

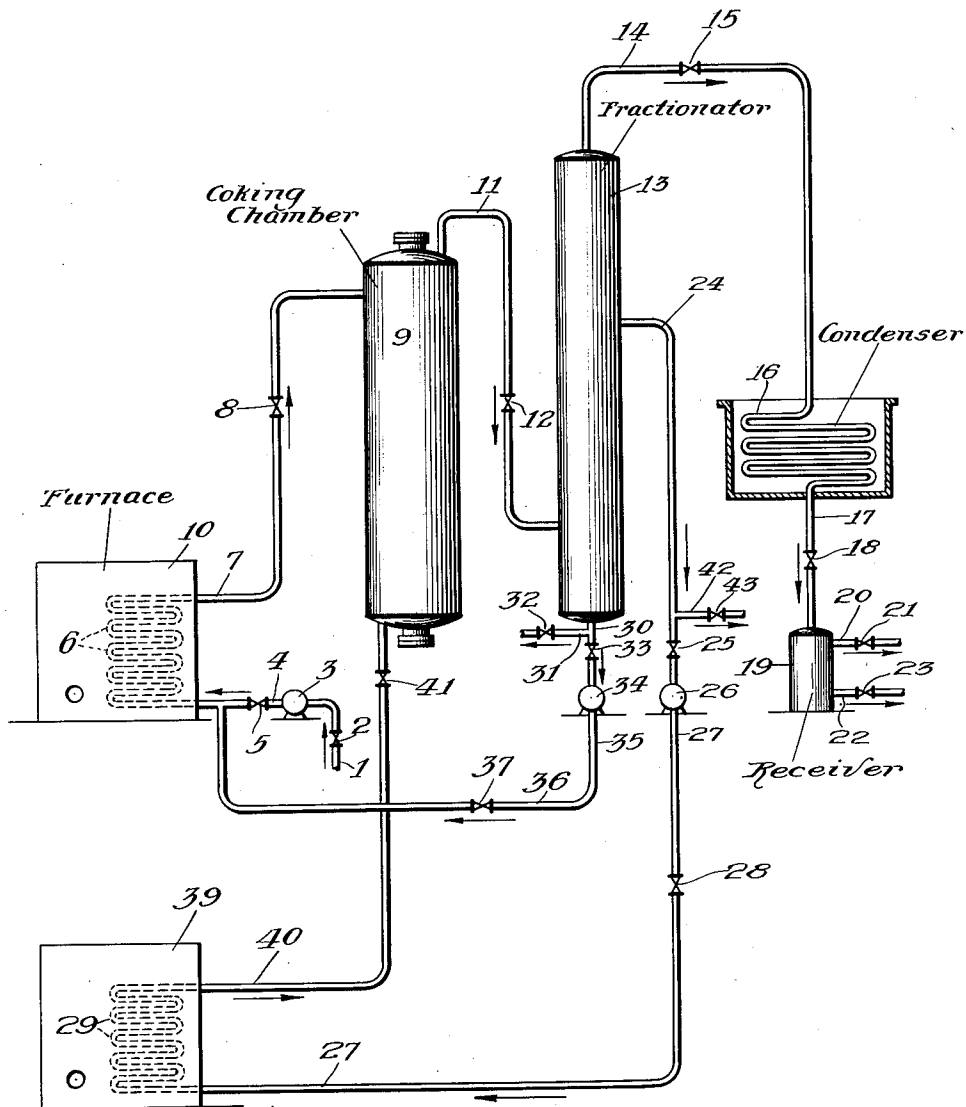
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TREATMENT OF HYDROCARBON OILS AND COAL

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TREATMENT OF HYDROCARBON OILS
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This invention relates to the simultaneous treatment of hydrocarbon oil and coal and more particularly refers to the pyrolytic conversion of coal and oil mixtures accompanied by coking and substantial devolatilization of the residual material at reduced pressure.

The present invention comprises subjecting light intermediate products resulting from the conversion of hydrocarbon oil and coal to independently controlled conversion conditions and utilizing this heated oil as a heat carrying medium to assist conversion and coking of the hydrocarbon oil and coal mixture which is separately heated and introduced into a low pressure coking zone.

The advantages of avoiding overheating of the charging stock and thus avoiding excessive formation and deposition of coke in the heating element and the advantages of producing a substantially devolatilized carbonaceous residue resulting in the maximum production of desirable light products are obvious. The present invention provides for the use of a heat carrying medium of particular characteristics produced within the system, which makes the operation self-contained and provides for conversion of the material thus utilized under independently controlled conversion conditions most suitable for the production therefrom of maximum yields of desirable light products such as motor fuel of high antiknock value.

An additional advantage of the present invention resides in the use of substantially atmospheric or relatively low superatmospheric pressure in the coking zone. This feature, in combination with the relatively light character of the oil utilized as the heat carrying medium, materially improves the character of the coke produced, permitting the production of a carbonaceous residue of low volatile content which, at the same time, retains a good structural strength. Independent control of the temperature and pressure conditions to which the charging stock and heat carrying medium are subjected in their respective heating elements permits the desired degree of conversion of each, regardless of the low pressure preferably employed in the coking zone.

While the foregoing has specifically mentioned a charging stock comprising a mixture of hydrocarbon oil and coal, it will be evident that solid hydrocarbonaceous materials other than coal may also be treated to advantage by use of the principles of the present invention. Examples of such materials which may be employed are peat, lignite, cannel coal, coal breeze or other coal wastes, tars, pitches, shales, asphaltic materials

(either natural or synthetic) gilsonite, grahamite, albertite, and all other materials falling within the general classification of solid hydrocarbonaceous substances. The liquid portion of the charging stock may comprise any hydrocarbon oil varying from high coke-forming residual oils, heavy crudes and the like to light distillates such as naphthas, gasoline, etc., and may also include tars and pitches from coal, wood, peat, lignite, shale and the like. The oil utilized may be a natural petroleum product or a product resulting from cracking or from synthesis or any suitable blend of two or more oils may be employed.

The specific embodiment of the present invention may comprise subjecting a mixture of hydrocarbon oil and coal to relatively mild conversion conditions in a heating element, introducing the heated mixture into an enlarged coking zone maintained at substantially atmospheric or relatively low super-atmospheric pressure, subjecting vapors from the coking zone to fractionation, subjecting desirable light products from the fractionator to condensation and collecting the resulting distillate and uncondensable gas, separating the intermediate products condensed from the vapors in the fractionator, into relatively light and relatively heavy components, returning said relatively heavy components to the heating element, together with the charging stock, for further conversion, subjecting said relatively light components to independently controlled relatively severe conversion conditions in a separate heating element and thence introducing the heated material into direct contact with the residual products in the coking zone for the purpose of assisting their further conversion, coking and substantial devolatilization.

The present invention, as well as some of the possible modifications of the specific embodiment above described, will be more apparent with reference to the attached diagrammatic drawing of an apparatus wherein the present invention may be practiced and with reference to the following description of the drawing.

Charging stock for the process may be supplied through line 1 and valve 2 to pump 3 from which it is fed through line 4, valve 5, heating element 6, line 7 and valve 8 into coking chamber 9. The heating element is located in a furnace 10 of any suitable form capable of heating the oil to the desired temperature which is preferably within but may be below the conversion range, depending primarily upon the character of charging stock employed, and the relative percentages of the solid and liquid ingredients therein. Prefer-

ably the temperature is sufficiently low, under the pressure, velocity and time conditions employed, to preclude any substantial formation and deposition of coke in the heating element and/or in the line leading from the heating element to the coking chamber. Any suitable and well known means of preheating the charging stock, prior to its introduction into the heating element, may be employed although such provisions are not illustrated in the drawing.

One or a plurality of coking zones may be utilized although only one is illustrated in the drawing for the sake of convenience. In case a plurality of such zones is employed they may be operated either alternately or simultaneously, thus permitting a larger deposit of carbonaceous material than when only one zone is employed and prolonging the operating cycle.

Vapors from the coking zone pass through line 11 and valve 12 to be subjected to fractionation in fractionator 13 wherein intermediate products comprising the insufficiently converted components of the vapors are condensed as reflux condensate while their relatively light desirable components leave the fractionator as vapors and gases through line 14 and valve 15, are subjected to condensation and cooling in condenser 16 from which distillate and uncondensable gas passes through line 17 and valve 18 to be collected in receiver 19. Uncondensable gas may be released from the receiver through line 20 and valve 21. Distillate may be withdrawn from this zone through line 22 and valve 23. Gas from the receiver may, when desired, be subjected to scrubbing in any suitable form of scrubber or absorption tower, not illustrated, for the purpose of freeing it of entrained liquefiable components and the distillate may, if desired, be subjected to stabilization.

The insufficiently converted components of the vapors from the coking zone, which are condensed as reflux condensate in the fractionator, are divided into two streams; the heavy or high boiling components of the condensate collecting in the lower portion of the fractionator while its lighter, lower boiling, components are withdrawn as a side stream from any desired point in the fractionator above the point at which vapors are introduced thereto and below the points from which vapors are withdrawn.

The relatively heavy components of the condensate are withdrawn from the lower portion of the fractionator through line 30 and may be removed, all or in part, from the system to cooling and storage or elsewhere, as desired, through line 31 and valve 32 or may be directed, all or in part, through valve 33, in line 30, to line 34 to be fed therefrom through line 36 and valve 37 to heating element 6 for further conversion, together with the charging stock supplied to this zone, as already described.

The relatively light components of the reflux condensate, preferably corresponding to what is commonly termed pressure distillate bottoms, are withdrawn from the fractionator at a point where this type of material is concentrated, passing through line 24 and valve 25 to pump 26 from which it is fed through line 27 and valve 28 to heating elements 29. When desired, a portion of this intermediate product may be withdrawn from the system by diverting it from line 24 through line 42 and valve 43 to cooling and storage or elsewhere, as desired. One of the principal advantages of separating the light and heavy reflux for separate treatment is that the heavier

reflux may contain tarry substances which are preferably returned to the heating coil for the primary charging stock and which permits heating the clean secondary reflux stock to high conversion temperatures thus obtaining the necessary conversion rates per pass as well as the additional heat required to coke the contents of the coking chamber.

Heating element 29 is located in a furnace 39 of any suitable form and the relatively light condensate from the fractionator supplied to this zone is subjected, under the independently controlled temperature and pressure conditions maintained therein to relatively severe conversion conditions suitable for the conversion of this product into substantial yields of more desirable light materials, such as motor fuel of high anti-knock value. The heated material is discharged from heating element 29 through line 40 and valve 41 into coking chamber 9, preferably entering this zone below the level of residual material therein, coming into direct contact therewith at a sufficiently high temperature to insure coking and substantial devolatilization thereof.

The heating element to which the charging stock is supplied preferably utilizes relatively mild conversion conditions with temperature of the order of 800 to 900° F. and pressures of from substantially atmospheric to 500 pounds, or more, per square inch. Lower temperatures which preclude any substantial conversion of the charging stock may, however, be employed in this heating element, when desired. Substantially atmospheric or relatively low superatmospheric pressure up to 100 pounds, or thereabouts, per square inch, is preferably employed in the coking zone and may be substantially equalized or somewhat reduced in the succeeding fractionating, condensing and collecting portions of the system. Temperatures of the order of 900 to 1050° F. and a substantial superatmospheric pressure of the order of 100 to 800 pounds, or more, per square inch, may be employed in the heating element to which the relatively light reflux condensate from the fractionator is supplied.

As an example of the operation of the process of the present invention, the charging stock supplied to the system comprises about 25 percent by weight of pulverized coal suspended in a hydrocarbon oil of about 18° A. P. I. gravity. The coal employed is a bituminous waste product having a volatile content of approximately 40 percent. The charging stock is subjected to a temperature of approximately 830° F. under a pressure of approximately 250 pounds per square inch, and is introduced into alternately operated coking chambers maintained at substantially atmospheric pressure. Relatively heavy portions of the reflux condensate from the fractionator of the system, including coal tars and the like resulting from treatment of the coal, are returned to the heating element to which the charging stock is supplied while the lighter portion of the reflux condensate is subjected to a temperature of approximately 950° F. under a superatmospheric pressure of approximately 400 pounds per square inch in the separate heating element 29 and introduced into the lower portion of the coking zone. This operation may yield, per ton of charging stock, approximately 875 pounds of carbonaceous material comprising a mixture of petroleum coke and carbonized coal, having a volatile content of less than 8 percent. In addition about 150 gallons of motor fuel having an anti-knock value equivalent to an octane number of

approximately 68 and about 2500 cubic feet of uncondensable gas having a calorific value of approximately 1600 B. t. u.'s per cubic feet may be recovered, per ton of charging stock.

5 I claim as my invention:

1. In a process for the simultaneous treatment of solid bituminous material and hydrocarbon oil to carbonize the solid bituminous material and convert the volatile products thereof, and to crack the hydrocarbon into relatively low boiling products the improvement which comprises, introducing a mixture of hydrocarbon oil with finely divided solid bituminous material suspended therein into a heating coil wherein the mixture is heated to a relatively mild conversion temperature insufficient to cause substantial deposition of coke in the heating coil, discharging the mixture directly from the coil into a coking chamber maintained under reduced pressure relative to the heating coil, subjecting the vapors leaving the coking chamber to fractionation, removing the relatively heavy reflux condensate from the fractionator and commingling the same with the mixture of solid bituminous material and hydrocarbon oil being heated in the heating coil, removing an intermediate reflux condensate from the fractionator and subjecting the same to a higher temperature than said relatively mild conversion temperature in a separate heating coil and introducing the highly heated stream from the second coil into the coking chamber to assist in the carbonization and devolatilization of the contents thereof and recovering the overhead product from the fractionator.

2. In a process for the simultaneous treatment of solid bituminous material and hydrocarbon oil to carbonize the solid bituminous material and convert the volatile products thereof, and to crack the hydrocarbon into relatively low boiling products the improvement which comprises, introducing a mixture of hydrocarbon oil with finely divided solid bituminous material suspended therein into a heating coil wherein the mixture is heated to a relatively mild conversion tempera-

ture insufficient to cause substantial deposition of coke in the heating coil, discharging the mixture directly from the coil into a coking chamber, subjecting the vapors leaving the coking chamber to fractionation, removing the relatively heavy reflux condensate from the fractionator and commingling the same with the mixture of solid bituminous material and hydrocarbon oil being heated in the heating coil, removing an intermediate reflux condensate from the fractionator and subjecting the same to a higher temperature than said relatively mild conversion temperature in a separate heating coil and introducing the highly heated stream from the second coil into the coking chamber to assist in the carbonization and devolatilization of the contents thereof and recovering the overhead product from the fractionator.

3. In a process for the simultaneous treatment of coal and hydrocarbon oil for devolatilizing said coal and cracking said oil which comprises, subjecting a mixture of hydrocarbon oil and coal to relatively mild conversion conditions in a heating coil, introducing the heated mixture directly from the coil into an enlarged coking zone maintained under reduced pressure relative to the heating coil, subjecting vapors from the coking zone to fractionation, recovering vapors remaining uncondensed after fractionation as the distillate product of the process, separating the products condensed from the vapors in the fractionator as relatively light and relatively heavy reflux condensate, returning said relatively heavy reflux condensate to the heating coil together with fresh charging stock for further conversion, subjecting said relatively light reflux condensate to independently controlled relatively severe conversion conditions in a separate heating element and introducing the highly heated relatively light reflux condensate into direct contact with the residual products in the coking zone to assist in their conversion, coking and substantial devolatilization.

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