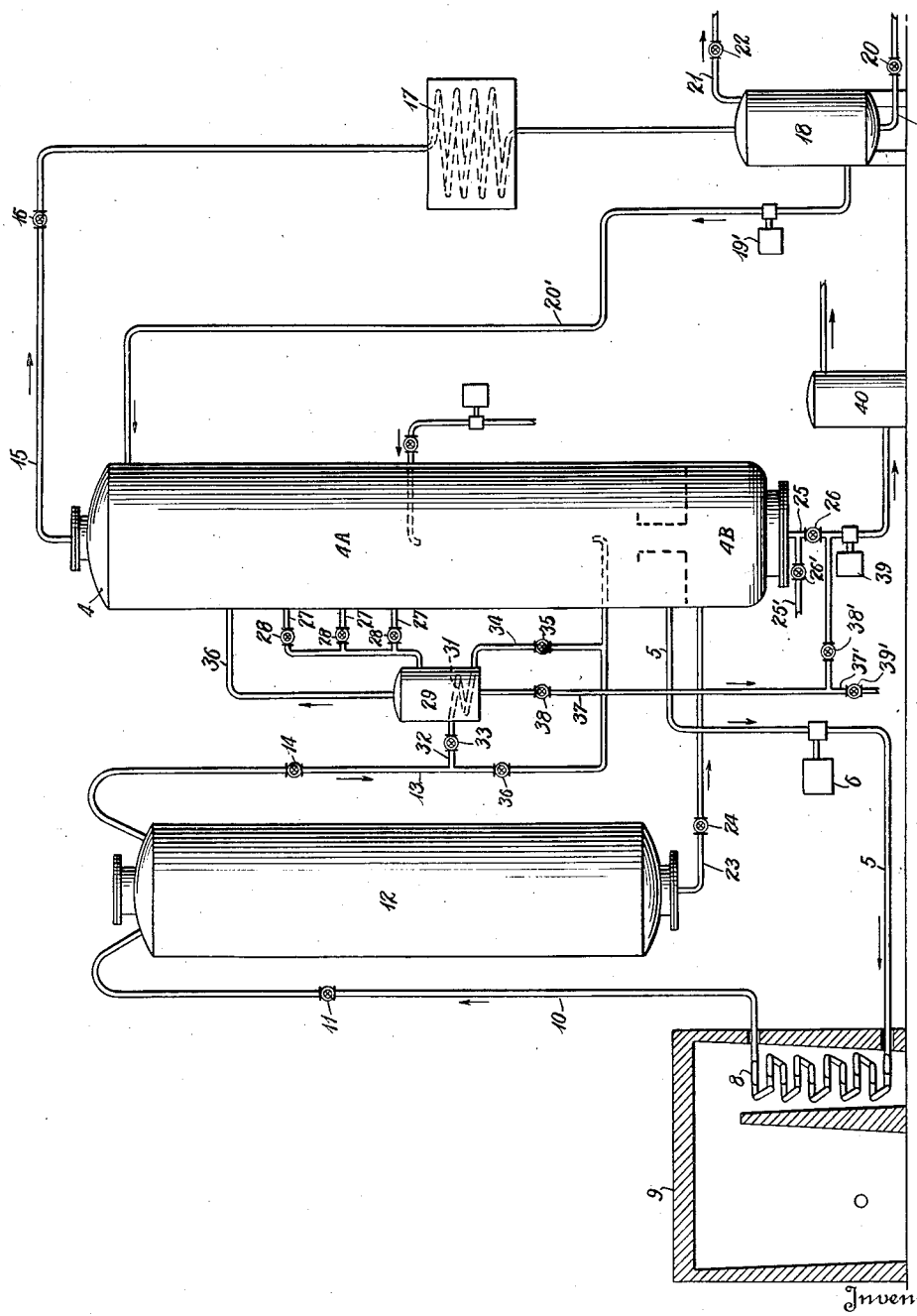
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PROCESS FOR CRACKING HEAVY HYDROCARBON OILS

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PROCESS FOR CRACKING HEAVY HYDROCARBON OILS

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This invention relates to an improvement in a process for the cracking or conversion of heavy hydrocarbon oils into lower boiling products suitable for motor fuels.

In a process in extensive commercial use for cracking hydrocarbon oils one step consists in withdrawing the residual oil from the reaction zone and by reduction in pressure permitting a portion of it to vaporize in a flash chamber. This procedure allows a larger amount of stock to be returned to the cracking system and permits larger yields of lower boiling point hydrocarbons. The quality of the fuel oil residue is also greatly improved by this method of operation.

The extent to which the flashing or vaporization of the fuel oil is carried on depends upon several factors, such as the transfer temperature from the heating coil to the reaction zone; the reduction of pressure between the reaction zone and the flashing zone and finally, the character of the residuum itself.

The extent to which it is desirable to flash and obtain increased recovery of the so-called recycle stock, made possible by flashing off the lighter portions of the residuum withdrawn from the reaction zone, is dependent largely upon the character of the fuel oil which can be used or marketed. Usually this fuel oil must have a viscosity which permits flow through fuel lines and it must have a low B. S. content, i. e. suspended matter. It is obvious that the maximum yields of gasoline are only possible when the largest proportion of the raw oil is converted into lighter hydrocarbons. On the other hand, the extent of possible conversion is a function of the quality of the fuel oil; that is, if too much of the lighter constituents are vaporized from the residuum by flashing or other means in order to obtain a maximum yield of gasoline, the remaining fuel oil or residuum becomes so heavy that it is difficult to handle and sell.

I have discovered that I may vaporize a very large proportion of the residuum from the reaction zone and replace the rather heavy distillates taken off by a very much smaller quantity of a very light refractory stock withdrawn from the system in order to give the flashed residuum the proper characteristics for a marketable fuel oil. This constitutes one of the features of my invention. By this expedient I am able not only to obtain maximum yields of gasoline and a marketable fuel oil, but I am permitted to withdraw from the system a refractory stock which is exceedingly difficult to recrack and often desirable to remove from the system. Further, it improves the character of the stock undergoing cracking.

In commercial cracking operations employing the flashing system, the percentage of vaporization which controls the viscosity of the fuel oil from the process is usually limited by the transfer temperature, since the degree of flashing is a function of the self-contained heat of the residuum and bears a direct relation to the transfer temperature.

As the capacity of the plant is usually increased by high transfer temperatures, and it is desirable to employ them, nevertheless, they normally result in a fuel oil too viscous for the market. Of course, the extent of vaporization of the residuum on flashing may be controlled to give a desirable quality of fuel oil, even with high transfer temperature by increasing the pressure on the flash chamber. It will be understood, however, that in so doing the yield of gasoline will be substantially reduced below the maximum possible by employing my invention.

It should be pointed out that as one of the features of my method of operation, the blending of the light distillate with the flashed residuum is to take place before passing to storage, whereby a better solvent effect is realized than if distillate is blended with the heavy flashed residuum after withdrawal from the cracking unit. In many instances if the latter procedure is followed, the B. S. content of the resultant fuel oil will be objectionably high, whereas if the blending takes places in the system, as I contemplate, the fuel oil will be of good quality.

Referring to the figure, which is a diagrammatic side elevational view of a form of apparatus suitable for carrying out my process, the operation will be obvious to those skilled in the art.

Raw oil is introduced by means of pump 1 to line 2 and valve 3 into combination tower and flash chamber 4 wherein it aids in condensation of insufficiently converted oil, and together with the reflux condensate flows down to the bottom of a section 4A of tower 4, out through line 5, hot oil pump 6 to coil 8. This coil is located in any suitable furnace 9, capable of heating the oil to the desired temperature. The heated oil passes out through line 10, controlled by valve 11, into reaction chamber 12. Vapors from the latter pass out through line 13, controlled by valve 14, and into the lower part of section 4A of tower 4, thru valve 36, then through the upper part of tower 4 and out through line 15, controlled by valve 16, to condenser coil 17. Section 4A may be the bubble type of fractionating column or a combination of bubble trays and pans or any other suit-

able fractionating device. The condensate and uncondensible gas pass into receiver 18 and the condensate may be withdrawn through line 19 and valve 20; a portion of the condensate may be recirculated to the top of tower 4 by means of pump 19' and line 20',—the uncondensable gas may be withdrawn through line 21 and valve 22, which may be used to control the pressure on the system.

The unvaporized oil from reaction chamber 12 passes out through line 23 and valve 24 whereby the pressure may be substantially reduced and the vapors separated from the flashed residuum in the bottom section 4B of combination tower 4. This section is sometimes known as a flash chamber. The flashed residuum will be withdrawn through line 25, controlled by valve 26, and blended with distillate to suitable characteristics, such as viscosity, etc., the blend of distillate and residuum passing through pump 39 into blending tank 40, or the residuum may be withdrawn through line 25' and valve 25' and passed direct to storage after cooling.

The flashed residuum, if withdrawn directly from the flash chamber, would normally have too high a viscosity to make a suitable fuel oil and must be blended with a lighter non-viscous oil from the plates or pans of the fractionating or dephlegmation section 4A of tower 4. This liquid may be withdrawn through lines 27, controlled by valves 28, and run through reboiler 29, the vapors from which will pass out through line 30, back to an upper part of fractionating or dephlegmating section 4A of tower 4. In the bottom of reboiler 29 is placed a coil 31 for the purpose of supplying heat for reboiling the distillate. This coil may be connected with line 13, and by means of line 32, valve 33, and also by line 34 and valve 35. It will be seen that by controlling valves 33, 35 and 36, that the vapors from the reaction chamber may be passed in any desired proportion of the total vapors through coil 31 to supply the heat for reboiling. The reboiled distillate will pass out through line 37, controlled by valves 38 and 38' into pump 39 and blending tank 40 or it may be withdrawn for other purposes through line 37' controlled by valve 39'.

A plurality of lines 27 and valves 28 are provided in order that the proper quality of distillate may be removed from the section 4A of tower 4. This distillate withdrawn from the section 4A for fuel blending purposes may be a very refractory stock in which case it may be desirable to remove it from the cracking system as it quite materially lowers the capacity of the plant if allowed to remain in.

In the operation of the process just described, a differential pressure may be carried between the coil 8 and reaction chamber 12 by manipulation of valve 11. The pressure carried on the reaction chamber 12 will be controlled by valve 14 and a substantial reduction in pressure will take place at this point. Substantially atmospheric pressure, or a relatively low pressure e. g., up to 30 pounds per square inch more or less is desirable in all sections of combination tower 4.

As an example of the operation of my process given for the purpose of illustration only, a 20° A. P. I. gravity Mid-Continent reduced crude was charged to the combination tower, the combined feed entering the heating coil at approximately 550° F. and emerging at about 900° F. A 10° A. P. I. gravity flashed residuum, having a viscosity of approximately 300 Saybolt Furol, was withdrawn from the bottom of flash chamber and by blending it in the system with the proper quantity of distillate from the reboiler a fuel oil of approximately 14° A. P. I. gravity having a viscosity of approximately 250 Saybolt Furol may be obtained, having a B. S. content of about 1.3% by the benzol centrifugal test. In this operation approximately 70 percent of pressure distillate was recovered having a gasoline content of approximately 75 percent or 52½ percent based on the raw oil. The yield of blended residuum was approximately 26 percent, there being approximately four percent gas and coke loss.

In a previous operation without employing my invention, it was only possible to produce approximately 27 percent of gasoline and obtain a marketable fuel oil having characteristics similar in viscosity and B. S. content to those given above.

Having thus described my invention, what I claim is:—

1. A hydrocarbon oil cracking process which comprises heating the oil to cracking temperature under pressure in a heating zone, discharging the heated oil into a vapor separating zone and separating the same therein under pressure into vapors and unvaporized oil, passing the vapors from said separating zone to a dephlegmating zone and condensing insufficiently cracked fractions of the vapors therein, in a manner to obtain a heavy cut and a lighter cut, returning the heavy cut to the heating zone for retreatment, separately removing the unvaporized oil from said separating zone and partially distilling the same by pressure reduction in flashing zone thereby forming residual oil, removing said lighter cut from said dephlegmating zone and reboiling the same by heat exchange with vapors in transit from said separating zone to said dephlegmating zone, blending the bottoms of such reboiling with the residual oil produced in said flashing zone, and removing the resultant blend from the system as a product of the process.

2. A hydrocarbon oil cracking process which comprises subjecting the oil to cracking conditions of temperature and superatmospheric pressure in a cracking zone, separately removing vapors and unvaporized oil from the cracking zone, flash distilling the unvaporized oil by lowering the pressure thereon thereby forming additional vapors and residual oil, combining said additional vapors with the first-mentioned vapors, dephlegmating the resultant vaporous mixture in a manner to obtain therefrom a heavy liquid cut and a lighter liquid cut of insufficiently cracked fractions and a sufficiently cracked vapor, returning said heavy cut to the cracking zone, finally condensing said sufficiently cracked vapor as a product of the process, blending said lighter cut with said residual oil and recovering the resultant blend as another product of the process.

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