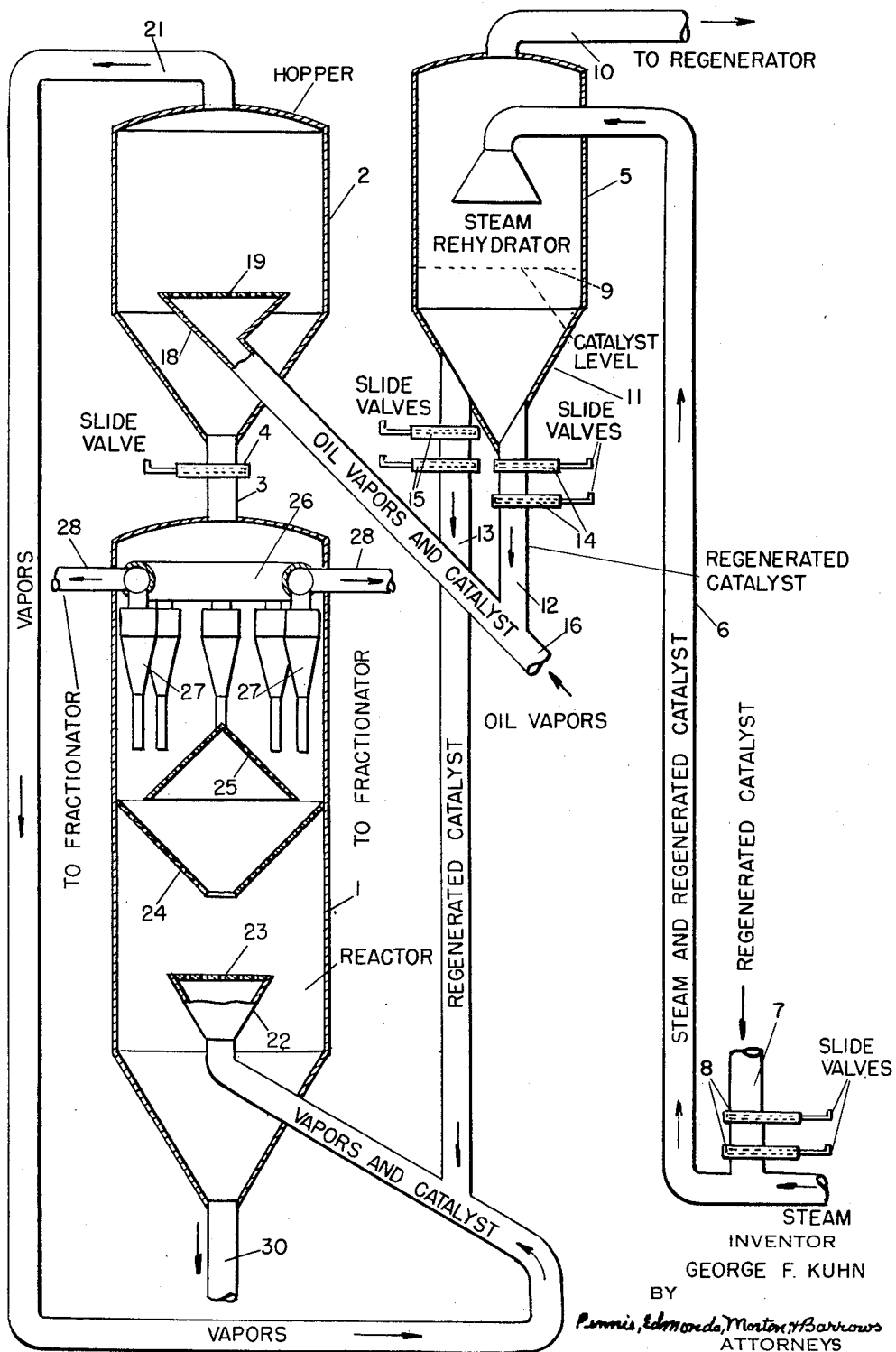


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CATALYTIC CONVERSION OF HYDROCARBONS WITH FINELY
DIVIDED CATALYST IN TWO STAGES
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CATALYTIC CONVERSION OF HYDROCARBONS WITH FINELY DIVIDED CATALYST IN TWO STAGES

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4 Claims. (Cl. 196—49)

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This invention relates to pyrolytic conversion of hydrocarbons and more particularly to pyrolytic conversion processes involving the use of catalysts.

In the conversion of hydrocarbon base stocks to produce products having desired properties, such as high octane number for use in gasoline, the stock is submitted to one of several processes, such as cracking, hydrogenation, dehydrogenation, etc., in the presence of a catalyst.

In practicing the process of the present invention, the oil vapors and finely divided catalyst flow countercurrently through the main reactor. The regenerated catalyst is mixed with the preheated charge oil and delivered to a chamber where initial conversion occurs. This may be mild or severe, depending on catalyst rates and other conditions. In this chamber the catalyst and vapors, flowing co-currently, are separated by gravity and the vapors are conveyed to the bottom of the reactor. Additional catalyst may be added to the vapors, if desired, depending upon the particular conversion process being performed and on other factors.

The initial chamber is preferably arranged over the main reactor and connected to the top of the main reactor by a valved conduit. Thus, when the valve is opened, catalyst collected in the upper chamber flows downwardly, by gravity, counter-current to the vapors delivered to the bottom of the main reactor. The main reactor is preferably provided with a plurality of distributing grids to promote admixture between the counter-currently flowing vapors and catalyst.

As a further refinement of the invention, the regenerated catalyst, before admixture with the vapors and delivery to the initial chamber, may be conveyed by steam into a chamber serving as a rehydrator. This is particularly desirable in connection with certain types of catalyst.

The invention further comprises an organization of apparatus elements consisting of a main reactor, a chamber over the main reactor with a connection between the two to deliver the catalyst to the top of the reactor and with another connection to deliver vapors from the initial chamber to the bottom of the main reactor. The invention includes means for delivering the mixture of vapors and catalyst to the initial chamber and means for adding additional catalyst to the stream of vapors delivered to the bottom of the reactor, if desired.

In the accompanying drawing I have shown, more or less diagrammatically, a vertical section of apparatus used in practicing the process and forming a part of the invention.

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In the drawing, the reference numeral 1 designates the main reactor. A chamber 2 is arranged over the main reactor and connected thereto by a conduit 3. A valve 4 is arranged in this conduit. A chamber 5 serving as a steam rehydrator for regenerated catalyst may also be provided and this chamber is connected to the initial chamber 2 in the manner herein described.

The regenerated catalyst is delivered to the rehydrator through a pipe 6. This pipe is connected to a source of superheated steam and the catalyst from the regenerator is delivered thereto through pipe 7. Pipe 7 is provided with a suitable valve or valves 8 to control delivery of the catalyst to the pipe 6. The catalyst settles in the rehydrator as indicated by the dotted line 9, and the steam is exhausted therefrom, preferably to the regenerator, through a pipe 10. The bottom of the rehydrator is preferably funnel-shaped, as indicated at 11, and is provided with one or more outlets. In the drawing I have illustrated a pair of outlets 12 and 13 controlled by valves 14 and 15.

The catalyst outlet 12 is connected to conduit 16 through which the preheated vaporized charge oil is delivered to the initial chamber 2. As shown, the end of the conduit 16 is flared as at 18 and is provided with a grid 19, the flared end and grid being located in the lower portion of the chamber 2. The oil vapors and catalyst delivered into the chamber 2 rise in the chamber and the catalyst has a tendency to settle out forming a bed in the chamber. The vapors, containing some of the catalyst, are removed from the top of the chamber 2 through a pipe 21. The other end of this pipe is arranged in the lower portion of the main reactor 1 and is provided with a flared end 22 covered by a grid 23. As shown, the second outlet 13 of the chamber 5 may communicate with the pipe 21 to deliver additional catalyst to the oil stream being fed into the reactor 1. The reactor is also provided with a plurality of grids 24 and 25 which are preferably conical and with alternate grids reversed. In the upper part of the reactor I provide a pipe 26 communicating with the interior of the reactor through one or more cyclone separators 27 and connected to one or more outlet pipes 28 leading to fractionators or other apparatus in which the treated vapors are submitted to further treatment.

In practicing the process, valves 8 in pipe 7 are opened to deliver the finely divided catalyst into the pipe 6 and steam is injected into this pipe to convey the catalyst into the chamber 5. In the chamber 5 the catalyst settles, remaining in con-

tact with the steam for some appreciable period of time before the steam exhausts from the pipe 10, causing rehydration of the catalyst which is desirable in some types of operations and with certain types of catalyst. The catalyst is fed from the rehydrator through pipe 12, by opening valves 14, and is mixed with the preheated oil vapors fed through the pipe 16.

The mixture of catalyst and oil vapors is delivered to the initial chamber 2. In this chamber the flow of vapors and catalyst is co-current but the catalyst tends to settle out forming a body of catalyst in the bottom of the chamber. The oil vapors containing some catalyst, pass through the pipe 21 to the bottom of the reactor 1. The treatment in the initial chamber 2 may be of any type desired, either mild or more severe than that which occurs in the main chamber. Additional catalyst may or may not be delivered to the vapor stream in pipe 21 through pipe 13.

The vapors flowing into the bottom of the reactor travel upwardly and catalyst is delivered from the chamber 2, by opening valve 4, into the top of the reactor and thus flows counter-current to the vapors. The admixture of the vapors and catalyst is promoted by the grids 24 and 25. The treated vapors exhaust through cyclone separators 27, pipe 26 and discharge pipes 28. The catalyst collects in the bottom of the reactor, and is removed therefrom through pipe 30 which may be provided with suitable control valves (not shown).

I claim:

1. In the pyrolytic conversion of hydrocarbons wherein a charge oil in vapor phase is subjected to conversion temperatures in the presence of a finely divided catalyst, the steps comprising delivering vaporized charge oil with the catalyst suspended therein to an initial conversion chamber wherein conversion of the charge oil is initiated and a major portion of the catalyst separated from the vapors, withdrawing the vapors from an upper zone of the chamber and passing them directly with residual catalyst suspended therein to a lower zone of a second conversion chamber and passing the vapors upwardly through said second chamber, withdrawing catalyst from a lower zone of the initial conversion chamber and passing the withdrawn catalyst to an upper zone of the second conversion chamber and channeling the flow of said catalyst alternately towards and away from the periphery of the chamber whereby the catalyst is caused to flow across the rising stream of vapors and withdrawing spent catalyst from a lower zone and the vapors from an upper zone of the second conversion chamber.

2. Apparatus of the character described comprising a primary conversion chamber, a second conversion chamber positioned at an elevation

lower than that of the first chamber, a rehydrating chamber in communication with the upper chamber, a conduit adapted to deliver a suspension of catalyst in steam to the rehydrating chamber, a conduit adapted to deliver a vaporized charge oil to the upper chamber, a conduit connection extending from the rehydrating chamber to the last-mentioned conduit and adapted to deliver catalyst to said conduit, a conduit connecting an upper zone of the upper chamber with a lower zone of the lower chamber, conduit means for conveying catalyst from a lower zone of the upper chamber to an upper zone of the lower chamber and conduit means for delivering catalyst from the rehydrating chamber to the said conduit connecting the upper chamber with the lower zone of the lower chamber.

3. Apparatus of the character described comprising a reactor, a chamber over the reactor, a rehydrator in communication with the chamber, a conduit to deliver steam and catalyst to the rehydrator, a conduit to deliver vaporized oil to the chamber, a connection extending from the rehydrator to the last-mentioned conduit to deliver catalyst to said conduit, a conduit extending from the chamber to the bottom of the reactor, a connection between the bottom of the chamber and the top of the reactor to deliver catalyst to the top of the reactor and conduit means for delivering catalyst from the rehydrator to the conduit which extends from the chamber to the bottom of the reactor.

4. Apparatus in accordance with claim 3 in which the rehydrator is positioned at an elevation higher than the reactor and the last said conduit means is adapted to convey the catalyst from the rehydrator by gravity.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,325,136	Kassel	July 27, 1943
2,349,574	Conn	May 23, 1944
2,398,759	Angell	Apr. 23, 1946
2,400,645	Huff	May 21, 1946
2,401,739	Johnson	June 11, 1946
2,408,600	Berg	Oct. 1, 1946
2,411,208	Hall et al.	Nov. 19, 1946
2,416,730	Arveson	Mar. 4, 1947
2,440,620	Taff	Apr. 27, 1948
2,450,724	Grote	Oct. 5, 1948

FOREIGN PATENTS

Number	Country	Date
574,892	Great Britain	Jan. 24, 1946