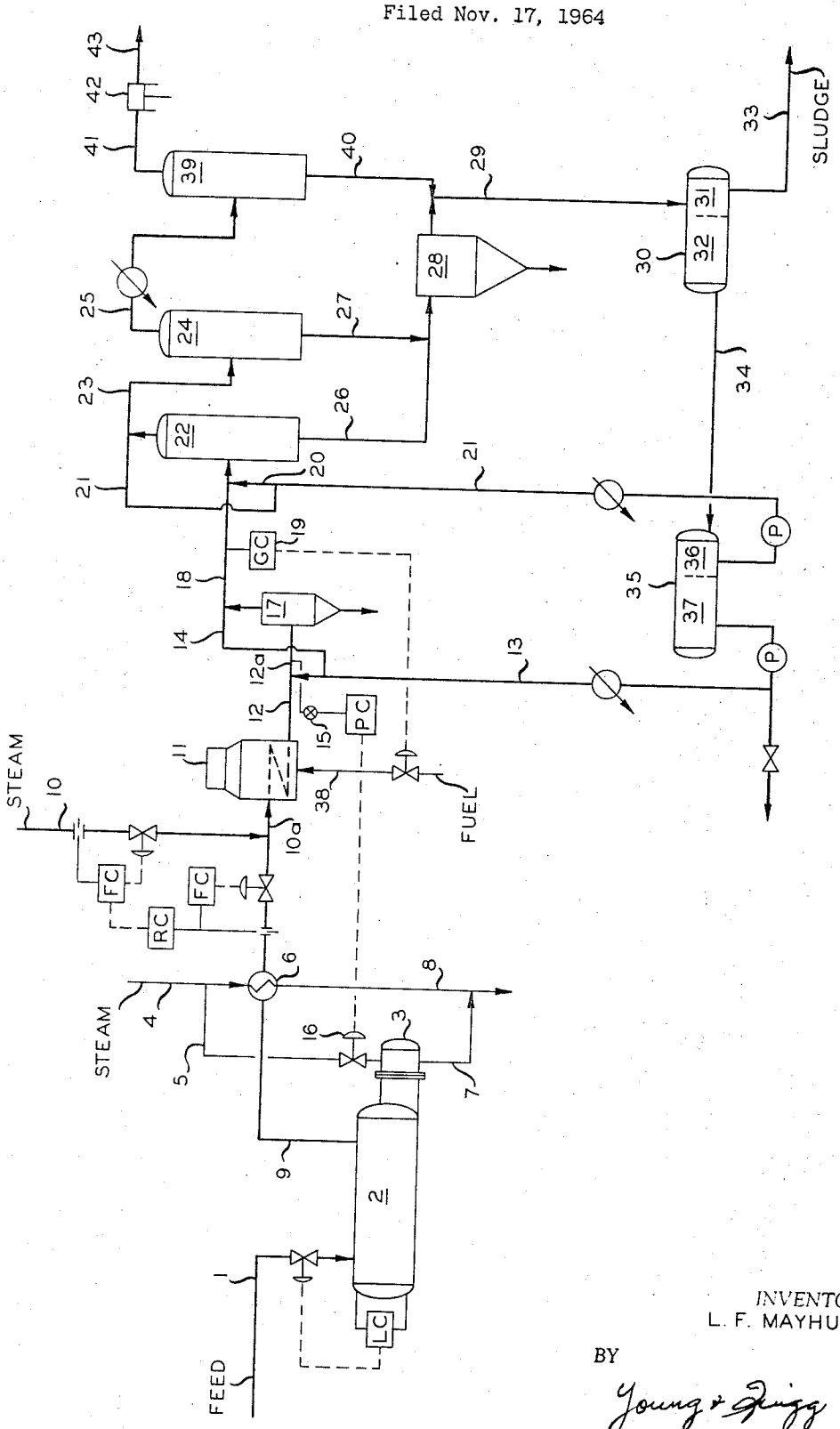
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MAINTAINING PRESSURE IN A HYDROCARBON THERMALCRACKING ZONE

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MAINTAINING PRESSURE IN A HYDROCARBON THERMALCRACKING ZONE

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This invention relates to conversion of hydrocarbons. In one of its aspects, it relates to a process for converting hydrocarbons wherein hydrocarbons are cracked to short chain hydrocarbons, quenched, and oil scrubbed, and the rate at which the hydrocarbons are fed to the cracking zone is regulated according to the pressure of the cracker effluent. In a still further aspect, the invention relates to a process for cracking propane to ethylene, wherein propane in liquid form is heated to vapor and the vapor is passed to a cracking zone, the effluent from the cracking zone is water quenched, oil scrubbed, and the amount of heat supplied, and thus the amount of propane vaporized, is controlled in accordance with the pressure of the effluent from the cracking zone. In a still further aspect, the invention relates to an apparatus for cracking hydrocarbons wherein there is provided a storage tank, a means for supplying heat to said storage tank, a thermocracking furnace, means for passing vaporized hydrocarbon from said storage tank to said cracking furnace, means for sensing the pressure of the effluent from the cracking furnace, and means for regulating the amount of heat supplied to said storage tank in accordance with the sensed pressure.

In the cracking of a paraffin to an olefin in a cracking furnace, such as a Selas-type cracking furnace, carbon deposits build up in the reactor tubes. This coke deposition causes hot spots within the tubes and impedes the flow of gases through the furnace tubes. As the cracking operation continues, and the coke depositions build up, the pressure drop across the cracking furnace increases. If the pressure of the incoming gases remains constant, the pressure of the cracked effluent will decrease. It is desirable to maintain the effluent from the cracking unit at a predetermined pressure. This pressure can be maintained, it has been discovered, by varying the input to the cracking unit in accordance with the effluent pressure.

It is, therefore, an object of this invention to provide a process for cracking a hydrocarbon.

It is a further object of this invention to maintain a constant pressure in a reaction effluent from a thermocracking furnace.

It is a still further object of this invention to minimize the effect of coke deposition in a thermocracking process.

It is a still further object of this invention to provide an apparatus for the process of this invention.

Other aspects, objects, and the several advantages of this invention are apparent from a study of this disclosure, the drawing, and the appended claims.

According to the invention, the effluent from a thermocracking furnace is kept at a constant pressure by sensing the pressure of the effluent and adjusting the input of the furnace accordingly. More specifically, the pressure of the effluent is sensed and a pressure controller controls the flow of heat to a vaporizer which supplies the hydrocarbon to be cracked.

The invention can be better understood by reference to the accompanying drawing. The figure shows a schematic of the process of the invention.

Referring now to the drawing, a liquid hydrocarbon such as liquid propane enters storage tank 2 through line 1. Heat exchanger 3 supplies heat to tank 2 sufficient to vaporize a portion of the liquid in that tank. Heat exchanger 3 is supplied with steam from lines 4 and 5. The condensed and cooled steam leaves heat exchanger 3 through line 7. The vaporized hydrocarbon such as propane leaves tank 2 through line 9, passes through feed superheater 6 supplied with steam from line 4, which steam, after passing through feed superheater 6, is combined by way of line 8 with steam and steam condensate from line 7. Process steam is added to line 9 through line 10. The mixture of steam and propane, for example, passes into cracking furnace 11 wherein a paraffin hydrocarbon such as propane is cracked to an olefin such as ethylene. The cracking furnace can be any suitable tube type cracking furnace such as a Selas-type cracking furnace. The effluent from reactor 11 passing through line 12 is quenched with water from line 13. The pressure of the effluent in line 12 is sensed by pressure sensor 15 which transmits a signal to a pressure controller which in turn transmits a signal to valve 16 which operates the flow of steam through line 5 into heat exchanger 3. The pressure controller maintains a predetermined pressure in effluent line 12 and adjusts the heat supplied to heat exchanger 3 accordingly. In other words, if the pressure in the effluent should drop due to coke deposition in the cracking furnace, pressure controller 15 will further open valve 16 to allow more steam to pass into heat exchanger 3. It is essential that sufficient pressure be present in the system so that there is proper operation of subsequent compression in compressor 42. The increase in heat supplied to tank 2 will vaporize more hydrocarbon to pass through line 9, thus increasing the pressure of hydrocarbon entering cracking furnace 11. The increase in pressure of hydrocarbon in line 9 will increase the pressure of effluent in line 12.

The effluent in line 12 is passed to carbon separator 17 wherein carbonaceous solids are removed. The vapor is contacted again with water which enters line 18 through line 14. The gravity of the effluent vapor is sensed by gravity controller 19 which adjusts a valve accordingly to allow more or less fuel to pass through line 38 into furnace 11. The effluent in line 18 is contacted with oil from line 20 and the mixture is passed to phase separator 22 wherein liquid products are separated and removed through line 26. Vaporous products leave separator 22 through line 23 and are contacted with oil from line 21. The mixture is then separated in separator 24 and the liquid containing mostly oil and some water leaves vessel 24 through line 27 and is combined with oil and water in line 26. Heavier products are removed through separator 28 and the resulting mixture is passed through line 29 into phase separator 30 wherein the heavy oil phase 31 separates from the lighter water phase 32. A small portion of the oil or oily sludge in 31 is removed from vessel 30 through line 33. The majority of the heavy aromatic oil passes out of vessel 30 through line 34 and into separator vessel 35 wherein a substantially pure more dense oil phase 36 is separated from a substantially pure less dense water phase 37. The oil phase 36 is removed from 35 through line 21 and recirculated to be used in the oil scrubbing part of the process. Water is removed through line 13 and is recycled for quenching purposes. Ethylene and other gaseous hydrocarbon products leave separator 24 through line 25 by way of a condenser in line 25 to further condense out water from the cracked vapor, and the thusly-cooled stream is charged to separator 39 to accomplish this separation. The water stream from separator 39 is removed therefrom by line 40 and is added to the material flowing in line 29. Cleaned product vapor is passed by line 41, compressor 42, and line 43 for further processing, including ethylene recovery, as desired.

TABLE I

[Specific example, pounds/hour]

Stream, Component	Feed (1)	Effluent (12)	Quench Water (13)	Water Wash (14)	Wash Oil (20)	Wash Oil (21)	Liquid Phase (26+27)	Liquid Phase (40)	Vapor Phase (41)
Hydrogen		51							51
Methane		906							906
Acetylene		11							11
Ethylene		1,212							1,212
Ethane	180	246							246
Propylene		507							507
Propane	3,400	286							286
Butadienes		44							44
Butylenes		78							78
Isobutane	148	19							19
Pentane and Heavier		368					284		84
Total Hydrocarbons	3,728	3,728					284		3,444
Steam or Water Vapor	[1] 927	[1] 927							180
Liquid Water			3,247	556			3,002	1,548	
Liquid Oil					[2] 2,114	[2] 84,499	86,613		
Total, pounds per hour	4,655	4,655	3,247	556	2,114	84,499	89,899	1,548	3,624
Temperature, ° F	80	1,500	90	90	90	90	190	100	100

[1] Process steam via line (10), 390 p.s.i.a., 442° F.
[2] Highly aromatic oil produced in the process; API at 60° less than 9.8.

TABLE II

Unit Number Condition	Feed (1)	Feed Vaporizer (2)	Furnace Feed (10a)	Furnace Effluent (12)	Quenched Fluid (12a)	Water Washed Fluid (18)	Separator (22)	Separator (24)	Separator (39)
Temp., ° F	80	64	282	1,500	400	250	225	188	100
Pressure, p.s.i.a.	140	114	79		25	20	18	18	15

It is to be understood that the reaction generally takes place at a constant temperature. The invention provides a method for regulating the pressure of effluent from the cracking furnace **11** while maintaining the temperature of the hydrocarbons within the cracking furnace at a constant temperature. Thus, should the temperature of hydrocarbons within furnace **11** change for any reason, such change will be reflected in the gravity of the effluent which is sensed by gravity controller **19**. Accordingly, the amount of heat supplied to furnace **11** is adjusted by adjusting the amount of fuel supplied through line **38** to a burner in the furnace.

Reasonable variation and modification are possible within the scope of the foregoing disclosure, the drawing, and the appended claims to the invention, the essence of which is that the effluent from a thermocracking reactor is maintained at a constant pressure by controlling the amount of feed supplied to the reactor in accordance with the pressure of the effluent.

I claim:

1. A process for thermocracking of a hydrocarbon comprising feeding a liquid hydrocarbon to a storage zone, supplying heat to said storage zone to vaporize said hydrocarbon, passing said vaporized hydrocarbon through a cracking zone and therein cracking said hydrocarbon, removing effluent from said cracking zone, quenching said effluent from said cracking zone with a primary water quench, sensing the pressure in the effluent from said cracking zone, and using said sensed pressure of effluent in said cracking zone to adjust the supply of heat to said liquid storage zone to vaporize said hydrocarbon, separating carbonaceous solids from vapor in said effluent, quenching the thus separated vapors with a secondary water quench, quenching said secondary water-quenched vapors with a primary oil quench, separating liquid from the oil-quenched vapors, passing said liquid thus separated from said oil-quenched vapors to a separation zone wherein water and oil are separated, quenching said oil-quenched vapors with a secondary oil quench, separating resulting quench vapors from liquids, passing said liquids separated from said resulting quenched vapors to a separator wherein oil is separated from water, using the water from said separator as said primary and said secondary quench water, and using the oil separated in said separator for said primary and said secondary oil quenches.

2. A process according to claim **1** wherein said hydrocarbon is propane and said cracked effluent contains ethylene.

3. A process according to claim **1** wherein an effluent property representative of the temperature of said hydrocarbon in said cracking zone is sensed after said water quenching and the heat supplied to said cracking zone is adjusted in accordance with said sensed property to maintain the temperature of said hydrocarbon in said cracking zone at a predetermined temperature.

4. In a continuous cracking process wherein a paraffin is cracked to an olefin in a tube reactor and wherein the coke build-up in the tubes of said reactor causes a decrease in the pressure of the effluent from said reactor, the improvement which comprises feeding paraffin from a liquid storage zone from which it is vaporized, sensing the pressure of said effluent from said reactor, and adjusting the heat supply to said liquid storage zone to vaporize said paraffin in accordance with said sensed pressure of said reactor effluent to maintain a predetermined pressure of said effluent.

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