

Feb. 7, 1933.

R. TILLMANN

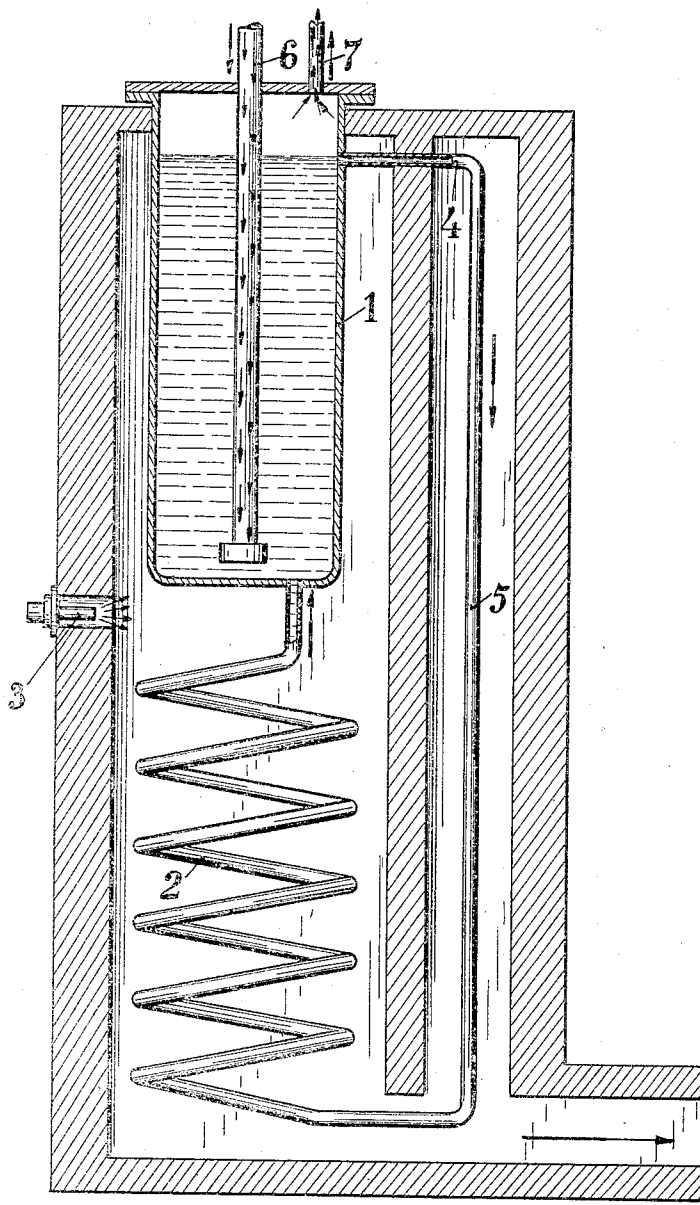
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PROCESS AND APPARATUS FOR CRACKING HYDROCARBONS

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2 Sheets-Sheet 1

Fig1.



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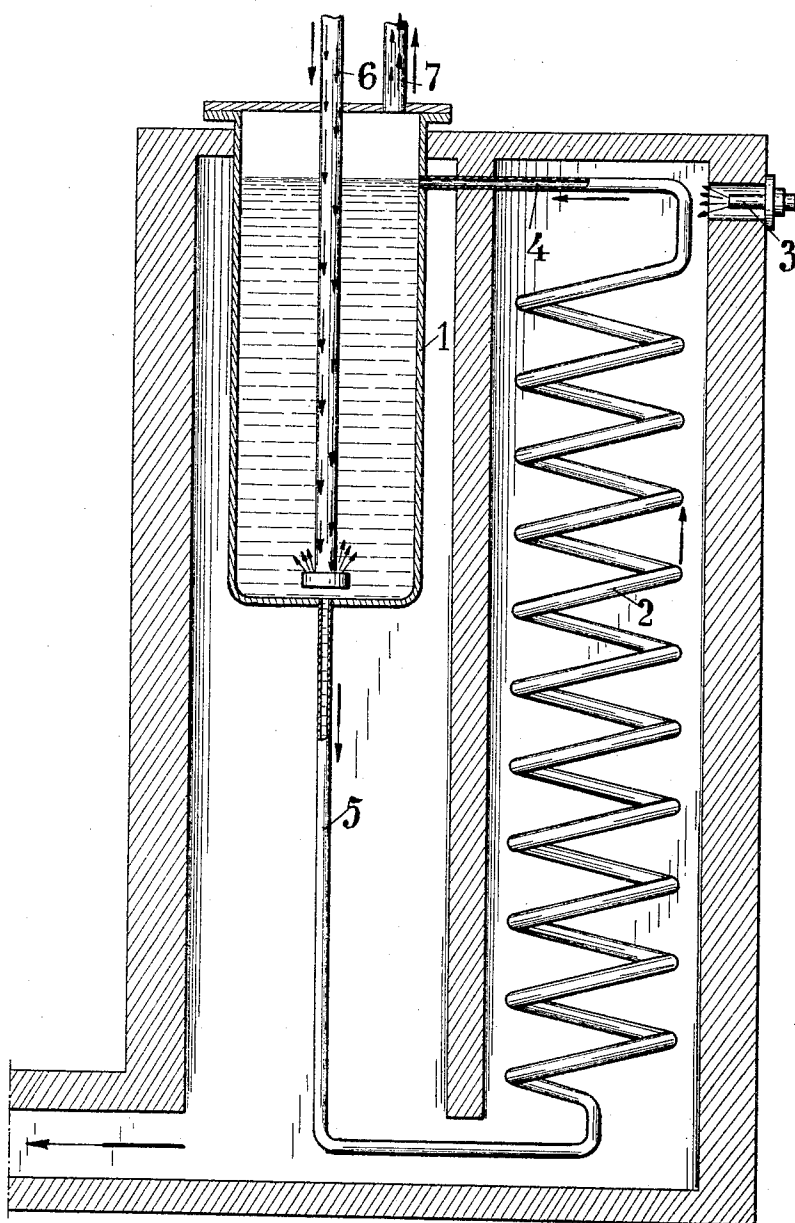
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2 Sheets-Sheet. 2

Fig. 2.



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UNITED STATES PATENT OFFICE

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PROCESS AND APPARATUS FOR CRACKING HYDROCARBONS

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The invention relates to a process and apparatus for manufacturing hydrocarbons with lower molecular weight from hydrocarbons with higher molecular weight with the aid of a molten bath such as a lead bath.

It is known how to split or crack hydrocarbons with the aid of lead baths whereby the products to be split are conducted in the gaseous or vapour state into contact with molten lead heated to the required reaction temperature. The necessary heat is conducted through the sides of the vessel containing the lead, the objection to which lies in the fact that with larger capacities and higher reaction temperatures and particularly with larger-sized vessels it is difficult to obtain an even distribution of heat in the mass of lead, especially when the reaction has to be carried out under high pressure. Conductance of the heat through the sides of the reaction vessel promotes differences in temperature between the inner and outer walls of the vessel, which give rise to strains which, together with the strains due to internal pressure, cause the working to be seriously disturbed or even rendered totally impossible. Also the supply of heat per unit surface area of the vessel is small.

The present invention now provides the means of preventing the above mentioned disadvantages. In principle the process according to the invention consists in the hydrocarbons to be split being brought in contact with a molten mass of lead heated to the required reaction temperature and moving along in a stream.

It is thereby possible according to the invention to conduct the hydrocarbons in counter-current to or in the same direction as that of the stream of lead. The invention is explained further with reference to the drawings.

Figure 1 is a schematic representation of one manner of constructing the apparatus according to the invention, while Figure 2 refers to a modified form of construction.

Underneath the reaction chamber 1 a coil of tubing is connected up which is heated by flue gases entering at 3. The reaction chamber and the coil are filled with molten lead.

The heated lead rises and enters the tube 5 through the overflow 4 at the top of the reaction chamber, tube 5 connecting up again with the coil 2. The hydrocarbons to be cracked are conducted in the gaseous form into the lead bath through the tube 6, which reaches nearly to the bottom of the reaction chamber. The tube 7 serves as outlet for the split products. Thus the lead and the gases flow in the same direction.

The apparatus can be modified within the scope of the invention in various ways; for instance the gases to be split can be led in at the bottom of the coil.

A modified form of construction is shown schematically in Fig. 2. Here the lead heated in the coil 2 rises and passes via tube 4 into the top of the reaction chamber 1, in which it proceeds downwards, through tube 5 and re-enters the coil 2 at the bottom. Consequently with this construction the gases to be cracked and the molten lead flow in opposite directions.

The reaction chamber 1 and the tube 5 need not be heated, though it may be preferable to circulate a weak current of flue gas at least round the reaction chamber in order to avoid loss of heat. With a view to regulating the temperature better, the compartment in which tube 5 is placed can according to the invention be cooled down, for instance by means of a current of cold air or deeply cooled flue gas.

When the right dimensions are taken for the coil, the tube 5 and the height through which the molten lead has to be raised by thermosiphonic action, and when the temperature of the lead in tube 5 is properly controlled, the rate of circulation of the lead can be arranged in such a way that a uniform temperature prevails in the reaction chamber. The dimensions and form of the reaction chamber are now only determined by the reaction itself and not by the necessity of transmitting certain quantities of heat through the sides of the chamber to the lead. There is no objection to intensive heating of the tubes, which can be made from materials of superior quality at no great extra cost, because in view of the small diameters

and wall thicknesses even for large capacities the heat tensions are low.

It is obvious that many varying forms of construction of the apparatus and application of the process are possible within the scope of the invention, which is, therefore, by no means restricted to the forms described here, a few forms only being given on which the principle of the invention may be applied in practice.

What I claim is:

1. Process of cracking hydrocarbons comprising the steps of: bubbling the hydrocarbons in vapor form upwardly through a bath of molten lead, circulating the lead downwardly through the bath and through a separate heater, supplying sufficient heat to the latter to maintain the bath at reaction temperature and maintain the lead circulation by thermosiphonic action in such a manner that substantially no heating of the reaction chamber takes place from the outside, and withdrawing the reaction products from the bath.

2. Apparatus for cracking hydrocarbons comprising: a reaction vessel adapted to contain hot liquid, means for admitting hydrocarbon vapor at the bottom thereof, means for removing reaction products from the top of said vessel, an external siphon circulation system having a coil in its upflow limb, said coil being connected to the top of the vessel near the liquid surface while the downflow limb is connected to the bottom of said vessel, and means for heating the coil in such a manner that substantially no heating of the reaction chamber takes place from the outside.

3. An apparatus for cracking hydrocarbons comprising a reaction vessel adapted to contain a molten metal, means for introducing a hydrocarbon into the lower portion thereof, means for discharging reaction products from the upper portion thereof, and external thermo-siphon circulation system for the molten metal, said system including upflow and downflow limbs connected to opposite ends of the reaction vessel, a casing surrounding the reaction vessel and siphon circulation system, a baffle dividing said casing into two chambers communicating at the lower portion thereof, the upflow limb of the siphon being positioned in one chamber and the downflow limb of the siphon being positioned in the other chamber, and means for introducing a heating medium into the chamber containing the upflow limb at a point adjacent the upper portion of the upflow limb, and outlet means at the lower portion of the casing for discharging the heating medium whereby the downflow limb is substantially out of the path of the flow of the heating medium.

4. An apparatus for cracking hydrocarbons comprising a reaction vessel adapted to

contain a molten metal, means for introducing a hydrocarbon into the lower portion thereof, means for discharging reaction products from the upper portion thereof, and external thermo-siphon circulation system for the molten metal, said system including upflow and downflow limbs connected to opposite ends of the reaction vessel, a casing surrounding the reaction vessel and siphon circulation system, a baffle dividing said casing into two chambers communicating at the lower portion thereof, the upflow limb of the siphon being positioned in one chamber and the downflow limb of the siphon being positioned in the other chamber, and means for introducing a heating medium into the chamber containing the upflow limb at a point adjacent the upper portion of the upflow limb, and outlet means at the lower portion of the casing for discharging the heating medium whereby the downflow limb is substantially out of the path of flow of the heating medium, said upflow limb containing a coil to increase the heat transfer to the molten metal therein.

5. An apparatus for cracking hydrocarbons comprising a reaction vessel adapted to contain a molten metal, means for introducing a hydrocarbon into the lower portion thereof, means for discharging reaction products from the upper portion thereof, and external thermo-siphon circulation system for the molten metal, said system including upflow and downflow limbs connected to opposite ends of the reaction vessel, a casing surrounding the reaction vessel and siphon circulation system, a baffle dividing said casing into two chambers communicating at the lower portion thereof, the upflow limb of the siphon being positioned in one chamber and the downflow limb of the siphon being positioned in the other chamber, said reaction vessel being positioned in the same chamber as the downflow limb of the siphon, means for introducing a heating medium into the chamber containing the upflow limb at a point adjacent the upper portion of the upflow limb, and outlet means at the lower portion of the casing for discharging the heating medium whereby the downflow limb is substantially out of the path of flow of the heating medium.

6. An apparatus for cracking hydrocarbons comprising a reaction vessel adapted to contain a molten metal, means for introducing a hydrocarbon into the lower portion thereof, means for discharging reaction products from the upper portion thereof, and external thermo-siphon circulation system for the molten metal, said system including upflow and downflow limbs connected to opposite ends of the reaction vessel, a casing surrounding the reaction vessel and siphon circulation system, a baffle dividing said casing into two chambers communicating at the lower portion thereof, the upflow limb of the

siphon being positioned in one chamber and the downflow limb of the siphon being positioned in the other chamber, said reaction vessel being positioned in the same chamber as the upflow limb of the siphon and above the same, and means for introducing a heating medium into the chamber containing the reaction vessel and upflow limb of the siphon at a point below the reaction vessel, and outlet means at the lower portion of the casing for discharging the heating medium whereby both the reaction vessel and the downflow limb of the siphon are substantially out of the path of the flow of the heating medium.

7. A process of cracking hydrocarbons in a system comprising an enlarged reaction vessel substantially filled with a body of molten metal and a tubular siphon having upflow and downflow limbs for circulation of hot metal from opposite ends of the reaction vessel, the steps consisting of passing hydrocarbons through the body of molten metal, discharging reaction products from the upper portion of the vessel, setting up a flow of a heating medium and directing the flow of the heating medium so as to by-pass the reaction vessel and the downflow limb of the siphon, and concentrating the heating effect thereof on the upflow limb of the siphon to circulate the molten metal through the reaction vessel and siphon.

In testimony whereof, I have affixed my signature.

RICHARD TILLMANN.