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METHOD AND APPARATUS FOR CONVERTING HYDROCARBONS

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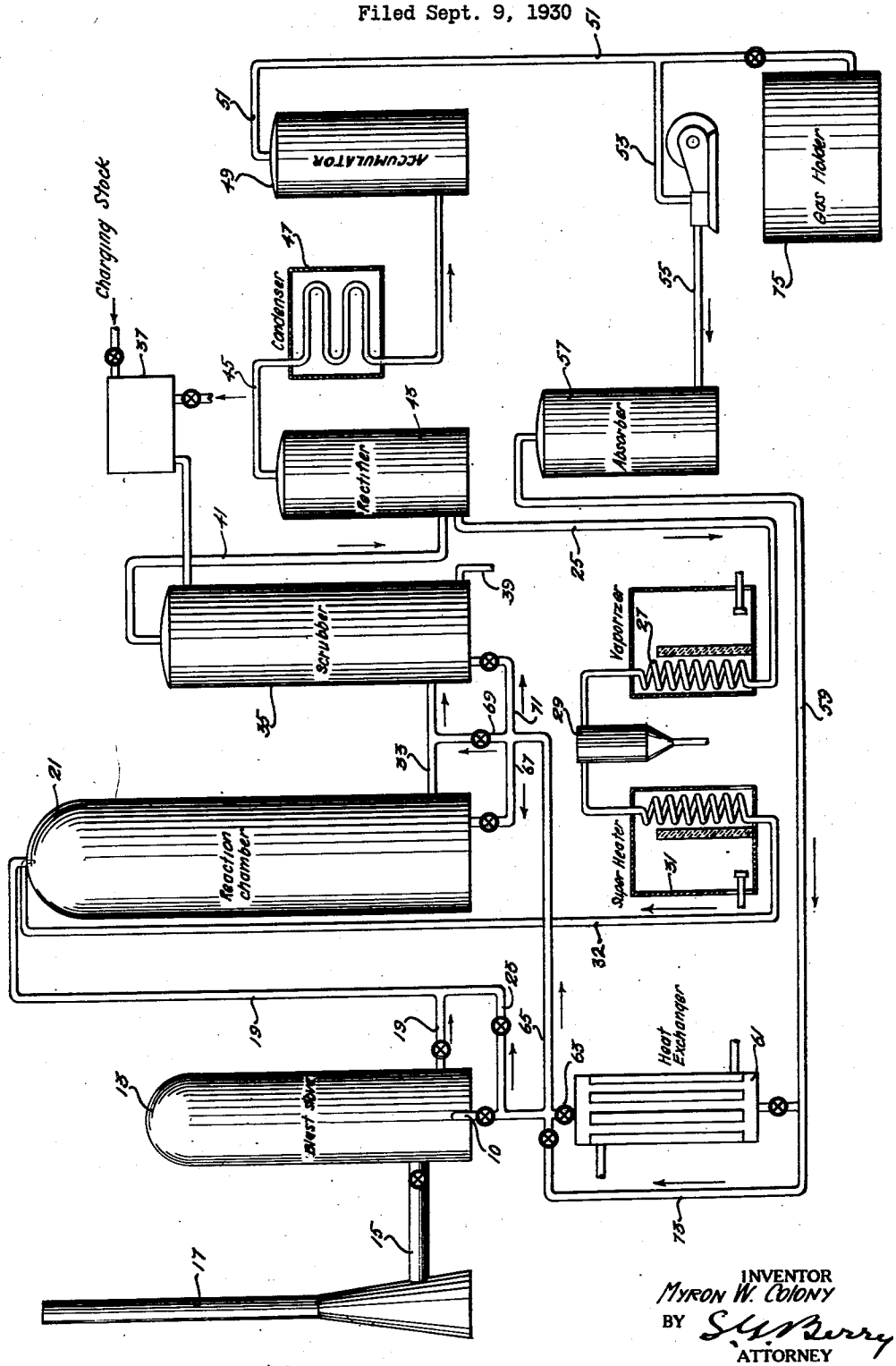

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METHOD AND APPARATUS FOR CONVERTING HYDROCARBONS

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4 Claims. (Cl. 196—66)

My present invention relates to improvements in methods in and apparatus for converting hydrocarbon oils, particularly for the purpose of producing motor fuels of the gasoline type. In the system of oil conversion to which my invention is applicable, hydrocarbon material as, for example, petroleum oil, is first vaporized and the vapor led to a reaction chamber wherein it is converted by the action of a neutral, non-condensible heat-carrier gas which has been raised to a suitable temperature, as by means of a heater of the regenerative type. The carrier gas, admixed with the vapor products, is then passed from the reaction chamber and led to a scrubbing chamber wherein it is contacted with oil which washes out the carbon contained in the gas and vapor products. This oil preferably is constituted in part by the charging stock. Part of such oil is vaporized, and the vapor is led off with the vapors of the desired cracked product which is still uncondensed. The products are then subjected to further condensation conditions to separate out first the comparatively heavy fractions suitable for conversion, and then fractions are suitable for motor fuels which, usually, are the desired product of the system. The carrier gas after being stripped of residual vapors may be divided into a portion which is led out of the system, and a portion which is led back into the system and suitably heated by available heat therein. The gas is then admixed to the regenerative heater to recommence another cycle. The presence of a large volume of gas in the scrubber greatly facilitates the vaporization of the oil therein, and in the present invention this effect is relied upon to vaporize all the fractions in the charging stock which it is desired to convert.

The present invention seeks to provide for maintaining the proper balance between the amount of carrier gas needed to convert the oil, and that which is subsequently required to vaporize the desired components of the charging stock. In accordance with my invention, I admit additional carrier gas, preferably heated to a suitable temperature, to the scrubber in order that sufficient carrier gas may be present to accomplish the desired vaporization of the charging stock.

My invention will be best understood by reference to the following detailed description taken with the annexed drawing, in which the single figure shows a layout of apparatus containing a preferred embodiment of the invention.

Referring to the drawing in detail, gas from pipe 10 from a source to be described is admitted to heater 13 which is conveniently of the hot blast stove type. This heater has, previous to the admission of the gas, been fired with fuel from a source (not shown) until it is at the requisite temperature e. g. 1500 to 1800° F., during which operation the products of combustion are led out through a pipe 15 and up a stack 17. When the desired temperature in the stove has been reached, the combustion is stopped, the stove purged of combustion gases, and the heat-yielding cycle begun by admitting carrier gas through pipe 10. The gas passes through the stove and is thereby heated and leaves same through a pipe 19 and passes to reaction chamber 21. A bypass 23 from pipe 10 to pipe 19 provides for the admission to pipe 19 of a regulated supply of the unheated gas for the purpose of maintaining the temperature of the gas in pipe 19 substantially constant.

Oil vapor to be converted is admitted to reaction chamber 21 and is produced preferably in the following manner: Oil to be converted from rectifier 43 to be described, passes through pipe 25 through a vaporizer 27 and thence to a flash drum 29. Vapor from this drum is then passed to a superheater 31 where it is rapidly superheated without sufficient time elapsing for it to become cracked. The superheated oil vapors leave the heater 31 thru pipe 32 through which they are conducted to chamber 21 where they mingle with the carrier gas therein, are by it converted by virtue of the fact that the carrier gas is of sufficient quantity and temperature to bring about such conversion at a temperature in excess of 900° F. and preferably at approximately 960° F. The converted products, including the carrier gas, then leave the chamber through pipe 33 and pass thence into scrubber 35. Here the products are washed with oil from tank 37 constituting in part, at least, the charging stock, in which operation the gas and vapor products are thoughly scrubbed and are deprived of their carbon and a portion of their heat content. The unvaporized scrubbing oil leaves the scrubber through a pipe 39, whence it is passed to suitable heat exchange devices not necessary to describe herein whereupon a portion thereof is removed from the system as residue, and a further portion returned to tank 37 by piping not shown.

The scrubbed products leave the scrubber 35 through pipe 41 and are admitted to a rectifier 43 wherein the fractions suitable for cracking are dropped out and leave through pipe 25, above

mentioned. The products uncondensed from rectifier 43 leave through a pipe 45 and pass to a condenser 47 wherein the desired products of the system, such as motor fuel, are dropped out and collected in accumulator 49. The carrier gas leaves the accumulator through pipe 51 and may be passed therefrom through pipe 53 and pump 55 to an absorber 57 wherein the residual vapors are stripped from the gas by means well understood in the art. The stripped gas then passes through pipe 59 to a heat exchanger 61 through which may be circulated the hot scrubbing liquid from scrubber 35 by means of piping, not shown. The carrier gas preferably at a temperature of 500° F. leaves the heat exchanger 61 through a pipe 63 and thence through a pipe 65. This pipe, which admits the desired excess carrier gas to the scrubber, preferably has three branches 67, 69, 71, so that the gas can be admitted either to the bottom of the reaction chamber through pipe 67 or into pipe 33 connecting the reaction chamber with the scrubber, or through pipe 71 joining the scrubber directly. In order that the temperature of the gas may be regulated, a by-pass 73 is provided around a heat exchanger 61 so that if desired the gas used may have a temperature lower than the gas issuing from the heat exchanger through pipe 63. Gas which is not used for recycling may be accumulated in tank 75 which connects with an extension of pipe 51.

The effect of the added gas is to facilitate evaporation both by lowering the partial pressures on the components of the oil undergoing evaporation, and by furnishing additional heat. It will be evident, however, that the added gas will facilitate evaporation, even through its temperature may vary considerably. Accordingly, it will be seen that by the use of the supply of gas through pipe 65 conditions in the scrubber may be accurately controlled whereby complete vaporization may be effected of the fractions which it is desired to convert.

I claim:

1. In an apparatus for converting hydrocarbons, a reaction chamber, a source of heat-carrier gas, means for admitting hydrocarbon compounds into said reaction chamber, there to be subjected to the action of the heat-carrier gas, a scrubbing chamber, means for leading off the gas and vapor products from said reaction chamber and admitting them directly to said scrubbing chamber, means for admitting charging stock to the scrubbing chamber, means for separating from said carrier gas the desired products of the conversion reaction, means for leading back to the system the residual carrier gas, means for utilizing a portion of said gas to regulate the vaporization of the desired components of the charging stock including means for heating said residual gas comprising a heat exchange apparatus and a by-pass therefor.

2. In the process of converting hydrocarbons by the aid of a heated non-condensible heat-carrier gas, the steps which consist in admitting hydrocarbon liquid to a vaporizing zone, admitting to a reaction zone the hydrocarbon vapor formed in said vaporizing zone and said heated heat-carrier gas, said reaction zone being maintained at a temperature of in excess of 900° F., passing the non-liquid fluid products from said reaction zone after the conversion has proceeded to the desired degree directly to a scrubbing zone, there introducing a scrubbing liquid comprising in part at least the charging stock under conditions of temperature and of gas to liquid contact as to vaporize from said stock substantially all the components which it is desired to convert in said reaction zone, and regulating the degree of vaporization of said stock by admitting to said scrubbing zone a supply of a neutral gas independent of the gas comprised in said non-liquid fluid products, then passing said stream of products from said scrubbing zone to a third zone, there condensing out the heavier fractions in said stream, and recommencing the cycle by subjecting said fractions to vaporizing conditions and passing the produced vapor to said reaction zone to be converted without returning any of the residual scrubbing liquid to the vaporizing zone and then recovering the converted products of a boiling point suitable for motor fuels by subjecting said stream of products to further condensation.

3. In the process of converting hydrocarbons by the aid of a heated non-condensible heat-carrier gas, the steps which consist in admitting to the reaction zone the hydrocarbons in vapor form and said heat-carrier gas, passing the non-liquid fluid products from said reaction zone after the conversion has proceeded to the desired degree directly to a scrubbing zone, passing charging stock from a bulk supply directly to said scrubbing zone without stripping said stock of vaporizable components and causing it to contact with said non-liquid fluid products under conditions resulting in the vaporization from said stock of the components thereof which it is desired to convert in said reaction zone, and regulating the vaporization of said stock by admitting to said scrubbing zone a supply of a neutral gas independent of that contained in the non-liquid fluid products, then passing said stream of products from said scrubbing zone to a third zone, there condensing out the heavier fractions in said stream, subjecting said fractions to vaporizing conditions and passing the produced vapor to said reaction zone to be converted and recovering the converted products of a boiling point suitable for motor fuels by subjecting said stream of products to further condensing conditions.

4. In the process of converting hydrocarbons by the aid of a heated, non-condensable heat-carrier gas, the steps which consist in admitting to a reaction zone the hydrocarbons in vapor form and said heat-carrier gas and there conducting the conversion reaction in the absence of liquid oil, passing the non-liquid fluid products from said zone in a stream directly to a scrubbing zone, there introducing a scrubbing liquid comprising in part at least the charging stock under conditions of temperature and of gas to liquid contact as to vaporize from said stock substantially all the components which it is desired to convert in said reaction zone, and regulating the degree of vaporization of said stock by admitting to said scrubbing zone a supply of a neutral gas independent of the gas comprised in said non-liquid fluid products, then passing said stream of products from said scrubbing zone to a third zone, there condensing out the previously vaporized charging stock in said stream and then returning to the reaction zone as vapor said stock so obtained, and then recovering the converted products having a boiling point suitable for motor fuels by subjecting said stream of products to further liquefaction conditions.

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