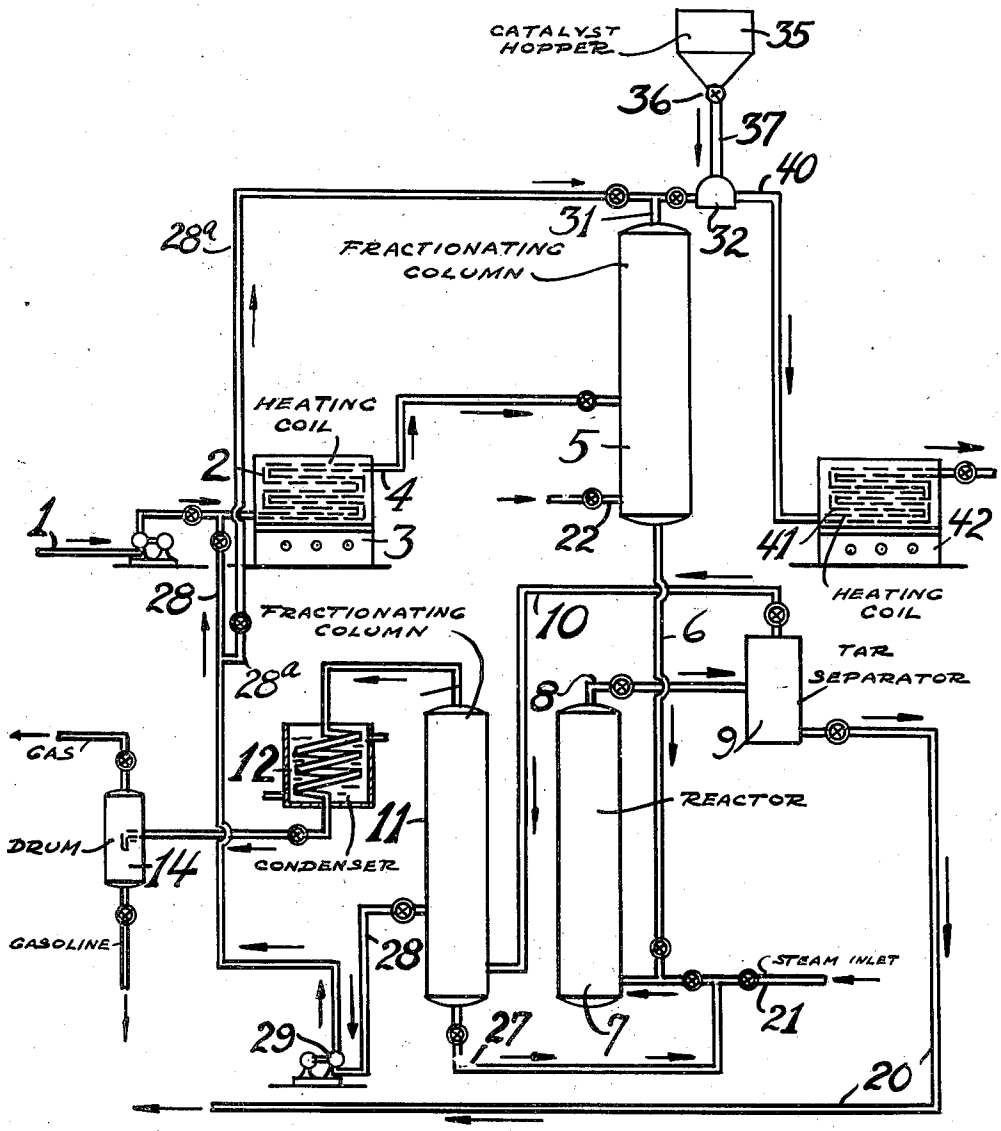
May 23, 1944. C. E. HEMMINGER 2,349,428

ART OF TREATING HYDROCARBONS

Filed Dec. 30, 1939



Charles E. Hemminger Inventor

By P. L. Young Attorney

Patented May 23, 1944

2,349,428

UNITED STATES PATENT OFFICE

2,349,428

ART OF TREATING HYDROCARBONS

Charles E. Hemminger, Westfield, N. J., assignor to Standard Oil Development Company, a corporation of Delaware

Application December 30, 1939, Serial No. 311,832

2 Claims. (Cl. 196—49)

The present invention relates to improvements in the art of treating hydrocarbon oils. More particularly, the present invention relates to improvements in the art of preparing from a relatively high boiling petroleum oil, a "crackable" stock, e. g., a gas oil.

It is of course appreciated by me that numerous schemes have been proposed heretofore for obtaining a suitable feed stock for some cracking operation but in so far as I am aware, the sequence of steps which I employ and which are hereinafter disclosed in the ensuing description and claims have never been heretofore carried out. It is my belief that certain very definite advantages accrue from my process and among others it may be mentioned that I am able to secure a cracking feed stock which is relatively free of tar or gummy constituents, or tar forming components, is of relatively low molecular weight and is otherwise of high quality. Furthermore, I may obtain, according to my process, a high yield of a "crackable" feed stock.

The prior investigators in this field have heated a feed stock such as a reduced crude, fractionated the material to remove fractions boiling in the gas oil range and above, and thereafter subjected the bottoms from the fractionator to say, a viscosity breaking operation or to a coking operation. In any event, the conditions were such that the pressure in the viscosity breaker or coking drum was greater than that in the fractionator. In my process, I operate under conditions such that the pressure in the fractionator is greater than that in the viscosity breaking zone or in the coking drum.

Furthermore, I operate my process under conditions such that I obtain from the viscosity breaker or coker, a maximum quantity of gas oil. Moreover, the combination of a low pressure viscosity lowering or coking operation with a catalytic cracking process, makes it possible to transfer a lower boiling gas oil to the catalytic cracking operation, the higher boiling gas oil returning to the viscosity breaking or coking, where by cracking and polymerization, it is converted into a lower boiling gas oil and a heavy tar, which latter gas oil is conducted to the cracking operation and the heavy tar withdrawn for use as a fuel oil, such as bunker C fuel, or for some similar purpose.

To the accomplishment of the foregoing and similar ends, I provide a suitable process and combination of apparatus elements in which my process may be performed, which process is fully described hereinafter, reference being had to the accompanying drawing.

The drawing represents diagrammatically a combination of elements in which my invention may be performed.

It is believed that my invention will be best understood by a concrete illustration setting forth fully, in connection with the drawing, the manner in which I may treat a given charging stock.

A reduced East Texas crude having an A. P. I. specific gravity of 18° is introduced into the system through line 1 and then pumped into a coil 2 disposed in known manner in furnace setting 3. In this coil, the feed stock is heated sufficiently to cause the material withdrawn through line 4 to be at a temperature of about 850° F., the coil itself operating under a back pressure of about 25 pounds per square inch. The material, as indicated, is withdrawn through line 4 and discharged into a fractionating column 5. The bottoms from this column are withdrawn through line 6 at a temperature of about 800° F. and then passed into the viscosity lowering reactor 7 as shown. The bottoms from 5 may amount to about 35% by weight of material charged to column 5. These bottoms remain in liquid phase reaction chamber 7 for sufficient time to effect the desired reaction. For instance, they may remain in said drum for a period of between 1 and 2 minutes at a temperature of about 775° F. to 800° F. and a pressure lower than that in column 5 and preferably considerably lower as, for example, a pressure of about 3 to 25 mm. of mercury, absolute pressure, so that the viscosity of these bottoms fed through line 6 is lowered from about 500 seconds at 210° F. to about 2000 seconds at 122° F. Furol viscosity. The overhead product withdrawn from reactor 7 at a temperature of about 775° F. in line 8 is discharged into a tar separator 9 from which an overhead product is withdrawn through line 10, and fed into a fractionating column 11, from which the overhead is passed in condenser 12, and then discharged from said condenser into receiving drum 14 from which normally gaseous material is taken off overhead and a gasoline fraction is recovered from the bottom of drum 14. The bottoms from tar separator 9 are withdrawn through line 20 at a temperature of about 775° F. and these bottoms may be employed as a fuel. As an alternative procedure, the material in vessel 7 may remain for an extended period of time therein to produce a hard coke at the bottom of the said

vessel, this treatment requiring 2 to 5 minutes. In this operation, also, the vessel is operated under a pressure lower than that in column 5, e. g., a pressure of about 5 mm. of mercury absolute pressure. Somewhat higher pressures could be used, however, provided they are always lower than the pressure in column 5. In order to facilitate the operation in vessel 7, it is desirable to introduce superheated steam at a temperature of about 900° F. into line 6 through line 21.

Referring now to fractionating column 11, the bottoms thereof may be withdrawn through line 27 and returned to reactor 7. A gas oil cut may be withdrawn through line 28, at a temperature of about 725° F. A pressure of about 50 pounds per square inch gauge in line 28 may be developed by means of pump 29. This product, having a mid-boiling point of about 775° F., may then be discharged into heating coil 2 with the feed stock.

Referring again to column 5, the overhead material is withdrawn through line 31 at a temperature of about 800° F. This material has a mid-boiling point of about 700° F. In order to assist in the vaporization, steam is fed to the bottom of column 5 through line 22. This steam may be at a temperature of about 925° F. The material of line 31 is then discharged into injector 32 and meanwhile catalyst in the form of a powder, grains, granules, or the like is fed from a hopper 35 through a star conveyor 36 into line 37 and thence into injector 32 where it is dispersed in the material fed from line 31. This catalyst may be an adsorbent material such as acid treated clay, silica-alumina gels and the like and preferably is at a temperature of about 1000° F. The amount of catalyst added to the oil may vary from ½ to 20 parts of catalyst per part of oil by weight. The dispersion of catalyst in oil is discharged into line 40 and thence in superheating coil 41 disposed in furnace setting 42 where sufficient heat is added to elevate the temperature to about 950° F. The material leav- the furnace may be under a pressure of 15 pounds per square inch gauge. The superheated material is then discharged to a reaction zone (not shown) and subjected to known conditions of temperature, pressure, time of reaction, etc., to effect the desired conversion.

Numerous modifications of the present invention falling within the scope of the invention of the same will be obvious to those skilled in the art. For instance, reaction drum 7 may be a coil and furthermore, the viscosity-breaking or coking operation therein carried out may be accomplished in the presence of a powdered or granular material such as pumice or petroleum coke. Furthermore, the material in line 28 may be fed directly through line 28–*a* to line 31, i. e. omitting return to coil 2 in furnace 3. This is an important modification of my invention, although not the preferred, for the reason that this material will not further burden the fractionation carried out in tower 5. The return of the material to line 31 thus enables reduction of the size of the tower 5 affording therefore, a saving of equipment, installation and maintenance cost. Another advantage is that where hot regenerated catalyst is contained in receiver 35, the latter when mixed with the liquid product in line 28–*a* in injector 32 serves to supply a portion of the heat required to vaporize the product. Another general advantage of my process in all modifications is that the amount of gasoline produced in drum 7 is relatively small and this is important since the gasoline thus produced would be of low octane number.

What I claim is:

1. A process for treating crude residual oils to obtain vaporizable constituents suitable for further cracking treatment which comprises heating said oil to a temperature sufficient to vaporize a portion of said oil, thereafter separating the vapors so formed from the unvaporized residue, reducing the pressure on the unvaporized residue so separated, maintaining said residue at said reduced pressure for a period between 1 and 2 minutes and at a temperature between 775 and 800° F. so as to materially viscosity break said residuum, thereafter separating the vapors formed during said viscosity breaking treatment, condensing a portion of said last-named vapors and combining the portion so condensed with said fresh oil prior to said first-named heating step.

2. A process for treating crude residual oils to obtain vaporizable constituents suitable for catalytic cracking which comprises heating said oil to a temperature sufficient to vaporize a portion of said oil, thereafter separating the vapors so formed from the unvaporized residue, reducing the pressure on the unvaporized residue so separated, maintaining said residue at the reduced pressure for a period between 1 and 2 minutes and at a temperature between 750 and 800° F. so as to materially viscosity break said oil, thereafter separating the vapors formed during said viscosity breaking treatment from unvaporized residue, fractionating the vapors so separated to segregate a heavy condensate fraction, an intermediate condensate fraction and a light condensate fraction, combining said heavy condensate fraction with said first-named unvaporized residue prior to subjecting the same to said viscosity breaking treatment and combining said intermediate condensate fraction with said crude residual oil prior to said first-named heating step.

CHARLES E. HEMMINGER.