

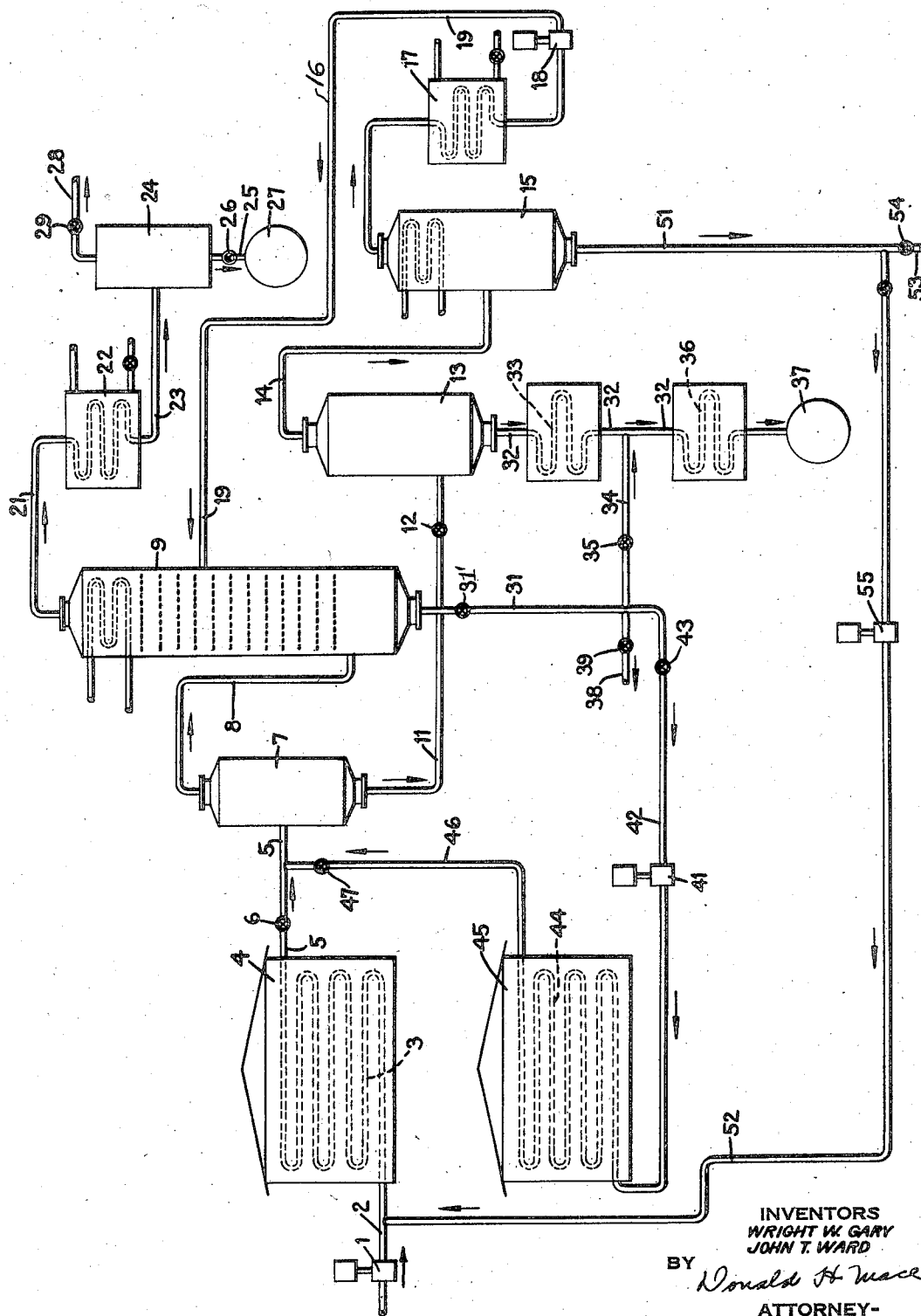
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TREATMENT OF HYDROCARBON OILS

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TREATMENT OF HYDROCARBON OILS

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This invention relates to the pyrolytic conversion of hydrocarbon oils, more particularly petroleum oils, for example, petroleum oils and charging stocks of a character unsuitable for charging directly into a drastic cracking operation for the primary purpose of producing a large yield of gasoline and to oils containing considerable amounts of waxy constituents.

It is generally known that the lighter products such as gasoline, resulting from the pyrolytic decomposition of petroleum oils, are far more valuable than the heavier products such as fuel oils and tars, and it is the general objective of the art to produce more of the former at the expense of the latter. Some oils and charging stocks, however, generally referred to as of a more or less "dirty" character, cannot advantageously be subjected to drastic cracking operations due to the formation of coke which would result. Moreover, many oils and charging stocks contain a sufficient amount of waxy constituents to produce fuel oils of unsuitably high pour point and viscosity.

Our invention has particular relation to a type of mild cracking operation herein referred to as "viscosity breaking" and hereinbelow defined.

Our invention has for an object the provision of a method of pyrolytically decomposing or cracking a hydrocarbon oil, and more especially a hydrocarbon oil of the character recited hereinabove, in which an increased yield of products of relatively high value may be obtained, as well as a reduction of the amount and an improvement in the quality of products of relatively low value, together with numerous additional advantages set forth more specifically hereinbelow. Our invention has for a further object the provision of a method of pyrolytically decomposing hydrocarbon oil to produce a fuel oil of satisfactory characteristics, especially as to pour point and amount of waxy constituents, in which original constituents of potentially valuable character are replaced with constituents of relatively low value and it may be of refractory character, and in which the total production of fuel oil is reduced while the yield of valuable products such as gasoline is increased.

Our invention has for a still further object the provision of an improved and advantageous method of pyrolytically decomposing hydrocarbon oils or charging stocks of the character recited hereinabove in which relatively high yields of valuable products and reduced yields of products of lower value are obtained without subjecting

the oil or charging stock to conditions so severe as to produce operating difficulties.

Our invention has for further objects such additional operative advantages and improvements as may hereinafter be found to obtain.

Our invention contemplates subjecting oils, and more particularly oils of the character recited hereinabove to a "viscosity breaking" or mild cracking operation, flashing the products to produce a residual material, that is to say, a tar or pitch, which is too heavy to meet the usual requirements of a fuel oil.

We have found that by operating in this manner, even when the charging stock contains considerable amounts of waxy constituents, a heavy tar or pitch substantially free from waxy constituents may be obtained, and that this tar or pitch may be blended with lighter material, also preferably free from waxy constituents and preferably of a rather refractory character, to produce a fuel oil having a low "pour point" and being satisfactory in other respects for the use to which it is intended to be put.

In instances where the charging stock contains a considerable amount of waxy constituents which would tend to impart to the fuel oil an undesirably high pour point, our invention further contemplates the maintenance of fractionating conditions to obtain an oil for use in cutting back the tar or pitch produced as above set forth which shall be substantially free from such waxy constituents, as well as the ultimate separation and pyrolytic conversion of such waxy constituents to products of a more valuable nature.

Our invention also contemplates, where so desired, subjecting a portion of the oil obtained from the volatilized products liberated in the flashing operation to a further and more drastic cracking operation to increase the yield and enhance the quality of the more valuable products such as gasoline, and to enable the use as a cut-back material of an oil having a relatively high potency for this purpose but of a rather refractory character with respect to cracking for the primary purpose of producing gasoline.

As herein employed, the term "drastic cracking" is intended to mean a pyrolytic decomposition operation carried out primarily for the purpose of producing gasoline directly from a petroleum oil, such for example as a topped or reduced crude or a distillate recovered in the simple distillation of crude petroleum, in an amount sufficient to be considered a commercially satisfac-

tory yield, that is to say, a yield approximating 20% or more of gasoline per pass.

By "viscosity breaking", as intended solely for the purposes of the present specification, is meant a mild cracking operation. Viscosity-breaking, as the term is thus employed, is intended to designate an operation, suitable for the treatment of "dirty" or "black" oils which tend to decompose markedly under drastic cracking conditions to coke, in which cracking conditions are limited to a considerable extent to prevent excessive coke formation in the coils or other cracking apparatus, the object being to reduce the viscosity of the stock rather than to obtain directly a yield of gasoline high enough to be regarded as satisfactory in a commercial drastic cracking operation.

While the actual conditions of pressure and temperature employed vary considerably with different stocks, and generally are such that not over 13% of gasoline is produced per pass, this limit being established by the extent to which the particular stock may be cracked without producing coke in undesirable quantities, it will be understood that the above definition is intended to apply to the degree or extent of the cracking operation, however, rather than to the manner in which the operation is conducted or the purpose for which it is carried out, and the actual working conditions may therefore be somewhat more severe than would be true if, as is sometimes true of viscosity-breaking, the operation were conducted merely as a preliminary to a drastic cracking operation, that is to say, primarily for the purpose of producing a stock to be subjected to a drastic cracking operation.

In order that my invention may be clearly set forth and understood, we now describe, with reference to the accompanying drawing, a preferred manner in which our invention may be embodied and carried out. In this drawing,

The single figure is a more or less diagrammatic representation of a system for the pyrolytic conversion of hydrocarbon oil in accordance with my invention.

Referring to the drawing, a petroleum oil, for example a reduced crude of a dirty or waxy nature, which cannot advantageously be subjected to a drastic cracking operation for the primary purpose of producing a high yield of gasoline, is forced by a pump 1 through a conduit 2 into and through a coil 3 located within a viscosity-breaking furnace 4. The temperature conditions ordinarily maintained in the coils 3 are from 850° to 900° F., while the pressure may vary from 200 to 400 pounds per square inch, it being understood that while this is the preferred range, the pressure and temperature conditions may be varied somewhat from this range to meet the requirements of particular charging stocks.

The treated oil then passes through a conduit 5 having a reducing valve 6 for use where necessary, into a high pressure flash tower 7 which may be maintained for example at a pressure of 200 pounds per square inch and in which the separation of volatilized and unvolatilized products of particular temperature and pressure conditions occurs. By way of example, we may maintain temperatures from 730° to 750° F. in the upper or vapor portion of the tower 7 and temperatures of from 780° to 800° F. in the lower or liquid portion of the tower.

The volatilized products pass from the tower 7 through a conduit 8 to a fractionating tower 9 which may be of conventional "bubble tower" type of construction and which is preferably main-

tained at substantially the same pressure which obtains in the high-pressure flash tower 7, while the bottoms from the high-pressure flash tower 7 pass through the conduit 11 having a pressure reducing valve 12 into a low-pressure flash tower 13. The pressure within the flash tower 13 is preferably atmospheric, and the flashing or evaporation which occurs is of a sufficiently drastic order to produce a residual material or pitch of a very heavy nature unsuitable for use directly as a fuel oil, and preferably substantially completely free from waxy constituents even when these are present to a considerable extent in the original charging stock.

The temperatures in the upper and lower portions of the flash tower 13 may be of the order of from 680° to 710° F. and from 730° to 760° F., respectively. The products volatilized in the atmospheric flash tower 13 pass through a vapor line 14 to a partial condenser or fractionating tower 15 maintained at atmospheric pressure, and at temperatures somewhat below the temperatures obtaining in the flash tower 13. For example, the temperatures maintained in the upper and lower portions of the partial condenser 15 may be of the order of from 620° to 650° F. and 670° to 700° F., respectively.

The vapors not condensed in the partial condenser 15 in the present instance pass through a vapor line 16 to a condenser 17 where they are totally condensed. The condensate is then delivered by means of a pump 18 and conduit 19 to the high-pressure bubble tower 9, to which it may be supplied as a reflux.

The operation of the bubble tower 9 is so conducted as to effect a separation of the gasoline and lighter constituents from the remaining vapors. The vapors containing the gasoline and lighter constituents pass off through a vapor line 21 through a condenser 22 and a conduit 23 to a separator 24. Gasoline is withdrawn from the separator 24 through a conduit 25 having a valve 26 to a receiver 27, from which it may be delivered to a stabilizer or to storage. The uncondensed gases leave the separator through a conduit 28 having a valve 29.

Condensate is removed from the bubble tower 9 through a conduit 31 having a valve 31', the nature of this gas oil condensate preferably being such that it has a distillation end point of from 650° to 700° F., contains substantially no waxy constituents and is suitable for use as a cutting-back agent for the pitch produced in the atmospheric flash tower 13.

The pitch is withdrawn from the flash tower 13 through a conduit 32 and may be partially cooled in a cooler 33 before being cut back or blended with a portion of the condensate removed from the tower 9. For the purpose of blending the pitch and oil we provide the conduit 31 with a branch conduit 34 having a valve 35 and leading to the conduit 32. The blended fuel oil, the properties of which are regulated by the proportions of pitch and cut-back oil to produce a product having suitable characteristics for use as a fuel oil, for example a pour point of around 0° F., may then be cooled to atmospheric temperature in a cooler 36 and delivered to a receiver or tank 37.

The remainder of the condensate removed from the bubble tower 9 may be withdrawn through the conduit 31 and a branch conduit 38 having a valve 39 for use outside of the system shown. This condensate may, however, be delivered by means of a pump 41 and a conduit 42 having a

valve 43 to a coil 44 located in a cracking furnace 45.

The coils 44 are preferably maintained under conditions of temperature and pressure sufficient to effect a cracking which is considerably more drastic than that which is carried out in the viscosity-breaking furnace 4 and the coil 3. For example, the conditions in the coil 44 may vary from a vapor-phase type of operation, at for example 1000° F. and 200 pounds per square inch pressure, to a presumably liquid phase operation at 900° F. and 750 pounds per square inch pressure. The cracked products pass from the coil 44 through a conduit 46 having a pressure-reducing valve 47 and to the transfer line 5 or directly into the flash tower 7. The heavy flash distillate collected in the bottom of the partial condenser 15 is withdrawn through a conduit 51 and all or a portion thereof may be recycled, as shown, by means of a pump 55 located in a conduit 52 to the coil 3 for further treatment, the remaining portion being withdrawn from the system through a branch conduit 53 having a valve 54.

By way of example, we may state that when operating in accordance with my invention we find it possible to produce a fuel oil having a pour point of for example 0° F. as compared to prior operations in the same stock in which the fuel oil might have a pour point of about 70° F.

It will be apparent to those skilled in the art that in the type of operation just set forth, that is to say, an operation in which drastic cracking is combined with the initial viscosity-breaking, there will tend to accumulate in the cycle of the coil 44 a highly refractory material, and it is an advantage of this form of my invention that the use of a portion of this refractory stock as a cut-back agent is not only economically advantageous as compared with the use as a cut-back material of an oil of less refractory character, but serves to maintain the efficiency of the recycling operation by removing a portion or all of the refractory oil which would otherwise tend to accumulate.

It will further be apparent that the process of our invention is advantageous in that the operation of the viscosity-breaker is made unusually efficient as compared with prior operations sometimes known as viscosity-breaking, but in which the absence of recycling or the necessity of using low recycle ratios resulted in a comparatively low cracking effect per pass, and is also advantageous in that the gasoline produced is possessed of a high anti-knock value when used as a motor fuel as compared with such gasoline as is ordinarily produced as an incident to prior operations known as viscosity-breaking operations.

Further advantages of our invention comprise the facts that the production of fuel oil is decreased while the quality of the fuel oil is enhanced and the waxy constituents originally present in the charging stock, instead of being contained in the fuel oil, are subjected to pyrolytic conversion to more valuable products, their place in the fuel oil being taken by a lesser amount of a material less suitable for conversion into gasoline.

The fuel oil produced is also cleaner and it is possible to vary the characteristics of the fuel oil without difficulty over a wide range without interfering with the operation of the system as employed.

It will further be obvious to those skilled in the art that our invention is not limited to the specific details of the illustrative example or examples set forth or described hereinabove, but may variously be embodied within the scope of the claims hereinafter made.

We claim:

1. In the treatment of hydrocarbon oils to produce a fuel oil of desired viscosity and low pour point, the method which comprises subjecting a hydrocarbon oil containing waxy constituents to viscosity breaking treatment at elevated pressure, evaporating the treated oil under temperature and pressure conditions which will retain substantially all of the waxy constituents within residual oil, fractionating the evaporated vapors into a light fraction within the normal gasoline range and a heavier gas oil fraction, distilling residual oil resulting from said evaporation under a pressure materially lower than said last-named pressure and at a temperature which will vaporize waxy constituents contained in said residual oil, fractionating the distilled vapors into a heavier fraction containing the bulk of the waxy constituents and a lighter fraction, subjecting said heavier fraction containing the waxy constituents to said viscosity breaking treatment, and blending the residue resulting from said distillation with a portion of the heavier gas oil fraction resulting from said first-mentioned fractionation to produce a blended fuel oil product of desired viscosity and having a low pour point.

2. In the treatment of hydrocarbon oils to produce a fuel oil of desired viscosity and low pour point, the method which comprises subjecting a hydrocarbon oil containing waxy constituents to viscosity breaking treatment at elevated pressure, evaporating the treated oil under temperature and pressure conditions which will retain substantially all of the waxy constituents within residual oil, fractionating the evaporated vapors into a light fraction within the normal gasoline range and a heavier fraction, distilling residual oil resulting from said evaporation under a pressure materially lower than said last-named pressure and at a temperature which will vaporize waxy constituents contained in said residual oil, fractionating the distilled vapors into a heavier fraction containing the bulk of the waxy constituents and a lighter fraction, subjecting said heavier fraction containing the waxy constituents to said viscosity breaking treatment, blending the residue resulting from said distillation with a portion of the heavier fraction resulting from said first mentioned fractionation to produce a blended fuel oil product of desired viscosity and having a low pour point, and subjecting the remaining portion of said light gas oil to cracking in a separate cracking passageway.

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