where it mixes with the overhead distillate flowing through line 121, condenser 122 and cooler 123 into receiving tank 125. A vacuum is maintained on this tank by means of vacuum equipment 127. The oil is pumped from tank 125 by means of pump 126.

The oil leaving tank 116 through line 117 is now in condition to be subjected to fractional distillation for the production of lubricating distillates and high grade asphalt. The part of the complete process carried out in the lubricating oil distillation apparatus, which is shown diagrammatically and lettered *x*, need not be herein described, since it forms no part of the invention herein claimed and may be replaced by any suitable distillation plant. The plant *x* is fully described in the hereinbefore mentioned application as well as in an earlier application filed by me May 29, 1926, Serial No. 112,485 which matured into Patent No. 1,761,151, on June 3, 1930.

It will be noted that at no stage of the described process is the oil raised to a substantial cracking temperature, and that air is excluded throughout the entire process. There can thus be formed neither those decomposition products that are formed, by cracking, when oil is exposed to high temperatures for a substantial length of time, nor those oxidation products that are formed at a lower temperature when distillation occurs under conditions that do not exclude the presence of air. The fractionations are efficient, temperature and pressure conditions are carefully and accurately controlled, and the process may be so conducted that the lightest substantial fraction of oil that is distilled in the process following that herein claimed will have a viscosity of over 100 seconds Saybolt at 100° F.

Having now fully described my invention, what I claim and desire to protect by Letters Patent is:

1. In the process of preparing crude oil for distillation of lubricating fractions, distilling off low boiling constituents at a temperature below that at which substantial cracking occurs while excluding access of oxygen and then, without substantial application of heat and while substantially excluding access of oxygen, subjecting the re-

sidual oil to a sufficiently lower and subatmospheric absolute pressure to distil off higher boiling point constituents and leave a residual product containing the desired lubricating fractions.

2. In the process of preparing crude oil for distillation of lubricating fractions, distilling off low boiling constituents at a temperature below that at which substantial cracking occurs, then, adding an alkali solution to the residual oil and then, without substantial application of heat and at a temperature below that at which substantial cracking occurs, subjecting the oil to sufficiently low absolute pressure to evaporate off solvent introduced with the alkali and distil off higher boiling point constituents of the oil and leave a residual product containing the desired lubricating fractions, and substantially excluding access of oxygen throughout the process.

3. In the process of preparing crude oil for distillation of lubricating fractions, subjecting the oil to a superatmospheric pressure and mixing an alkali solution with the oil, then substantially reducing the absolute pressure on the thus treated oil while evaporating off most of the solvent introduced with the alkali and then subjecting the residual oil to a substantial vacuum while effecting partial vaporization of hydrocarbons leaving a residual product containing the desired lubricating fractions.

4. In the process of preparing crude oil for distillation of lubricating fractions, distilling off low boiling constituents at a temperature below that at which substantial cracking occurs, then mixing an alkali solution with the residual oil, then evaporating off solvent introduced with the alkali and without substantial application of heat subjecting the oil to a sufficiently low subatmospheric pressure to distil off higher boiling point constituents and leave a residual product containing the desired lubricating fractions, and substantially excluding access of oxygen throughout the process.

5. In the process of preparing crude oil for distillation of its lubricating fractions, separating lighter hydrocarbons in a substantially uncracked condition, then mixing an alkali solution with the residual oil, then evaporating off solvent introduced with the alkali without substantial application of heat and at a pressure substantially above that hereinafter specified, and then subjecting the oil to such substantially reduced subatmospheric pressure and to such temperature as to effect the vaporization of hydrocarbons heavier than those previously separated, leaving a residual product containing the desired lubricating fractions.

6. In the process of preparing crude oil for distillation of lubricating fractions, distilling off low boiling constituents at a temperature below that at which substantial cracking occurs, mixing an alkali solution with the residual oil, evaporating off solvent introduced with the oil while maintaining the oil under an absolute pressure substantially above that hereafter specified, and then, without substantial application of heat and while subjecting the oil to a substantial vacuum, effecting vaporization of higher boiling constituents of the oil, leaving a residual product containing the desired lubricating fractions.

7. In the process of preparing crude oil for distillation of lubricating fractions, distilling off low boiling hydrocarbons at a temperature below that at which substantial cracking occurs, mixing an alkali solution with the residual oil, evaporating off, without substantial application of heat, solvent introduced with the alkali, reducing the absolute pressure on the oil so far below atmospheric pressure as to effect vaporization of heavier hydrocarbons without substantial application of heat, and leave a residual product containing the desired lubricating fractions, and substantially excluding access of oxygen to the oil during the specified series of operations.

8. The process of preparing crude oil for distillation of lubricating fractions, which comprises subjecting the oil to a first vaporizing operation by applying extraneous heat to effect vaporization of relatively light hydrocarbons, adding to the residual oil an alkali solution and subjecting the oil to such superatmospheric pressure that the later vaporizing operations hereinafter specified may be effected without substantial application of extraneous heat by successive drops in pressure, subjecting the oil to a second vaporizing operation under a substantially reduced absolute pressure and so distributing the oil and so regulating said pressure drop as to effect evaporation of the alkali solvent, and subjecting the residual oil from the second vaporization to a third vaporizing operation under still further reduced absolute pressure and so regulating the pressure drop and the temperature as to effect evaporation of relatively heavy hydrocarbon constituents and leave a residual product containing the desired lubricating fractions.

9. The process of preparing crude oil for distillation of lubricating fractions, which comprises establishing a flowing stream of oil and in the course of its flow removing salt water from the oil under superatmospheric pressure, applying heat to the so purified oil and distilling off lighter hydrocarbons, transferring heat from the residual oil to the oil flowing toward the locus of salt water removal, adding an alkali solution to the cooled residual oil, distributing the oil so treated over a surface of large area and under such

absolute pressure as to allow evaporation of solvent introduced with the alkali, and then distributing the oil over a surface of large area while subjecting the oil to such reduced and sub-atmospheric pressure as to effect evaporation of hydrocarbon constituents which are higher boiling than those initially distilled off and leave a residual product containing the desired lubricating fractions.

10. In the process of preparing crude oil for distillation of lubricating fractions, removing salt water, distilling off low boiling constituents by the application of heat below a temperature adapted to effect cracking, adding an alkali solution to the residual oil, removing the alkali solvent, and then subjecting the residual oil, without substantial application of heat and at a temperature not above that acquired in the first mentioned distillation, to a subatmospheric absolute pressure sufficiently low, at such temperature to distil off higher boiling constituents of the oil and leave a residual product containing the desired lubricating fractions.

11. In the process of preparing crude oil containing salt water for distillation of lubricating fractions, establishing a flowing stream of relatively cool oil containing salt water, heating the oil in said stream by heat exchange at one locus with the residual oil stream hereinafter specified, substantially removing the salt water, distilling off lighter fractions under heat conditions producing a residuum at a temperature substantially in excess of 500° F., establishing a flowing stream of residual oil, cooling the oil in the residual stream at a second locus by heat exchange with a more advanced part of the residual stream and thereby reducing its temperature to not substantially above 500° F., further cooling said cooled residual oil at the first locus by the hereinbefore specified heat exchange with the oil in the first stream, and reheating the thus cooled residual oil at the second locus by the hereinbefore specified heat exchange with a less advanced part of the residual oil stream; whereby the oil in the first stream is heated sufficiently to enable the salt water to be subsequently substantially removed while it is not heated sufficiently to overheat any part of the oil to form a salt deposit in the exchanger.

12. In the process of preparing crude oil for distillation of lubricating fractions, distilling off low boiling constituents at a temperature below that at which substantial cracking occurs and then, at a temperature not above that of said distillation of lower boiling fractions, but under a high vacuum, distributing the residual oil over a surface of large area and evaporating therefrom higher boiling constituents, leaving a residual oil product containing the desired lubricating fractions, and substantially excluding access of oxygen throughout the process.

13. In the process of preparing crude oil for distillation of lubricating fractions, distilling off low boiling constituents at a temperature below that at which substantial cracking occurs and then, at a temperature substantially below that at which lower boiling fractions are distilled off, distilling off higher boiling fractions, leaving a residual product containing the desired lubricating fractions, the last mentioned distillation being conducted under a vacuum sufficiently high to more than compensate for the reduction in temperature and substantially excluding access of oxygen throughout the process.

14. In the process of preparing crude oil for distillation of lubricating fractions, distilling off low boiling constituents at a temperature below that at which substantial cracking occurs and then, at a temperature substantially below that at which lower boiling fractions are distilled off, distributing the residual oil over a surface of large area and evaporating therefrom higher boiling constituents, leaving a residual product containing the desired lubricating fractions, the last mentioned distillation being conducted under a vacuum sufficiently high to more than compensate for the reduction in temperature and substantially excluding access of oxygen throughout the process.

15. In the process of preparing crude oil for distillation of lubricating fractions, distilling off low boiling hydrocarbons at a temperature below that at which substantial cracking occurs, transferring heat from the residual oil to the oil flowing toward the locus of said distillation and then, at a temperature substantially below that of said distillation, distributing the residual oil over a surface of large area and under such high vacuum as to cause, notwithstanding the reduced temperature, evaporation of hydrocarbon constituents which are higher boiling than those initially distilled off, leaving a residual product containing the desired lubricating fractions.

16. In the process of preparing crude oil for distillation of lubricating fractions, distilling off low boiling hydrocarbons at a temperature below that at which substantial cracking occurs, then adding an alkali solution to the residual oil, and then, while the residual oil is at a temperature not above that of said distillation, distributing the residual oil so treated over a large area and under such absolute pressure as will effect evaporation of solvent introduced with the alkali and leave a residual product containing the desired lubricating fractions.

17. In the process of preparing crude oil for distillation of lubricating fractions, distilling off low boiling hydrocarbons at a temperature below that at which substantial cracking occurs, then adding an alkali solu-

tion to the residual oil, then evaporating solvent introduced with the alkali, and then, at a temperature substantially below that of the distillation of said low boiling hydrocarbons, distributing the oil so treated over a surface of large area and under such high vacuum as to cause evaporation of hydrocarbon constituents which are higher boiling than those initially distilled off and leave a residual product containing the desired lubricating fractions

18. In the process of preparing crude oil for distillation of lubricating fractions, distilling off low boiling hydrocarbons at a temperature below that at which substantial cracking occurs and separating said low boiling hydrocarbons from higher boiling hydrocarbons containing the desired lubricating fractions, then adding an alkali solution to the higher boiling hydrocarbons while in liquid phase and at a temperature not above that of said distillation and distributing said higher boiling hydrocarbons so treated over a large area under such absolute pressure as will effect evaporation of solvent introduced with the alkali and leave a residual oil containing the desired lubricating fractions.

19. In the process of preparing crude oil for distillation of lubricating fractions, distilling off low boiling hydrocarbons at a temperature below that at which substantial cracking occurs and separating said low boiling hydrocarbons from higher boiling hydrocarbons containing the desired lubricating fractions, then adding an alkali solution to the higher boiling hydrocarbons while in liquid phase and at a temperature not above that of said distillation and distributing said higher boiling hydrocarbons so treated over a large area under such absolute pressure as will effect evaporation of solvent introduced with the alkali and then distributing the residual oil over a surface of large area under such reduced and subatmospheric pressure as will effect evaporation of lower boiling constituents of the residual oil and leave a residual product constituting the desired lubricating oil stock.

20. The method of distilling petroleum which comprises subjecting it to distillation continuously by passing it through a pipe coil and heating it therein to a temperature sufficient to vaporize considerable proportions of the oil contained in the petroleum, discharging the resulting product into a vapor separating chamber at approximately atmospheric pressure with resulting production of distillate oils and a residual oil, withdrawing the residual oil and reducing the pressure on the residual oil by subjecting it to a high vacuum while it is still at a sufficiently high temperature to effect distillation of additional oils therefrom.

21. The method of distilling petroleum which comprises forcing the petroleum continuously under pressure through a pipe coil and heating it therein to a temperature sufficient to vaporize considerable proportions of the oil contained in the petroleum, discharging the resulting product into a vapor separating chamber at approximately atmospheric pressure and thereby effecting separation of oil vapors from residual oil, drawing off the oil vapors and subjecting them to condensation to recover distillate oils therefrom, drawing off the hot residual oil and subjecting it to a high vacuum while it is still at a high temperature and thereby effecting further distillation of oils therefrom with reduction of temperature, condensing the distillates produced by such vacuum distillation, and separately drawing off the residual oil from such vacuum distillation.

22. The method of distilling petroleum which comprises subjecting petroleum to distillation continuously by passing the petroleum through a pipe coil and heating it therein to approximately the maximum temperature to which it can be heated without objectionable decomposition and discharging the heated product into a vapor separating chamber at approximately atmospheric pressure, withdrawing the vapors produced by such distillation and condensing the oils therefrom, withdrawing the residual oil from such distillation and subjecting it to a high vacuum while it is still at a high temperature and thereby effecting further distillation of oils therefrom without objectionable decomposition of the residual oil, and separately condensing the distillates so produced.

23. The method of distilling petroleum which comprises first subjecting petroleum to distillation at substantially atmospheric pressure to produce distillate oils and a residual oil by heating it in a pipe coil to a temperature sufficient to vaporize considerable proportions of the oil contained in the petroleum, discharging the resulting product into a vapor separating chamber at approximately atmospheric pressure, separately collecting and condensing the oil vapors thus produced and withdrawing the residual oil continuously while it is still at approximately the temperature of the first distillation and subsequently subjecting it to a high vacuum to effect further distillation of high boiling point oils therefrom by the self-contained heat of the hot residual oil.

24. In the process of preparing crude oil for distillation of lubricating fractions, distilling off low boiling hydrocarbons at a temperature below that at which substantial cracking occurs and separating said low boiling hydrocarbons from higher boiling hydrocarbons containing the desired lubricating fractions, then adding an alkali solution to the higher boiling hydrocarbons while in liquid phase and at a temperature not above that of said distillation and distributing said

higher boiling hydrocarbons so treated over a large area under such absolute pressure as will effect evaporation of solvent introduced with the alkali and of such oil fractions as evaporate at such pressure and temperature and leave a residual oil containing the desired lubricating fractions.

In testimony of which invention, I have hereunto set my hand, at Philadelphia, Penna., on this 15th day of December, 1926.

ARTHUR E. PEW, JR.