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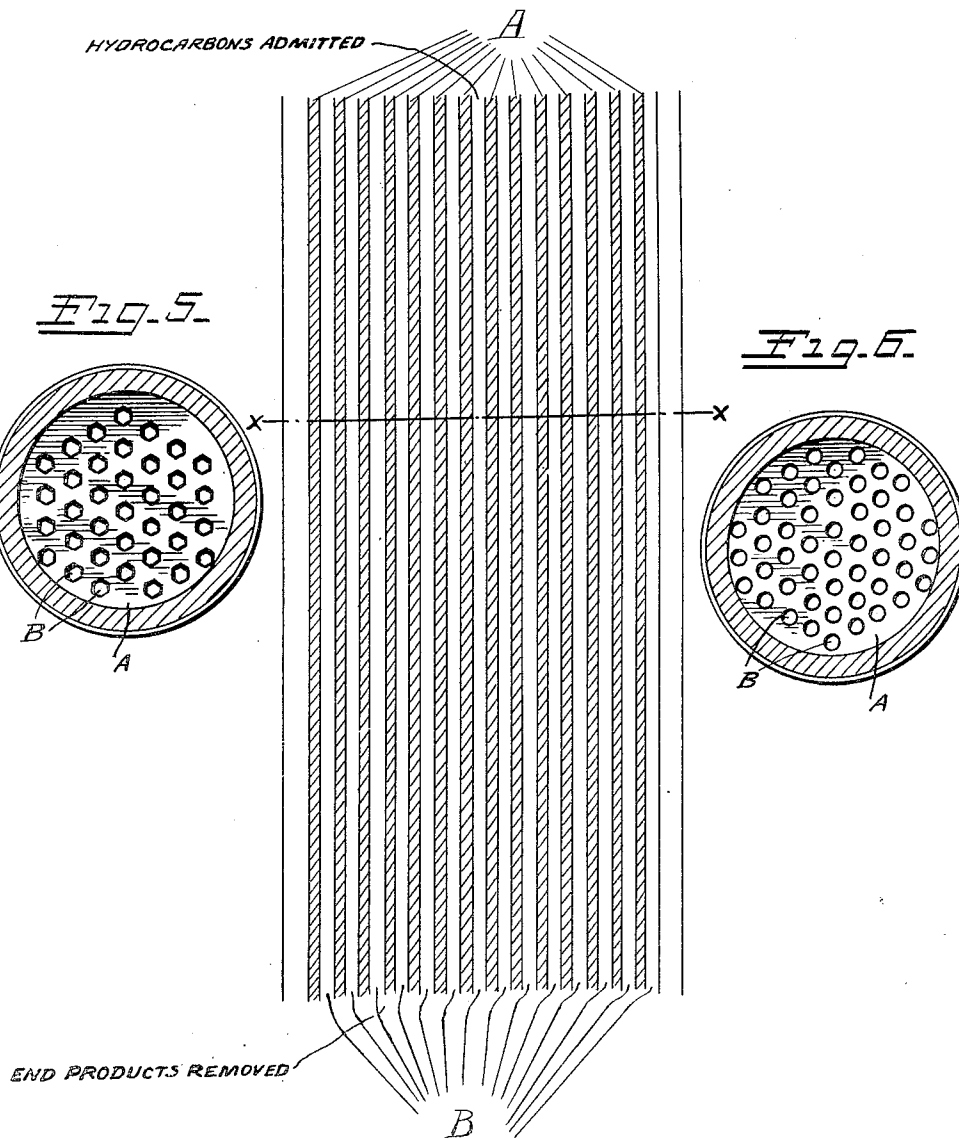
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CONVERSION OF HYDROCARBONS

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Fig. 1



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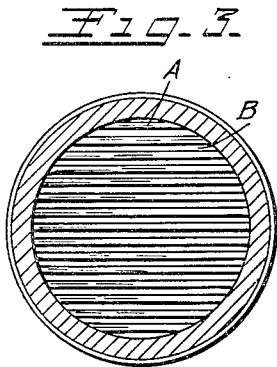
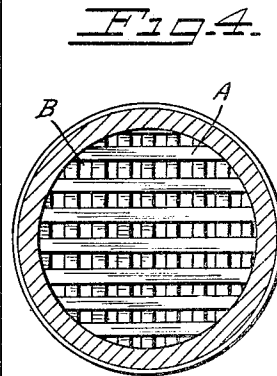
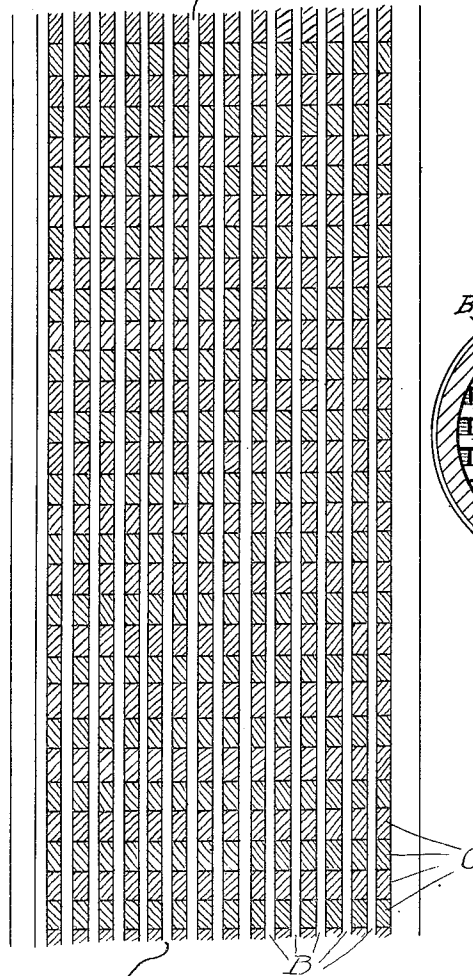
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Fig. 2.

HYDROCARBONS ADMITTED



END PRODUCTS REMOVED

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CONVERSION OF HYDROCARBONS

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6 Claims. (Cl. 196—10)

This invention relates to improvements in the thermal conversion of hydrocarbons and especially conversions in the gaseous phase, which expression also includes the vaporous phase in reaction chambers provided with fillers, and in apparatus for carrying out the said conversion.

We have found that the thermal conversion of hydrocarbons in reaction chambers provided with fillers is carried out with considerably better yields of the desired reaction products than was hitherto possible by maintaining the same linear velocity of flow of the said hydrocarbons over all parts of the surfaces of the fillers and by avoiding the presence in the path of the flowing hydrocarbons of surfaces, which would exercise a baffling action.

This is effected by arranging the fillers regularly and by providing regular channels between the said fillers, which channels should be of approximately the same diameter throughout and by avoiding sharp bends in the said channels. The said channels are advantageously straight and preferably pass throughout the whole of the reaction chamber.

In this manner irregular flowing and congestion giving rise to local overheating of the reaction products, such as was liable to take place in the arrangements hitherto employed, in which the filling bodies were charged irregularly into the reaction chamber or in which the flowing hydrocarbons encountered sharp bends, are entirely avoided. Also the deposition of carbon in the form of soot on the fillers is substantially avoided in accordance with the present invention, even if the process be carried out at very high temperatures above 900° or 1000° C. or more.

The channels between the filling bodies may have the shape of cylindrical bores, rectangular shafts or prisms. If desired the filling bodies may be entirely in one piece and the said channels may be bored therethrough.

In order to avoid congestion of the gases in the reaction chamber with greater certainty, it is advantageous to arrange the filling bodies in front of and behind the reaction zone in the same way as in the reaction zone itself. In this manner an unhindered passage of the substances to be treated and a rapid withdrawal of the reaction products is ensured.

The filling bodies may be supported by a grate, which is also preferably made of such a shape as to avoid the setting up of congestions in the flow of the materials undergoing treatment. Preferably the openings in the grate should have a similar shape to that of the channels. The filling

bodies may also be hung up in the reaction chamber with the aid of a suitable support arranged at the top of the reaction vessel.

Furthermore, it has been found to be advantageous to provide the parts of the reaction chamber, which come into contact with the gases or vapours, especially the filling bodies and the walls, with surfaces which are as smooth as possible, as for example, by glazing, because this precaution also contributes to the avoidance of undesirable deposits of carbon. In many cases it is even preferable to employ a filling having highly polished surfaces.

The special arrangement and nature of the filling bodies according to this invention are suitable when working under any pressure and for continuous or periodic operation.

The said filling bodies may be constructed of a material capable of retaining large amounts of heat as for example chamotte. They may further be constructed of materials exercising a catalytic action as for example silicon or silicon carbide or materials containing these if desired together with binding agents such as clay.

The process is applicable to the cracking or destructive hydrogenation of hydrocarbons in the liquid, but more especially in the gaseous or vaporous phase, particularly in the production of aromatic hydrocarbons according to the said processes, to the conversion of gases comprising methane or its homologues or gases containing these into olefines and other hydrocarbons such as benzene and its homologues, or to the production of hydrogen and gases containing hydrogen from hydrocarbons by treatment of these hydrocarbons with water vapor or oxygen or gases containing free oxygen such as air or carbon dioxide or mixtures of these gases.

Where it is desirable, diluent gases such as nitrogen may also be present in the said process. This may prove advantageous where a reduction of the partial pressure of the initial hydrocarbons is desirable as in the production of olefines or of diolefines.

Figures 1 and 2 of the accompanying drawings represent vertical sections of reaction chambers very suitable for carrying out the before-described conversion of hydrocarbons. Figure 3 shows a horizontal cross section along line X—X of Figure 1. Figures 4, 5 and 6 show horizontal cross sections of other arrangements of the fillers. Figures 1 and 2 are with reference to the following examples which will further illustrate the nature of this invention, but the invention is not restricted to these examples.

Example 1

A reaction chamber about 6 meters in height and about 26 centimeters broad and lined with chamotte is filled with well polished chamotte plates A as shown in Figure 1 which are 1 centimeter apart in such a way that shaft-shaped channels B pass through the whole reaction chamber. If 1 cubic meter of a gas containing 90 per cent methane be passed through the reaction chamber heated to about 1100° C., about 35 grams of liquid hydrocarbons consisting to the extent of 70 per cent of benzene are obtained smoothly without any deposition of soot.

If, on the contrary, a chamber irregularly filled with pieces of chamotte be employed under the same conditions considerable deposits of soot are noticed at those places at which a congestion of the gas takes place. Moreover the reaction gas contains more hydrogen than in the former case.

Example 2

This example is with reference to Figure 2. Cube shaped bodies C (the length of the edges being from about 8 to 10 millimeters) prepared from silicon powder by moulding with a binding agent are so arranged in an internally tinned high-pressure tube of chromium-nickel steel 1200 millimeters long and 45 millimeters in internal diameter, that channels B having a cross section as uniform as possible pass throughout the reaction chamber. A gas mixture consisting of 28.5 per cent of butane (by volume), 20.3 per cent of propane, 12.9 per cent of ethane, 22.1 per cent of nitrogen and also some butylene, propylene, ethylene, methane and hydrogen is preheated to about 440° C. and then passed at the rate of 850 liters per hour and under a pressure of 50 atmospheres through the said tube heated for 500 millimeters of its length to about 550° C. 1200 liters per hour of a gas mixture are obtained which contains 2.6 per cent by volume of butane, 10.4 per cent of propane, 17.8 per cent of ethane, 15.7 per cent of nitrogen, 37.6 per cent of methane and also butylene, propylene, ethylene and hydrogen. Furthermore, 95 grams of liquid hydrocarbons which are composed of saturated and unsaturated

aliphatic hydrocarbons may be condensed from each cubic meter of gases or vapors leaving the reaction vessel. 40 per cent of these hydrocarbons, which are suitable for example for the preparation of fuels and lubricating oils, boil up to 120° C. and 70 per cent boil up to 270° C. The conversion of the hydrocarbons in the said manner proceeds without the deposition of soot.

What we claim is:

1. In the production of aromatic hydrocarbons by thermal conversion of gaseous hydrocarbons which comprises effecting the conversion while preventing deposition of carbon by passing said gaseous hydrocarbons, while under a temperature suitable for the conversion, at a uniform velocity through a reaction space having a plurality of straight, unobstructed and similar passages extending longitudinally throughout the entire length of said reaction space and defined by walls comprising essentially a material selected from the class consisting of chamotte, silicon and silicon carbide.

2. The process as defined in claim 1 wherein said passages have substantially the same cross-sectional area.

3. The process as defined in claim 1 wherein said conversion is effected at a temperature ranging between about 900° and about 1100° C.

4. The process as defined in claim 1 wherein the surfaces of said passageways are substantially smooth.

5. The process as defined in claim 1 wherein said initial hydrocarbons are normally gaseous hydrocarbons.

6. In the production of aromatic hydrocarbons by thermal conversion of gaseous hydrocarbons which comprises effecting the conversion while preventing deposition of carbon by passing said gaseous hydrocarbons while under a temperature suitable for the conversion, at a uniform velocity through a reaction space having a plurality of straight, unobstructed and similar passages extending longitudinally throughout the entire length of said reaction space and defined by walls comprising essentially a refractory material.

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