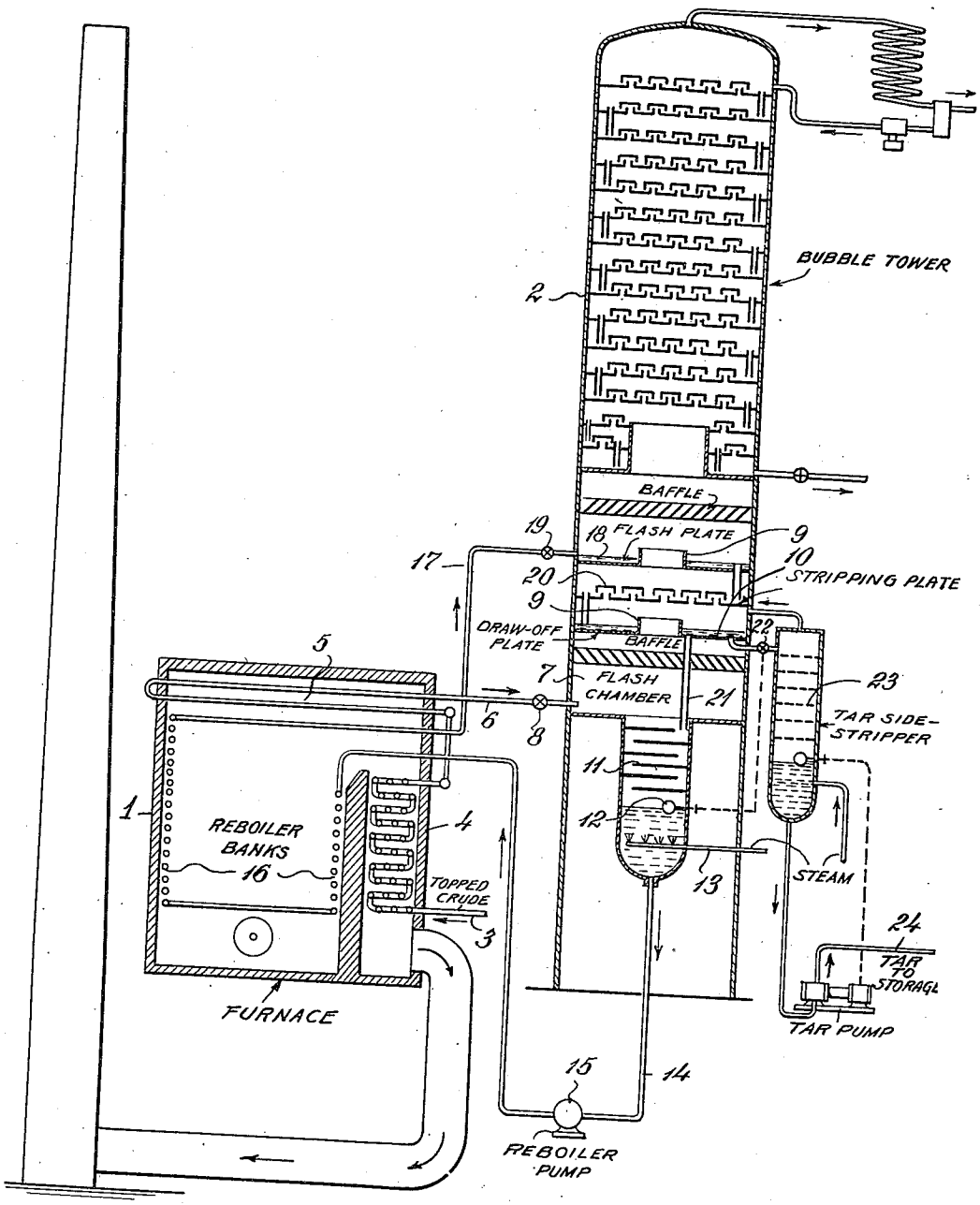
June 29, 1937.

F. L. FAST

2,085,422

METHOD OF DISTILLING OILS

Filed Dec. 4, 1935



Fred L Fast
INVENTOR

BY Neyon J Burkhard
ATTORNEY

Patented June 29, 1937 2,085,422

UNITED STATES PATENT OFFICE

2,085,422

METHOD OF DISTILLING OILS

Fred L. Fast, Woodbury, N. J., assignor to Socony-Vacuum Oil Company, Incorporated, New York, N. Y., a corporation of New York

Application December 4, 1935, Serial No. 52,755

4 Claims. (Cl. 196—73)

This invention relates to methods of distillation of the heavier fractions of crude petroleum oils.

Considerable difficulty is encountered in obtaining full yields of the heavier viscous distillates, particularly from crudes of a mixed base or asphaltic base nature in which the oils heavier than those whose recovery is desired are of an asphaltic nature. Batch fractional distillation, by shell stills or other methods taking narrow vapor cuts at increasing temperature levels are objectionable, even when carried out under vacuum, because of the combination of temperature and time elements of such a nature as to lead to serious decomposition of the desired fractions. Flash distillations, with or without steaming, at atmospheric pressure or under vacuum, are effective insofar as they are able to reduce exposure to conditions which promote decomposition, but since the heat for the vaporization of desired constituents must come from the sensible heat of the flash stream, vaporization occurs in a region of rapidly falling temperature, and dangerously high heat levels are necessary to attain good recovery, these heat levels often resulting in damage to the stock distilled, even under high vacuum and/or in the presence of considerable steam. It has been proposed to accomplish the supply of sufficient heat at a sufficiently high level to give desired vaporization by recirculation of residuum through the heater in company with the charge. Even this has not been able to accomplish the desired purpose in some instances, and resort has been had to adding a light volatile material of the nature of gas oil or kerosene to the charge oil entering the heater in order to take advantage of its carrying effect in the subsequent vaporization. The addition of this material adds to the heat load necessary to accomplish a given distillation, and its separation and recovery calls for additional fractionation and condensing equipment.

The object of this invention is to reduce the temperature level which must be carried to accomplish a desired vaporization of heavy distillates, without including in the charge of oil to be heated a carrier material of nature widely differing from that which it is desired to recover in the particular distillation step. A further object is to obtain a proper additional carrying effect of vapors lighter than the heaviest oil recovered as distillate, without introducing to the distillation system an oil which is foreign in nature to the oils handled therein, and without the expenditure of additional heat to create those lighter vapors.

It is a feature of this invention that an oil comprising a "long residuum", i. e. containing some gas oils, light and heavy lubricants, and whatever asphaltic residual matter is present in the crude, is first subjected to flash distillation to remove the greater portion of the desired material as vapors. The remainder, stripped of the greater proportion of vaporizable fractions, but at a lowered temperature due to the loss of heat absorbed by vaporization of the lighter fractions, is circulated through a heater to regain temperature and vaporized in such a way that advantage is taken of the carrying effect of the vapors previously formed. The reheated oil, now carrying a much smaller proportion of vaporizable to non-vaporizable material, will not lose as much temperature on flashing as the original mixture. The higher temperature thus prevailing is conducive to the vaporization of fractions of higher boiling point than vaporizable by the first flashing.

It is a further feature of this invention that the sensible heat carried by the residue of this second vaporization step is further used to impart heat to the cooler residue of the first vaporization step, which heat is imparted and dissipated with a minimum time element, thereby securing maximum vaporization with high heat economy and a minimum of decomposition.

It is a further feature of this invention that the final temperature of the residue of the second flashing step may be controlled by controlling the proportion of vaporizable to non-vaporizable materials present in the stream before the secondary vaporization occurs.

It is a further feature of this invention that vapors of similar nature, destined for commingling in the same final product, but originating in separate vaporization operations, are so handled that they may be fractionated and condensed together, resulting in marked economies of equipment for a given recovery of distillate.

Other features of the invention consist of certain novel modes of operation hereinafter described and particularly defined in the claims.

This invention is herein described as being pertinent to the recovery of heavy lubricating stock from the asphaltic residue of a mixed base crude. It is not limited to such use, but may be used for the separation of oils of high boiling point whether the residue be asphaltic or not, as well as for other uses hereinafter pointed out.

The vaporization steps of this invention may

be carried out at atmospheric pressure, or under vacuum, and in the presence or absence of steam. In general, it is more applicable to those processes where vacuum and/or steam are made use of to permit distillation at lower temperatures, and when so applied it will permit the performance of a desired distillation at a given maximum temperature with less vacuum and/or steam. With set limits of temperature and of vacuum and/or steam, it will permit the recovery of greater amounts of distillate for a given heat input.

This invention, as directed to the recovery of heavy lubricating oil distillates, is operated upon topped crude oil. That is, the charging stock to the distillation process is a crude oil from which gasoline, kerosene, and more or less gas oil have already been removed by a process of distillation as a step in preparation for the process of this invention. This topped crude, if from a mixed base oil, to which this invention is most applicable, will contain, in addition to the light and heavy lubricants which are desired, an asphaltic material to be rejected as residue and more or less gas oil lighter than the desired lubricant fractions. It may contain only the amount of gas oil normally recovered with and considered a part of the wax distillate cut, or it may contain more than that amount if desirable for its carrying effect in flash vaporization.

In order that this invention may be more thoroughly understood, reference is made to the drawing which is attached to and made a part of this specification. The single figure of this drawing shows in diagrammatic form an apparatus suitably equipped for carrying out this invention.

In the drawing, 1 designates a furnace or pipe still heater, and 2 the lower portion of a fractionating tower. Topped crude oil charge, under pump pressure, enters the furnace 1 through inlet 3 and passes through convection coils 4 and roof coils 5, to leave through transfer line 6, entering fractionating tower 2 in flash chamber 7. If desired a back pressure may be held upon the heating coil by control of valve 8. Upon entry of the heated topped crude to the flash chamber 7, a considerable portion, determined by the temperature in transfer line 6 and the nature of the charge, will vaporize, and rise through chimney 9 past drawoff plate 10, to continue upward through tower 2. Unvaporized residue will pass downward through baffles 11 to storage space 12, into which steam is led through pipe 13. This steam in passing through the oil in 12 and upward in contact with the oil passing baffles 11, will exert a stripping action thereon. This much of the operation is substantially identical with prior practice. As explained, due to conditions of heat drop in chamber 7 and across baffles 11, it is difficult to get complete vaporization of heavy lubricant fractions, even with the aid of steam from 13, without unduly high temperatures in transfer line 6.

In practice according to this invention, no attempt is made to get complete vaporization by means of high heat level in transfer line 6. Instead, residue from 12 is withdrawn through pipe 14 by pump 15, forced through coils 16 placed on the walls of the combustion chamber of the furnace 1, and delivered through transfer line 17 to flash plate 18 located in tower 2 above flash chamber 7. If desired back pressure may be held on this heating cycle by control of valve 19. Additional vaporization will take place on flash plate 18, and the oil not thereon vaporized will drop through one or more stripping plates 20, where it is contacted with light vapors from the first vaporization, collect on drawoff plate 10 and pass through tube 21 and over baffles 11 to storage space 12. The operation of this cycle is so conducted that the amount handled by pump 15 and heated per unit of time is much greater than the amount of residue from crude unvaporized in 7 during the same unit of time. That is, there is a continuous circulation of completely stripped asphaltic residue through 15, 16, 17, 18, 20, 10, 21, 12 to which is added a small amount of fresh incompletely stripped residue from chamber 7.

The present invention is an advance over prior practice in several very important respects.

Heavy oil fed to flash plate 18 contains enough heat storage medium so that such vaporization as occurs there is without substantial lowering of temperature. Heavy oil leaving flash plate 18 is at a high temperature, and is immediately contacted, at stripping plate 20, with light vapors and steam from flash chamber 7, and by them further stripped. The stripping action so accomplished is of sufficient magnitude so that for a certain temperature in transfer line 17, a much lower proportion of heat-carrying medium will give an equivalent vaporization, or with the same proportion of heat carrier, a lower temperature may be used. At the temperature levels necessary for vaporization of oils of this nature, even small differences of temperature are of major importance.

As a second feature of very considerable economic importance, all vapors pass together into the upper portion of tower 2, which is equipped with fractionation equipment of any type suitable, the functioning of which has nothing to do with this invention, and which is here omitted for simplicity.

The heavy, unvaporized hot oil from flash plate 18, after passing through and being stripped on stripping plate 20, collects on drawoff plate 10. That portion of it which is desired to be recovered as residuum is drawn through pipe 22 for removal from the system. If desired, this oil may be further concentrated by use of a stripping tower of the usual sort 23, from which final tar product is withdrawn to storage through pipe 24. The oil passing from drawoff plate 10 through pipe 21 has a further very useful duty to perform. It is at a much higher temperature than the residue from flash chamber 7, and is immediately mixed with that residue, and passes with it over baffles 11 in contact with steam from 13. In this manner, a source of heat at a useful high level is available for the stripping of the otherwise rapidly cooling residue from flash chamber 7. And, most important, that heat is available at a level which will not cause decomposition of valuable constituents in the residue from flash chamber 7.

Taken together, the new concepts present in the sequence of operations disclosed herein permit of recovering an equal amount of distillate with less demand for heating fuel, vacuum and steam than heretofore found possible, and at the same time subject that distillate to less rigorous conditions of temperature and time tending toward decomposition. Conversely, they permit of a greater recovery of distillate for the same expenditure of energy and risk of deterioration.

This method of operation is equally applicable to any problem of distillation confronted by a

maximum temperature limitation combined with a requirement for maximum yields. As an example of one such application, the finishing distillation of treated pressure distillate may be noted.

I claim:

1. The method of distilling an oil susceptible to decomposition effects above a certain temperature to obtain therefrom a full yield of uncracked distillate products which comprises the following steps: heating the oil in a confined stream to a temperature near, but substantially below its cracking temperature level, passing it to a vaporizing step and separating vapors from liquid oil, mixing the liquid oil with a hydrocarbon heat carrier which is at a higher temperature still below the cracking temperature level of constituents of the first oil, contacting the mixture with steam to cause vaporization of a further portion of the liquid oil, heating the mixture in a second confined heating stream to a temperature close to the cracking temperature level of constituents of the first oil, passing the heated mixture to a vaporizing step to separate vapors and leave a residuum, contacting the residuum with vapors and steam from the first vaporization to effect removal of a final portion of vapor therefrom, removing a portion of residue from the system, and mixing the remainder with liquid oil from the first vaporization as a heat carrier therefor.

2. The method of claim 1 in which the vaporization and stripping steps are conducted under reduced pressure.

3. The method of claim 1 in which the proportion of heat-carrying residue added to liquid oil from the first vaporization is sufficiently great so that no substantial drop in temperature occurs during the second vaporization.

4. The method of recovering a full yield of uncracked lubricating distillate from a mixed base crude oil without subjecting the oil to temperatures sufficiently great to cause substantial loss of the lubricant oil fraction by decomposition which comprises the following steps: heating a long residuum in a confined stream to a temperature sufficient to cause vaporization of a substantial portion of the lubricant distillate, flashing the heated oil to separate vapors from liquid oil, admixing the liquid oil with asphalt which is at a higher temperature, contacting the mixture with steam to vaporize further lubricating distillate, heating the mixture in a second confined stream to a temperature high enough to vaporize substantially all the remaining lubricating distillate, this temperature being higher than that of preceding heatings, but not sufficiently high to bring about substantial cracking of unvaporized constituents of the long residuum, flashing the heated mixture to separate lubricating distillate vapors and a residual asphalt, contacting the residual asphalt with vapors and steam from the first vaporization to insure complete stripping of lubricating distillate therefrom, removing a portion of the asphalt from the system, and mixing the remainder with the liquid oil from the first vaporization as a heat carrier therefor.

FRED L. FAST.