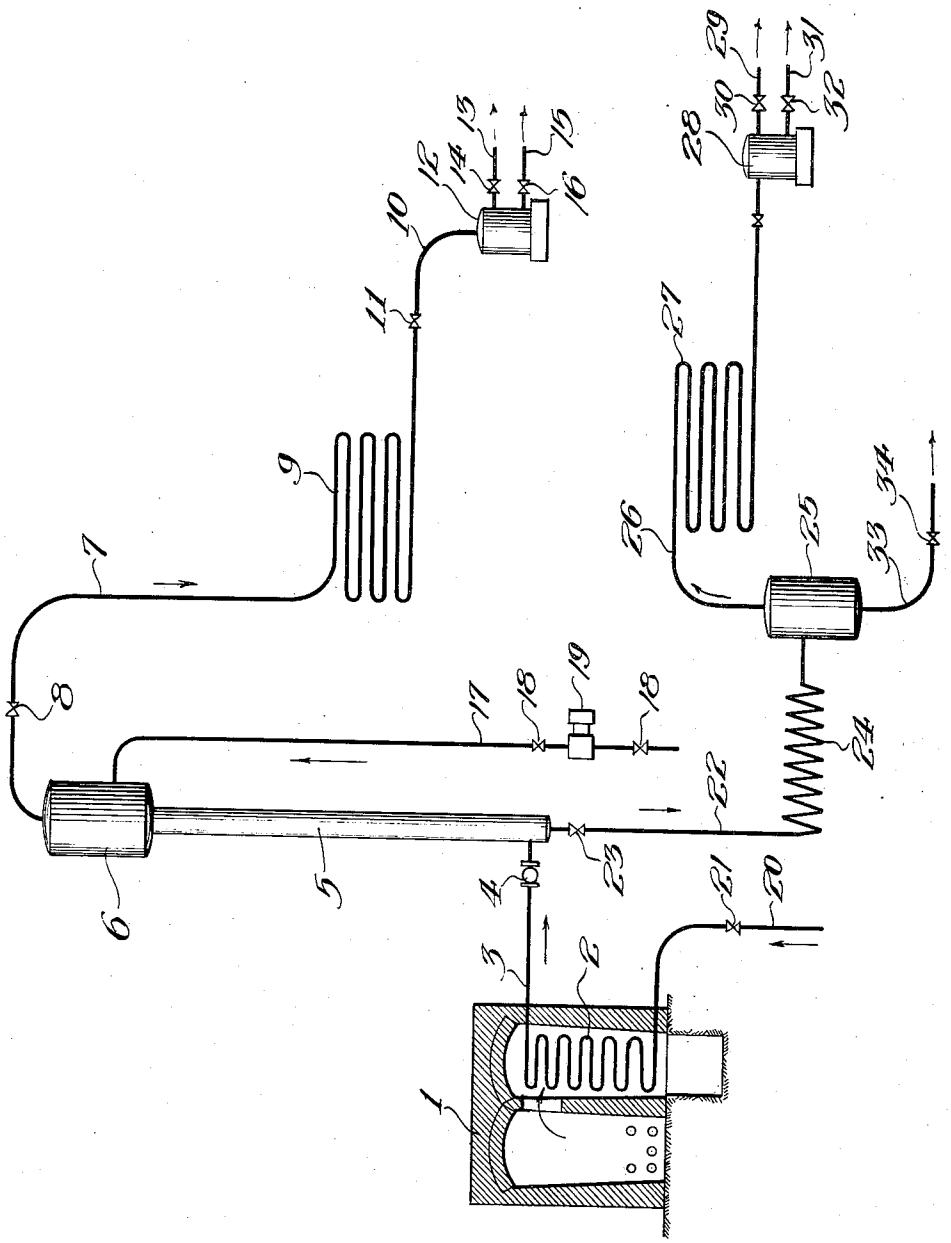
March 19, 1935. R. C. COOK 1,994,982

HYDROGENATION OF HYDROCARBONS

Filed July 21, 1928



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Patented Mar. 19, 1935 1,994,982

UNITED STATES PATENT OFFICE

1,994,982

HYDROGENATION OF HYDROCARBONS

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Application July 21, 1928, Serial No. 294,369

3 Claims. (Cl. 196—66)

This invention relates to improvements in hydrogenation of hydrocarbons, and relates more particularly to the conversion of heavy oils into gasoline or other desirable lighter hydrocarbons by the use of incondensable gas from a liquid, liquid-vapor, or vapor phase cracking process.

More specifically, it relates to the conversion of either cracked or uncracked residuum by subjecting same to the influence of incondensable gas produced as a by-product in the cracking and conversion of hydrocarbons to produce desirable commercial products.

The invention comprises subjecting said residuum while in contact with incondensable gas and hydrogen to high pressures and temperatures; if incondensable gas produced in the cracking operation is not already sufficiently rich in hydrogen for the purpose of the invention, the process includes preliminary operation whereby the hydrogen concentration of the incondensable gas is increased.

It is known, in the treatment of carbonaceous materials, such as coal, when finely powdered and mixed with a liquid petroleum and treated under high heat and pressure in contact with hydrogen, that a chemical union takes place, wherein a certain portion of the carbonaceous material is liquefied and a portion of it is even converted into lighter hydrocarbons such as those of the gasoline series.

In conventional cracking processes a certain portion of the intermediate oils is converted into fixed gas, heavy residuum and some carbon, constituting a substantial loss in value of products of the operation.

One of the objects of this invention comprises bringing about conditions whereby this loss will be minimized by again uniting the incondensable gas and residuum in such a manner as to form a material quantity of gasoline-like products as well as other desirable products.

The present process provides for the conversion of the heavy oils above referred to through the agency of the hydrogen contained in incondensable gas produced as a by-product from cracking under high heat and pressure. Numerous ways can be conceived by those skilled in this art by which this process may be carried out, and the accompanying drawing merely shows one form of apparatus which is suitable for the operation of the process. The utility of the invention as well as other objects and advantages thereof will be more particularly apparent from the following description.

The single figure in the drawing is a diagrammatic elevational view, partly in vertical section, of apparatus in which the invention may be carried out.

Referring more in detail to the drawing, 1 designates a furnace in which is located a tube or coil 2 communicating through a transfer line 3, in which may be interposed check valve 4, with a column 5 on which is superposed a drum 6 communicating through the medium of the line 7, in which may be interposed a valve 8, with the condenser 9. The latter may communicate through the medium of the line 10, in which may be interposed a valve 11, with a receiver 12 of conventional type which may be provided with the incondensable gas relief pipe 13, in which may be interposed valve 14, and with liquid draw-off line 15, in which may be interposed a valve 16.

Residuum may be charged to the system through the line 17, in which may be interposed the valves 18 and pump 19, said residuum being charged to the drum 6, filling the column 5. Incondensable gas may enter the system through the line 20, in which may be interposed a valve 21, being heated to a high temperature while passing through the coil 2. After passing through the heating coil 2, said incondensable gas may pass through the transfer line 3 into the column 5 where it will transfer a portion of its heat to the residuum contained therein. The excess incondensable gas may pass out through drum 6 and condenser 9 and be finally removed from receiver 12 through line 13, from which point it can either be returned to the system through the line 20 or discharged for other purposes.

After the residuum has been heated to the proper temperature, which will be in the neighborhood of from 800 to 900° F., more or less, a reaction will gradually take place between the incondensable gas entering at the bottom of the column 5 and the residuum contained in said column, whereby a portion of the heavy oil will be converted into lighter hydrocarbons by chemical reunion with the hydrogen contained in the incondensable gas. Said lighter oils will pass out through the top of drum 6, being condensed in the condenser 9 and collected as distillate in the receiver 12, from which it may be removed through liquid draw-off line 15. The residual or spent oil may be withdrawn through the line 22, in which may be interposed a valve 23, passing through a cooler 24 and into a separator 25. Any vapors released in separator 25 may be removed through line 26, condensed in the condenser 27 and collected as liquid distillate in the receiver 28, which latter may be provided

with the incondensable gas relief line 29, in which may be interposed a valve 30, and with the liquid draw-off line 31, in which may be interposed a valve 32. The residual oil may be withdrawn from the separator 25 through line 33, in which may be interposed a valve 34.

As a feature of the present invention, the process of hydrogenation is carried out while maintaining the process and apparatus under a pressure of from 1000 to 5000 lbs. per square inch, more or less, and special care, of course, is necessary in the selection of materials of which the apparatus is constructed. Residuum being removed through the line 22 will have its pressure materially reduced, if not released altogether, through proper manipulation of the valve 23 whereby vaporization may take place in separator 25 through the latent heat contained in said residue.

I have illustrated in the apparatus and have described the process as requiring the incondensable gas to be heated in the coil 2. This will be necessary in some instances for the purpose of conditioning the incondensable gas by heating it to a high temperature ranging from 1300 to 2000° F., more or less. The object of this heating is to crack the incondensable gas into smaller molecules in which the hydrogen percentage will be markedly increased. Under certain conditions it may be necessary to cool the gas before introducing same into the tubular column 5, which can be accomplished in any suitable manner by direct or indirect cooling means (not shown).

The step of heating the incondensable gas to the high temperatures referred to for the purpose of increasing the percentage of hydrogen contained therein is not necessary where the percentage of hydrogen in the incondensable gas is high enough for satisfactory processing.

I claim as my invention:

1. A process for producing low boiling hydrocarbon distillates from hydrocarbon gas and unvaporized residuum obtained in the cracking of hydrocarbon oils which comprises first heating the gas sufficiently to substantially increase its free hydrogen content and to impart sufficient heat thereto to maintain the residuum at hydrogenating temperature, then contacting the thus heated gas with the residuum under a pressure of at least 1000 pounds per square inch and thereby hydrogenating the residuum, and removing and condensing the resultant vapors.

2. A process for producing low boiling hydrocarbon distillates from hydrocarbon gas and unvaporized residuum obtained in the cracking of hydrocarbon oils which comprises first heating the gas sufficiently to substantially increase its free hydrogen content, then contacting the thus heated gas with the residuum under a pressure of at least 1000 pounds per square inch and thereby hydrogenating the residuum, lowering the pressure on the hydrogenated residuum and thus distilling the same, and condensing the resultant vapors.

3. A process for producing low boiling hydrocarbon distillates from hydrocarbon gas and unvaporized residuum obtained in the cracking of hydrocarbon oils which comprises first heating the gas sufficiently to substantially increase its free hydrogen content and to impart sufficient heat thereto to maintain the residuum at hydrogenating temperature, then contacting the thus heated gas with the residuum under a pressure of at least 1000 pounds per square inch and thereby hydrogenating the residuum, lowering the pressure on the hydrogenated residuum and thus distilling the same, and condensing the resultant vapors.

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