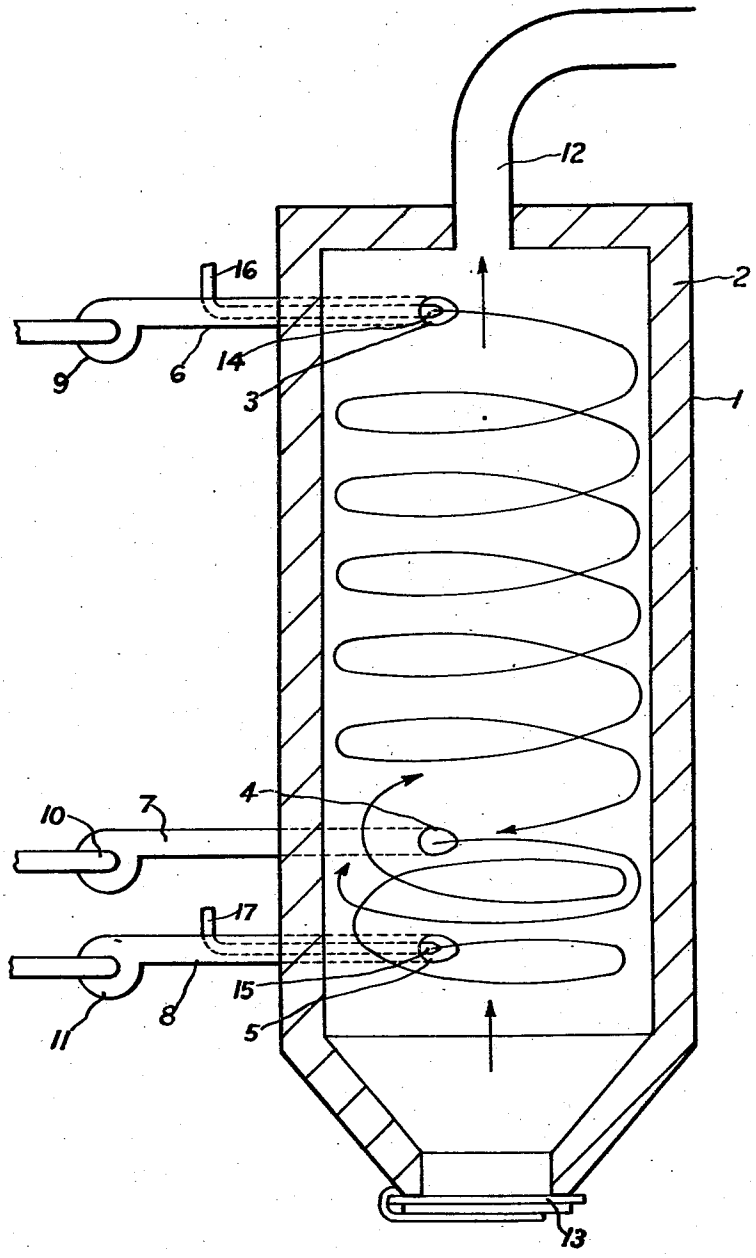
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METHOD OF CRACKING HYDROCARBONS IN THE PRESENCE OF A DILUENT GAS

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METHOD OF CRACKING HYDROCARBONS IN THE PRESENCE OF A DILUENT GAS

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This invention relates to the production of organic compounds and is more particularly concerned with the production of hydrocarbons from other hydrocarbons of higher molecular weight by cracking.

Cracking processes have in general developed upon two lines, namely those in which the hydrocarbon used as starting material is cracked in liquid form and those in which the hydrocarbon is used in vapour form. The cracking of hydrocarbons in vapour form can be made to give high yields of unsaturated gaseous hydrocarbons, and especially olefines, e. g., ethylene, propylene and the butylenes, both when the cracking is carried out under reduced pressure and also when the cracking is carried out in presence of diluents, especially valuable results in the latter connection being given when steam is the diluent gas. The present invention is concerned with an improved method of cracking hydrocarbons in vapour form and is of especial importance in connection with the cracking of hydrocarbons with the object of obtaining high yields of unsaturated hydrocarbons and especially gaseous olefines in the cracking products.

According to the invention, hydrocarbons are subjected to cracking while passing down a cracking chamber along a helical path.

Normally liquid hydrocarbons may be sprayed or atomised into the cracking chamber by means of nozzles or jets arranged tangentially near the top of the wall of a cylindrical cracking chamber so that the spray or mist of hydrocarbon and the vapour arising from its volatilisation adopt a helical path as they travel down the cracking chamber. If desired, particularly where steam or other diluent is used, this may be introduced together with the hydrocarbon and may be used to assist the development of a jet of finely-divided hydrocarbon particles and vapour. Additional diluent may be introduced lower down the cracking chamber and may be introduced in such a manner that it passes upwards to meet the descending hydrocarbon and preferably so that it also follows a helical path which merges with that followed by the descending hydrocarbon.

In order to obtain efficient cracking, a high temperature must be maintained within the cracking chamber, temperatures exceeding 800° C., for instance 800–950° C. or even higher, e. g., up to 1200° C., being suitable. In view of these high temperatures, the wall of the reaction vessel should be lined with a suitable heat-resistant material, such as firebrick, a firebrick having a

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basis of beryllia being especially suitable when very high temperatures are used.

It is preferred to heat the interior of the cracking chamber directly by means of suitable burners. Excellent results are obtained by the provision of burners situated somewhat below the point of entry of the steam or other diluent where this is employed, these burners being arranged tangentially so that their flame tends to follow a helical path merging with that of the diluent and hydrocarbon. Such burners may be supplied with oil, combustible gases or powdered fuels such as powdered coal, and the burners may be supplied with part only of the air needed for combustion, the remaining air being supplied higher up the cracking chamber. In this way it is possible to produce an extended flame following a helical path up the cracking chamber so that thorough heating is effected throughout the vessel. Instead of supplying air for the combustion of the heating gases, oxygen or air enriched in oxygen, may be used, so that dilution of the gases produced in the cracking operation can be considerably reduced.

The hydrocarbon particles and vapour tend to concentrate near the wall of the reaction chamber and it is possible to withdraw the cracking and combustion products from the centre of the top of the cracking chamber, a more or less well-defined column of the products and gases being formed near the centre of the chamber. The cracking and combustion products can, however, be withdrawn at any other convenient point, for example near the base of the cracking chamber below the point of introduction of the diluent if used and, if desired, the centre of the cracking chamber may be occupied by a column of firebrick or other suitable material. Such a column may be pierced at intervals so as to communicate with a central bore into and through which the cracking and combustion products may be drawn for removal from the furnace.

The process of the invention may be applied quite generally to the cracking of hydrocarbons, including normally gaseous hydrocarbons, but is especially valuable as applied to the cracking of oils which may be naturally occurring oils, such as petroleum fractions or the crude oils or oils obtained from coal by hydrogenation or extraction with organic solvents. The invention enables the production of very high yields of olefines to be obtained when the starting material consists of synthetic oil obtained from oxides of carbon and hydrogen by reaction in the presence of cobalt, nickel or iron-containing catalysts. The

cracking operation, whatever the nature of the oil, may be carried out at any desired pressure, but as previously indicated, it is preferred to use strongly reduced pressure, for example pressures of 0.1–0.2 of an atmosphere or even lower, e. g., down to 1/50 of an atmosphere, or to use a diluent gas or vapour, in which case the process can be operated efficiently at normal atmospheric pressure. Naturally, both a reduced pressure and a diluent gas or vapour may be used.

The accompanying drawing illustrates diagrammatically a furnace suitable for use in carrying out the process of the invention.

Referring to the drawing, the furnace has a mild steel shell 1 with a refractory lining 2 and is provided with tangential inlets 3, 4, 5 supplied by conduits 6, 7, 8 from blowers 9, 10, 11. An exhaust conduit 12 is provided in the roof of the furnace while the bottom of the latter is closed by a door 13. Jets 14, 15 provided with feed pipes 16, 17 are situated in the inlets 3, 5.

In operation the furnace is heated to a temperature of 900 to 950° C. by combustion of fuel supplied by feed pipe 17 to jet 15, combustion air being supplied through conduit 8 by blower 11. When the furnace is heated oil is supplied to jet 14 by feed pipe 16 and simultaneously steam superheated to 900° C. is supplied to conduit 6 by blower 9, and to conduit 7 by blower 10.

The oil used may be a crude mineral oil or fraction thereof, for example Pennsylvania gas oil, and is broken up into a fine spray which volatilises and is cracked during its passage down the furnace along a helical path, the spray and vapour merging with the flame and combustion products coming from the jet 15 and the steam from inlet 4, in the manner shown in the drawing.

The fuel used for heating the furnace may be, for example, the oil being cracked but any other desired fuel, for example gas or powdered coal, may be used, and while only one inlet 5 and one jet 15 are shown it is preferred to employ a number of such inlets and jets arranged round the circumference of the furnace. Similarly, although only one inlet 3, one inlet 4 and one jet 14 are shown it is preferred to employ a number of such inlets and jets for the introduction of steam and the oil to be cracked.

A column of the products of cracking and combustion products forms in the centre of the furnace the gases passing upwards and being withdrawn, through the exhaust conduit 12, whence, after being used to preheat steam being used in the cracking process, they may be passed to waste heat boilers, for example to generate this steam before being condensed and separated.

Having described my invention what I desire to secure by Letters Patent is:

1. Method of cracking hydrocarbons, wherein the cracking is effected in the presence of a diluent gas or vapor while the hydrocarbons are passing down a cracking chamber in the form of a self-supporting helical stream and wherein part at least of said diluent gas or vapor is introduced at a point below the point of introduction of the hydrocarbon and so as to assume the form of a self-supporting helical stream merging with that followed by the descending hydrocarbon.

2. Method of cracking hydrocarbons, wherein the cracking is effected in the presence of steam while the hydrocarbons are passing down a cracking chamber in the form of a self-supporting helical stream and wherein part at least of said steam is introduced at a point below the point of introduction of the hydrocarbon and so as to assume the form of a self-supporting helical stream merging with that followed by the descending hydrocarbon.

3. Method of cracking hydrocarbons, wherein the cracking is effected under sub-atmospheric pressure and in the presence of a diluent gas or vapor while the hydrocarbons are passing down a cracking chamber in the form of a self-supporting helical stream and wherein part at least of said diluent gas or vapor is introduced at a point below the point of introduction of the hydrocarbon and so as to assume the form of a self-supporting helical stream merging with that followed by the descending hydrocarbon.

4. Method of cracking hydrocarbons, wherein the cracking is effected under sub-atmospheric pressure and in the presence of steam while the hydrocarbons are passing down a cracking chamber in the form of a self-supporting helical stream and wherein part at least of said steam is introduced at a point below the point of introduction of the hydrocarbon and so as to assume the form of a self-supporting helical stream merging with that followed by the descending hydrocarbon.

HENRY DREYFUS.