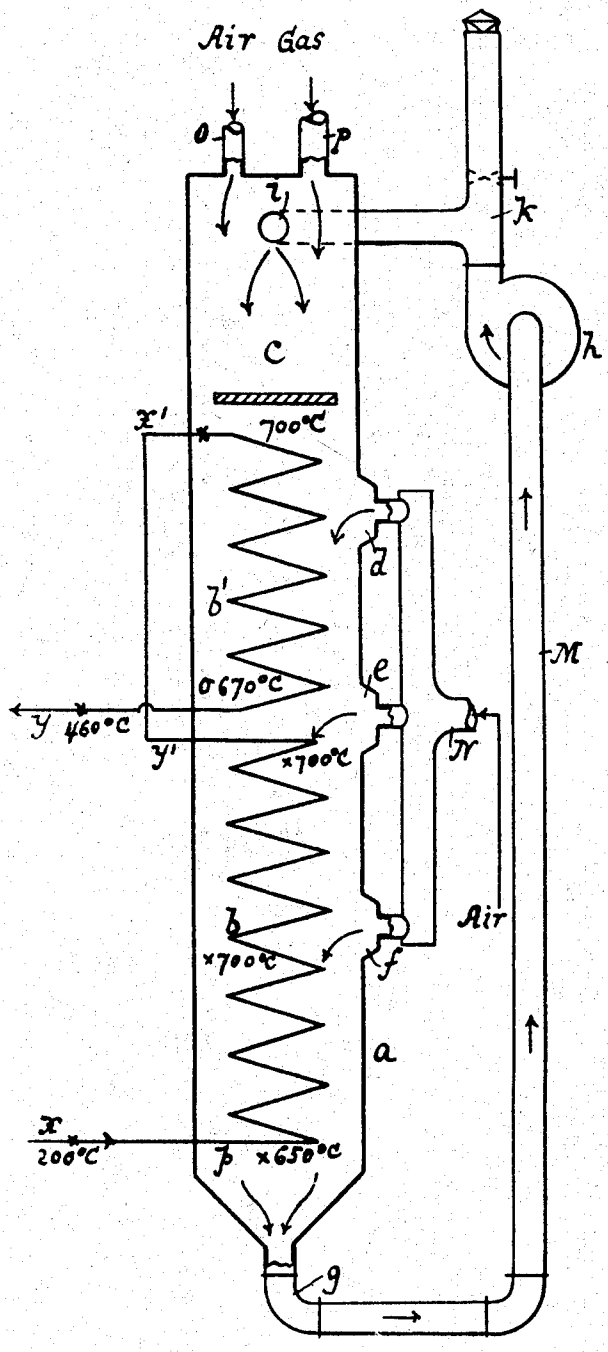
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PREHEATING CARBONACEOUS MATERIALS

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PREHEATING CARBONACEOUS MATERIALS

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This invention relates to improvements in and apparatus for preheating carbonaceous materials, which are to be subjected to heat treatments for the production of useful hydrocarbon products.

When working up carbonaceous materials such as various kinds of coal, tars, mineral oils and the like as well as materials containing coal and oil in general, as for example by destructive hydrogenation which, as is known, is carried out at temperatures between 300° and 700° C. and under an elevated pressure of at least 20 atmospheres, the initial material, namely the hydrogen or the hydrogen-containing gases on the one hand and the carbonaceous material on the other, have hitherto usually been preheated separately and then supplied to the reaction vessel. In this manner, especially at high temperatures as for example about 450° C., objections sometimes arise such as the deposition of carbon. The methods of heating employed in cracking processes also often lead to difficulties.

I have found that these objections are obviated by indirectly preheating the carbonaceous initial materials, if desired, together with hydrogen or hydrogen-containing gases, by burning combustible gases or vapors or atomized combustible substances in stages at several points. All of these substances are hereinafter referred to for the sake of brevity as "dispersed combustibles." It is thereby insured that the walls of the vessels containing the initial material, as for example, spiral pipes, are uniformly heated in all places so that injuries to the constructional material or leakage from the apparatus are avoided.

Any industrial combustible gases may be employed as dispersed combustibles in the process according to the present invention, and as examples may be mentioned water gas, producer gas, power gas, coal gas, hydrogen, carbon monoxide, methane, natural gas, combustible waste industrial gases, such as waste gases from destructive hydrogenations, cracked gases and the like. As further examples of dispersed combustibles may be mentioned mineral oil vapors or vaporized fuel oils. Pulverized solid fuels such as powdered coal or coke may also be employed, where these latter substances are available in large amounts. As examples of gases supporting combustion may be mentioned air, oxygen, or mixtures of air and oxygen.

The combustion in stages is effected either by employing the combustible itself or else the gas supporting combustion in great excess, and then adding in stages a gas supporting combustion in the first case, or a dispersed combustible in the second case. Since the injurious variations in temperature are avoided according to the present invention, it is possible to employ cheaper materials in the construction of the apparatus such as only slightly alloyed chromium or chromium nickel steels, or ordinary steels instead of particularly expensive and valuable materials as for example, highly alloyed steels. In order better to utilize the energy, a part of the combustion gases may be led back again into the heating chamber and thus at the same time local increases in temperature are avoided in all cases when supplying fresh gas in stages.

The preheating process according to the present invention is not only applicable in destructive hydrogenation and cracking processes, but also in other methods of working up carbonaceous materials by heat treatment such as low temperature carbonization, coking or heat-pressure treatments of carbonaceous materials with or without the employment of solvents.

The materials to be preheated according to the present invention may be under any desired pressure. They should however be under a pressure not lower or not very much lower than that prevailing in the process in which they are to undergo conversion, and may also be under a higher pressure.

The following example, given with reference to the accompanying drawing, will further illustrate the nature of this invention, but the invention is not restricted to this example, nor to the particular arrangement of apparatus shown in the drawing.

Example

A preheating coil *b*, which is situated in a fire chamber *a*, has an inlet at *x* where a carbonaceous product, preheated in any suitable manner to 200° C., is introduced together with hydrogen. The coil *b* extends about half way through the fire chamber *a*, and the material contained in the coil is then passed out of the chamber at y_1, and by-passed to the other end of the chamber *a*, where it is introduced into the coil b_1 at x_1 and passed back to the middle part of the chamber in opposite direction. The preheated material leaves the coil b_1 at *y* at a temperature of 460° C. in order to be converted into low boiling hydrocarbons in a closed reaction chamber with hydrogen under pressure. Combustible gas and air are so mixed in a combustion chamber *c* that the combustible gas is present in excess. The air which is lacking in order to insure complete combustion is supplied in stages at *d*, *e* and *f*. At these points the gases employed for heating are brought up to temperatures of 700° C. At the ends of the coils b_1 and *b* at *o* and *p*, they have temperatures of 670° and 650° C. respectively. A fan *h* sucks the gases of combustion away at *g* and returns them to the fire chamber *a* again at *i*. The excess of combustion gases passes through *k* to the open air.

In the above example and in the drawing,

merely the preheating stage of the process is described fully.

What I claim is:

1. In the destructive hydrogenation of carbonaceous materials, the step of preheating said materials by burning a mixture of a dispersed combustible and a gas supporting combustion, one of these components being present in a large excess and fresh portions of the other component being supplied to the combustion gases at at least one point different from the point of the initial combustion, bringing the initial carbonaceous material in a restricted stream into indirect heat exchange relation with the coolest combustion gases and then gradually heating the initial material by causing it to flow in indirect heat exchange relation with gases of gradually increasing temperature until the hottest combustion gases are reached and then passing the initial material through and in indirect heat exchange relation with the hottest combustion gases produced at the combustion points until the desired temperature is attained.

2. In the destructive hydrogenation of carbonaceous materials, the step of preheating said materials by burning a mixture of a combustible gas and air, one of these components being present in a large excess and fresh portions of the other component being supplied to combustion gases at at least one point different from the point of initial combustion, bringing the initial carbonaceous material in a restricted stream into heat exchange relation with the coolest combustion gases and then gradually heating the initial material by causing it to flow in indirect heat exchange relation with gases of gradually increasing temperature until the hottest combustion gases are reached and then passing the initial material through and in indirect heat exchange relation with the hottest combustion gases produced at the combustion points until the desired temperature is attained.

3. In the destructive hydrogenation of carbonaceous materials, the step of preheating said materials by burning a mixture of a combustible gas and a large excess of air, introducing fresh portions of the combustible gas at at least one point different from the point of initial combustion, bringing the initial carbonaceous material in a restricted stream into indirect heat exchange relation with the coolest combustion gases and then gradually heating the initial material by causing it to flow in indirect heat exchange relation with gases of gradually increasing temperature until the hottest combustion gases are reached and then passing the initial material through and in indirect heat exchange relation with the hottest combustion gases produced at the combustion points until the desired temperature is attained.

4. In the destructive hydrogenation of carbonaceous materials, the step of mixing the carbonaceous materials with hydrogen and preheating the mixture by burning a mixture of a dispersed combustible and a gas supporting combustion, one of these components being present in a large excess and fresh portions of the other component being supplied to the combustion gases at at least one point different from the point of the initial combustion, bringing the initial carbonaceous material mixed with hydrogen in a restricted stream into indirect heat exchange relation with the coolest combustion gases and then gradually heating the initial material by causing it to flow in indirect heat exchange relation with gases of gradually increasing temperature until the hottest combustion gases are reached and then passing the initial material through and in indirect heat exchange relation with the hottest combustion gases produced at the combustion points until the desired temperature is attained.

5. In the destructive hydrogenation of carbonaceous materials the step of preheating said materials by burning a mixture of a dispersed combustible and a gas supporting combustion, one of these components being present in a large excess, bringing the hot combustion gases into indirect heat-exchange relation with the said materials, using the said excess for combustion in stages with fresh portions of the other component supplied to the said combustion gases at several different points and bringing the gases thus obtained into further indirect heat-exchange relation with the said materials, these materials being first passed in counter-current to the hot combustion gases in the coolest part of said gases, then out of indirect contact with these gases and thereupon back into indirect contact with a hotter part of said gases, but in the same direction as these gases.

6. In the destructive hydrogenation of carbonaceous materials, the step of preheating said materials by burning a mixture of a dispersed combustible and a gas supporting combustion, one of these components being present in a large excess and fresh portions of the other component being supplied to the combustion gases at at least one point different from the point of the initial combustion, bringing the initial carbonaceous material in a restricted stream into indirect heat exchange relation with the coolest combustion gases, then gradually heating the initial material by causing it to flow in indirect heat exchange relation with gases of gradually increasing temperature until the hottest combustion gases are reached, passing the initial material through and in indirect heat exchange relation with the hottest combustion gases produced at the combustion points until the desired temperature is attained and finally passing the initial material through gases of gradually decreasing temperature.

7. In the destructive hydrogenation of carbonaceous materials, the step of preheating said materials by burning a mixture of a dispersed combustible and a gas supporting combustion, one of these components being present in a large excess and fresh portions of the other component being supplied to the combustion gases at at least one point different from the point of the initial combustion, bringing the initial carbonaceous material in a restricted stream into indirect heat exchange relation with the coolest combustion gases, then gradually heating the initial material by causing it to flow in indirect heat exchange relation with gases of gradually increasing temperature until the hottest combustion gases are reached, passing the initial material through and in indirect heat exchange relation with the hottest combustion gases produced at the combustion points, then as the carbonaceous material attains the desired reaction temperature preventing a high differential of temperature between the heating gases and the carbonaceous material by passing said material in concurrent flow and in indirect heat exchange with gases of gradually decreasing temperature.

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