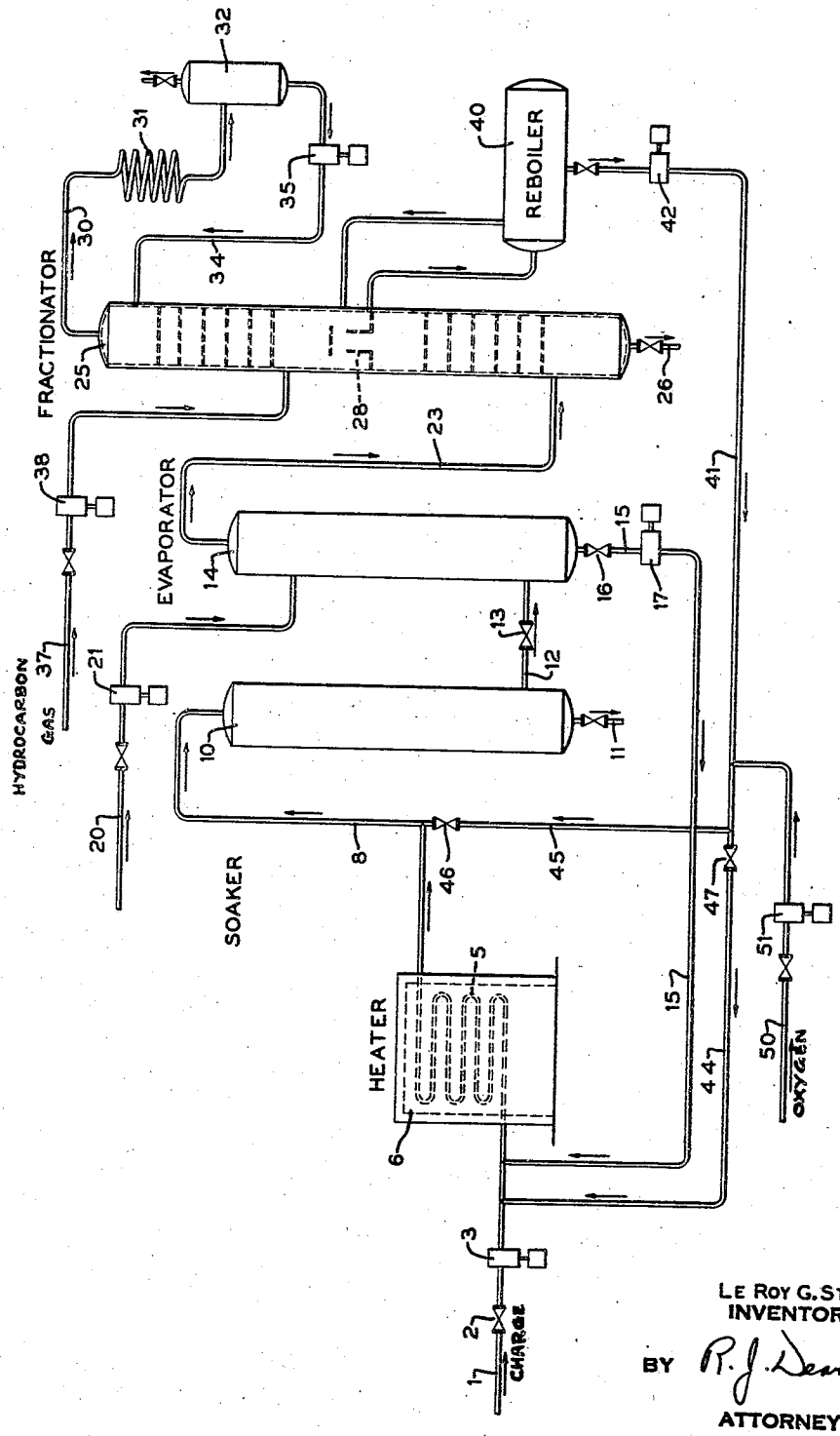
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MANUFACTURE OF LOW BOILING HYDROCARBON OILS

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MANUFACTURE OF LOW BOILING HYDROCARBON OILS

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This invention relates to the manufacture of low boiling hydrocarbon oils, such as gasoline, from higher boiling hydrocarbon oils and normally gaseous hydrocarbons and has to do particularly with a gas reversion type of operation in which a higher boiling hydrocarbon oil is cracked in the presence of normally gaseous hydrocarbons to increase the yield and improve the quality of the motor fuel product.

An important object of the invention is to contact the oil and gases undergoing conversion with a small amount of oxygen to promote the reaction between the heavier oil and the gases to produce products of intermediate boiling point range.

In accordance with the invention, a cracking stock is subjected to conversion conditions of temperature and pressure whereby higher boiling oils are converted into lower boiling products including gasoline, the cracked products separated into a residuum, a clean distillate which is recycled to the cracking operation, gasoline and gaseous products lighter than gasoline. The gaseous hydrocarbons are further fractionated to separate a normally gaseous hydrocarbon fraction, preferably predominating in C_3 and C_4 hydrocarbons, which is recycled to the cracking operation. A small amount of oxygen is contacted with the oil and gases subjected to conversion conditions in order to promote interaction between the oil and gases, or reversion of the gaseous hydrocarbons to products of boiling range between the gases and the oil charged. An extraneous gaseous hydrocarbon charge may be introduced into the system to increase the proportion of normally gaseous hydrocarbons in the charge to the cracking zone.

The invention will be more fully understood from the following description which is intended to be read in connection with the accompanying drawing showing a sketch of apparatus suitable for carrying out the process of the invention.

Referring to the drawing, a charging stock suitable for cracking or reforming, such as gas oil, naphtha or reduced crude, is charged through line 1 controlled by valve 2 and forced by the pump 3 into a heating coil 5 located in a furnace 6. In the heating coil the oil is subjected to cracking conditions of temperature and pressure, which will depend on the type of oil used, but it is intended that as high a temperature as possible will be maintained in the coil without encountering coking difficulties. Temperatures of 850–1100° F. and preferably around 950–1150° F., and pressures of 200–3000 pounds, and preferably around 750–1500 pounds, may be employed. The higher temperatures may be used in converting lighter products, such as naphtha or gas oil, and in such case the reaction is largely in the vapor phase. Products from the coil 5 are passed through the transfer line 8 to a soaker 10 wherein the cracked products pass downwardly affording additional time of reaction. The conditions maintained in the soaker are preferably as near as possible those maintained in the heating coil, except for the ordinary loss in temperature and pressure, encountered in passing through the coil and transfer line to the soaking drum. For example, the pressure may be about 100 pounds less in the coking drum and a drop in temperature of around 50° F. Residual products which may be heavy fuel oil or coke collect in the bottom and may be removed through the valve controlled line 11 or a suitable manhole. The vapor products separated in the soaker are withdrawn through the vapor line 12 controlled by valve 13 to evaporator 14. In this evaporator the vapors are partially condensed to form a clean condensate which is withdrawn from the bottom of the evaporator through the line 15, controlled by valve 16, and forced by the pump 17 back to the heating coil 5. A portion of the charging stock, if desired, may be introduced into the upper portion of the evaporator 14 through the line 20 by the pump 21. It is intended that substantially all the hydrocarbons of higher boiling point range than gasoline be condensed in the evaporator. The gasoline and lower boiling point hydrocarbons as vapor and gases pass from the top of the evaporator through the vapor line 23 to fractionator 25.

The fractionator 25 is divided into two sections and serves to stabilize the gasoline in the lower portion and to fractionate the normally gaseous hydrocarbons in the upper. In the lower portion of the fractionator the gasoline hydrocarbons are condensed and fractionated to produce a stable gasoline condensate which is withdrawn from the bottom of the tower through the valve controlled line 26. The vapors and gases of lower boiling point than gasoline pass through the conduit 28 to the upper portion of the fractionator wherein they are fractionated to separate a condensate fraction suitable for recycling to the system. Vapors from the top of the tower are withdrawn through the vapor line 30 to condenser 31 and the condensate collected in accumulator 32. This condensate which may be largely C_3 hydrocarbons including propane is withdrawn from the accumulator 32 through the

line 34 and recycled by pump 35 to the top of the tower as a reflux and cooling medium. Extraneous hydrocarbon gases, such as natural gasoline or a fraction thereof such as propane and butane, may be introduced into the upper portion of the fractionator through the line 37 by the pump 38; the condensate collected in the middle portion of the tower around the conduit 28 and preferably consisting essentially of C_3 and C_4 hydrocarbons passes through a re-coiler 40, the bottoms of which are withdrawn through the line 41 and recycled by the pump 42 back to the system. This gaseous fraction conveyed through line 41 may be conducted directly to the entrance of the heating coil 5 through the line 44, or a portion or all may be by-passed through the line 45, by suitable manipulation of the valves 46 and 47, directly to the soaker.

An oxygen-containing gas such as relatively pure oxygen or air is introduced through the line 50 by pump 51 into the system, preferably in combination with the gaseous hydrocarbon charge passing through the line 41. The amount of oxygen so introduced is usually less than 5% and preferably around ½% to 1% of the combined oil and gaseous charge to the heating coil 5. A convenient method of introducing the oxygen is mixing in proper proportions with the gaseous hydrocarbon charge and in such proportion to give the desired amount of oxygen to the charge. The normally gaseous hydrocarbons charged to the cracking coil may range from 5–30% and preferably around 10–20% of the fresh charge and recycle oil and the amount of oxygen added may be about 5–10% thereof.

As an example of the operation of the invention, a gas oil was subjected to cracking at about 1000° F. and a pressure of about 750 pounds, the cracked products separated into vapors and residuums, the vapors fractionated to form a recycle gas oil which was returned to the cracking coil. The gasoline was separated from the remaining vapors and the gaseous hydrocarbons fractionated to separate the C_3 and C_4 hydrocarbons which were also recycled to the cracking coil. The amount of recycle gaseous hydrocarbons was around 10% including about 5% extraneous hydrocarbon fraction consisting essentially of propane and butane. About 10% by volume of oxygen was added to the recycle gases. A yield of about 80% gasoline of about 78 octane number was obtained.

In United States Patent No. 2,149,800, March 7, 1939, to the present applicant, there is disclosed the conversion of hydrocarbon oils by partial oxidation with oxygen and oxygenated gases, whereby gasoline and a large amount of gaseous products are formed, and the polymerization of said gaseous products to produce additional gasoline.

Obviously many modifications and variations of the invention as hereinbefore set forth may be made without departing from the spirit and scope thereof and therefore only such limitations should be imposed as are indicated in the appended claims.

I claim:

1. A process for the manufacture of gasoline, which comprises subjecting higher boiling oil in mixture with a minor proportion of normally gaseous hydrocarbons and in the absence of gaseous products of combustion to cracking conditions of temperature and pressure whereby a substantial amount of lower boiling products containing oil of the gasoline boiling point range is formed from the higher boiling oil and gaseous hydrocarbons, separating the reaction products into a fraction heavier than gasoline, a gasoline fraction and normally gaseous hydrocarbons, fractionating the normally gaseous hydrocarbons to separate a fraction predominating in C_3 and C_4 hydrocarbons, recycling the fraction of C_3 and C_4 hydrocarbons to the cracking operation and contacting the oil and gaseous hydrocarbons while under cracking conditions with about ½ to 1% of oxygen as a catalyst to accelerate the conversion of the oil and gases to gasoline hydrocarbons.

2. A process for the manufacture of gasoline, which comprises subjecting a mixture of gas oil and normally gaseous hydrocarbons to cracking conditions of temperature and pressure, separating the cracked products into vapors and a residuum, separating from the vapors a clean condensate, recycling said condensate to the cracking operation, fractionating the uncondensed vapors to separate the gasoline, fractionating the gaseous hydrocarbons to separate a fraction predominating in hydrocarbons of 3 and 4 carbon atoms, recycling said fraction to the cracking operation and contacting the hydrocarbons while maintained under cracking conditions with about ½ to 1% of oxygen to promote the conversion of the oil and gaseous hydrocarbons to products of intermediate boiling point comprising gasoline.

3. A process for the manufacture of motor fuel, which comprises subjecting a high boiling point hydrocarbon oil and normally gaseous hydrocarbons free from pressure far from the system to cracking temperatures in a heating coil and enlarged reaction chamber, separating the cracked products into vapors and unvaporized residuum, separating from the vapors a gasoline fraction and a clean recycle stock, returning said recycle stock to the heating coil, fractionating the uncondensed vapors to produce a gaseous fraction predominating in hydrocarbons of 3 and 4 carbon atoms, recycling said gaseous fraction to the cracking operation and commingling with the products undergoing cracking ½ to 1% oxygen to promote the conversion of oil and gaseous hydrocarbons to intermediate boiling point products suitable for the manufacture of gasoline.

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