

- ## [54] INCREASED PRODUCTION OF DIESEL OIL AND FUEL OIL

[75] Inventor: **John P. James**, Old Ocean, Tex.

[73] Assignee: **Phillips Petroleum Company,**
Bartlesville, Okla.

[22] Filed: May 21, 1974

[21] Appl. No.: 471,879

[52] U.S. Cl. **208/78**; 208/100; 208/101;
208/103; 208/105; 260/683 R

[51] **Int. Cl.²**..... C10G 39/00

[58] **Field of Search**..... 260/683 R; 208/78, 100,
208/101, 103, 105

References Cited

UNITED STATES PATENTS

2,358,184	9/1944	Ostergaard.....	208/101
2,876,865	3/1959	Cobb	208/103

2,879,224	3/1959	Lawson.....	208/100
2,950,241	8/1960	Craft et al.....	208/78
3,103,485	9/1963	Cahn.....	260/683
3,342,724	9/1967	Goering.....	260/683
3,580,838	5/1971	Lutz.....	208/100

Primary Examiner—Delbert E. Gantz

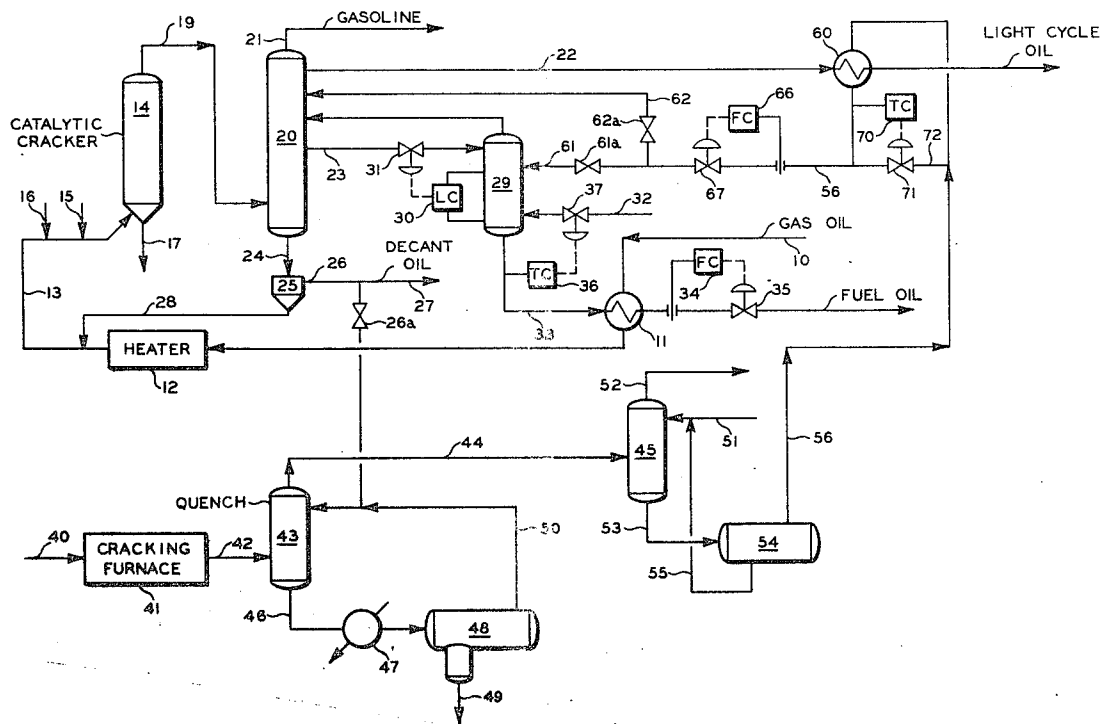
Assistant Examiner—C. E. Spresser

[57]

ABSTRACT

The effluent from a catalytic cracking reactor is fractionated to produce a plurality of streams including a heavy cycle oil and a decant or residual oil. The residual oil is employed to quench the effluent from a cracking furnace in which a light hydrocarbon is thermally cracked. A light oil recovered from the quench step is returned to the fractionator, either directly or through a heavy cycle oil stripper, to increase diesel oil and fuel oil production.

6 Claims, 2 Drawing Figures



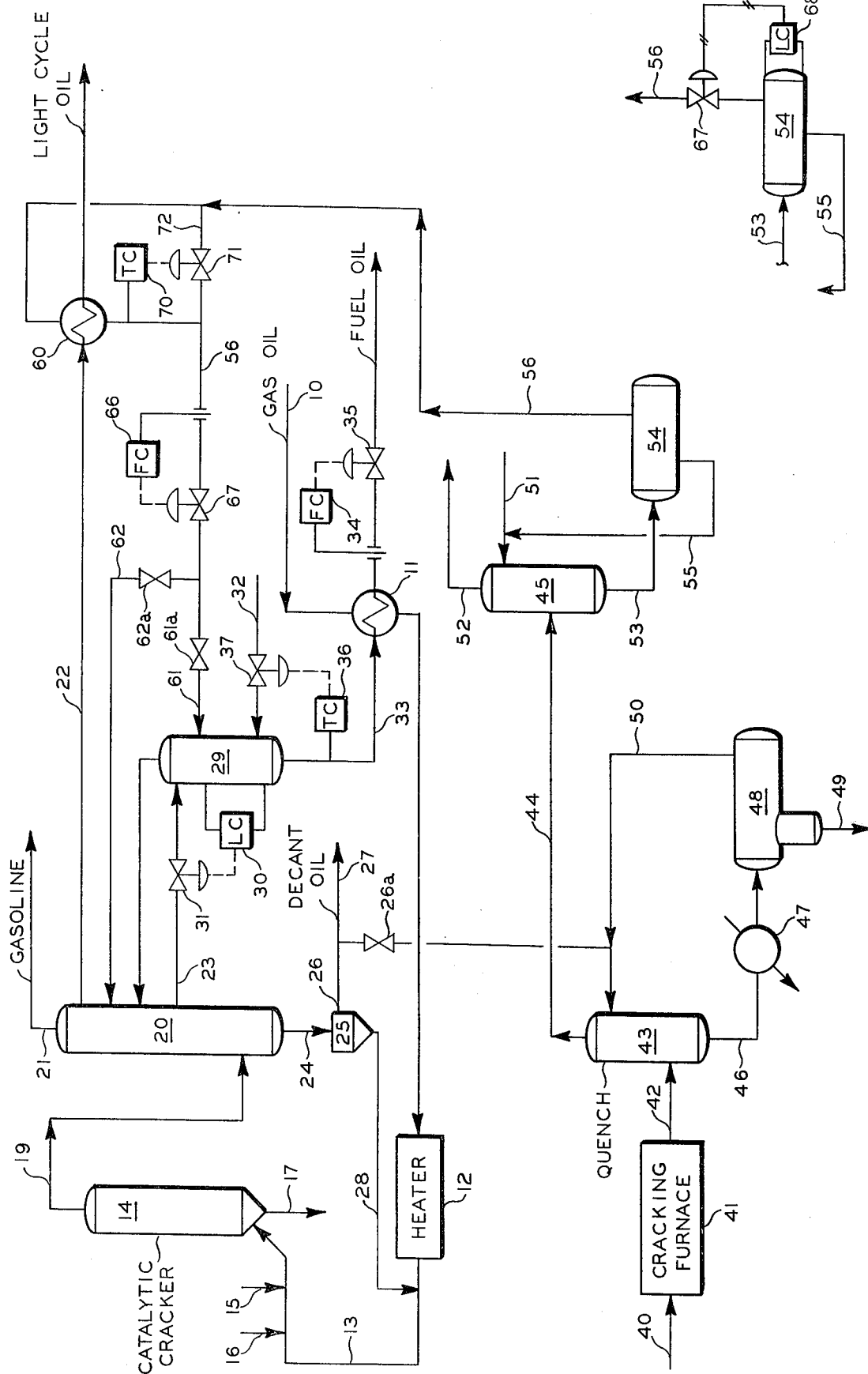


FIG. 1

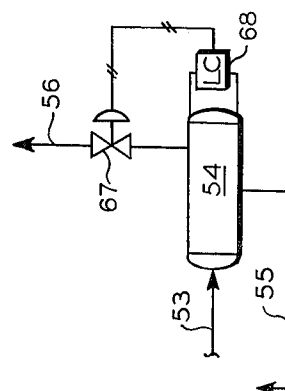


FIG. 2

INCREASED PRODUCTION OF DIESEL OIL AND FUEL OIL

It is often desirable to operate petroleum refineries in such a manner as to maximize the production of a given product or products. For example, it is sometimes necessary to produce maximum quantities of fuel oil distillates and diesel fuel, even at the expense of gasoline in order that adequate supplies of the distillates and diesel fuel may be available during peak seasons. This invention is directed to a process which accomplishes such a goal in a refinery which includes an oil cracking unit and a cracking furnace, the latter producing light unsaturated hydrocarbons such as ethylene and propylene.

In accordance with this invention, the effluent from the cracking furnace is quenched by an oil stream which is obtained as one of the product streams from a fractionator which receives as feed the effluent from a catalytic cracking reactor. A light oil recovered from the quench step is returned to the cracker effluent fractionator so as to increase production of light cycle oil which can be used to produce diesel fuel and fuel oil. The light oil preferably is introduced into a side stream stripper on the fractionator which receives a side draw heavy cycle oil stream from the fractionator. The light oil is thus returned to the fractionator as a part of the overhead stream from the stripper.

In the accompanying drawing,

FIG. 1 is a schematic representation of apparatus employed to carry out the process of this invention.

FIG. 2 illustrates a modified form of control apparatus which can be utilized in the system of FIG. 1.

Referring now to the drawing in detail and to FIG. 1 in particular, a gas oil feed is introduced through a conduit 10 which has a heat exchanger 11 associated therewith. Conduit 10 communicates with the inlet of a heater 12. The resulting heated feed oil is directed through a conduit 13 which extends into a catalytic cracking reactor 14. Regenerated catalyst is introduced through a conduit 15, and steam is introduced through a conduit 16. Spent catalyst is removed from the bottom of reactor 14 through a conduit 17 and passed to a catalyst regenerator, not shown. The regenerated catalyst is returned through conduit 15.

The effluent from reactor 14 is passed through a conduit 19 to the inlet of a main fractionator 20. Fractionator 20 is operated to produce a plurality of product streams which can include an overhead gasoline and lighter stream which is removed from the top through a conduit 21, a light cycle oil which is removed through a side draw conduit 22, a heavy cycle oil which is removed through a side draw conduit 23, and a kettle product which is removed through a conduit 24. The kettle product can be passed to a settler 25, from which is withdrawn a decant or residual oil through a conduit 26. A product withdrawal conduit 27 is connected to conduit 26. The remaining slurry oil is removed through a conduit 28 and recycled to feed conduit 13. The heavy cycle oil withdrawn through conduit 23 is introduced into a stripper 29. The flow through conduit 23 can be regulated by liquid level controller 30 on stripper 29, which adjusts a valve 31. Stripping steam is introduced into stripper 29 through a conduit 32. The lighter constituents of the heavy cycle oil are removed from the top of the stripper 29 and returned to fractionator 20, and the heavier constituents which form fuel oil are withdrawn through a conduit 33. Conduit 33

communicates with heat exchanger 11 to supply heat to the gas oil feed. The fuel oil can be withdrawn through conduit 33 at a predetermined rate which is regulated by a flow controller 34 which adjusts a valve 35. The rate at which steam is introduced through conduit 32 can be regulated by temperature controller 36 which senses the temperature of the fuel oil withdrawn through conduit 33 and regulates a valve 37 in conduit 32.

The apparatus thus far described constitutes a conventional oil cracking and fractionation system of the type disclosed in U.S. Pat. Nos. 3,338,821 and 3,547,805, for example.

A light hydrocarbon feed, such as ethane, propane, butane or naphtha, is introduced through a conduit 40 which communicates with the inlet of a thermal cracking furnace 41. The furnace effluent is passed by a conduit 42 to the inlet of a quench tower 43. Decant oil from conduit 26 is passed through valve 26a into the upper region of the quench tower to lower the temperature of the furnace effluent gases and to remove heavy constituents. The resulting rich oil is passed through a conduit 46 and a cooler 47 to a separator 48. A heavy oil is withdrawn through a conduit 49, and a light oil is recycled through a conduit 50 to tower 43. The overhead gases from tower 43 are passed through a conduit 44 to a second quench tower 45. Quench water is introduced into tower 45 by a conduit 51. The cracked gases are removed through a conduit 52. Water and oil are withdrawn through a conduit 53 and passed to a phase separator 54. The settled water is recycled through a conduit 55. The production of light unsaturated gases in cracking furnaces and quenching of the furnace effluent with an oil stream is known in the art. Systems of this type are disclosed in U.S. Pat. Nos. 2,899,475, 3,096,273 and 3,342,724, for example.

In accordance with this invention, light oil removed from separator 54 through a conduit 56 is returned to main fractionator 20. This light oil can advantageously be passed in heat exchange relationship with the light cycle oil removed from fractionator 20 through conduit 22. This can be accomplished by means of a heat exchanger 60. Conduit 56 branches into conduits 61 and 62 downstream of the heat exchanger. Conduit 61 communicates with stripper 29, and conduit 62 communicates directly with fractionator 20. Valves 61a and 62a can be positioned in respective conduits 61 and 62 to regulate the relative flows of the light oil through the two conduits. The preferred flow of the light oil is into stripper 29, so that valve 62a normally is closed. The flow through conduit 56 can be maintained at a predetermined rate by a flow controller 66 which regulates a valve 67. As an alternative, the flow through conduit 56 can be regulated by an interface level controller 68 which is connected to separator 54, as shown in FIG. 2. The temperature of the light oil introduced into stripper 29 or into fractionator 20 can be regulated by a temperature controller 70 which adjusts a valve 71 in a conduit 72 which bypasses heat exchanger 60. The light cycle oil is a convenient source of heat for the oil returned through conduit 56. However, other sources of heat can be used if desired.

In a typical operation in accordance with this invention, the feed supplied through conduit 10 can be a virgin gas oil recovered from crude oil by distillation and having an API gravity of about 27 and a boiling range of about 500° F. to 1100° F. The catalyst employed in reactor 14 can be a conventional silica-

alumina molecular sieve type cracking catalyst. Reactor 14 can be operated at about 985° F. and at a pressure of about 16 psig. The feed can comprise about 30,000 barrels per day of fresh gas oil and about 3,740 barrels per day of recycle oil from settler 25. Fractionator 20 can be operated at a bottom temperature of about 690° F., a top temperature of about 305° F., and at pressures of about 9 psig and 13 psig at the top and bottom, respectively. Temperatures at the points of removal of the light cycle and heavy cycle oil streams can be about 450° F. and 560° F., respectively. These conditions will produce about 16,320 barrels per day of gasoline and lighter, 7,170 barrels per day of light cycle oil, 790 barrels per day of heavy cycle oil, and 1,000 barrels per day of decant oil.

Cracking furnace 41 can be supplied with about 275 barrels per day of propane feed. The furnace can be operated at about 1,520° F., and at a pressure of about 22 psig. Decant oil is supplied to quench tower 43 at a rate of about 1,000 barrels per day. Tower 43 can be operated at a top temperature of about 300° F., a bottom temperature of about 375° F., and a pressure of about 16 psig. Separator 48 can be operated at a temperature of about 250° F. Tower 45 can be operated at a top temperature of about 110° F., a bottom temperature of about 195° F., and at a pressure of about 15 psig. About 487 barrels per day of light oil can be removed through conduit 56 and passed to stripper 29.

In a typical operation carried out prior to this invention, light oil was recycled to the feed to the cracking reactor rather than to stripper 29. Calculations have shown that, under corresponding operating conditions, light cycle oil can be increased by about 70 barrels per day, heavy cycle oil can be increased about 190 barrels per day in accordance with the foregoing example using about 500 barrels per day less fresh feed to the catalytic cracker and about 60 barrels per day less recycle oil from the settler. These increases in cycle oil production can be realized at a loss of about 180 barrels per day of gasoline and lighter, still based on a lower fresh oil charge rate. Moreover, the method of this invention permits a greater fresh feed charge to be employed because there is less recycle oil passed to the cracking reactor.

While this invention has been described in conjunction with a presently preferred embodiment, it obviously is not limited thereto.

What is claimed is:

1. A process which comprises cracking a hydrocarbon oil in a cracking zone; passing the effluent from the cracking zone to a fractionation zone to separate the effluent into a plurality of streams including a gasoline

stream, a light cycle oil stream, a heavy cycle oil stream and a kettle product stream; removing a residual oil from the kettle product stream; thermally cracking a hydrocarbon feed to produce an effluent stream containing unsaturated gaseous hydrocarbons; contacting said effluent stream in a quench zone with a stream of said residual oil to quench said effluent stream; removing a first stream containing a light oil and cracked gases and a second stream containing a rich oil from said quench zone; separating a stream of light oil from said first stream; and returning said light oil stream to said fractionation zone.

2. The process of claim 1 in which the heavy cycle oil stream is passed to a stripping zone wherein light constituents are stripped from the heavy cycle oil and returned to said fractionation zone, and wherein said light oil stream is introduced into said stripping zone, from which it enters said fractionation zone.

3. The process of claim 2 wherein said light oil stream is passed in heat exchange relationship with said light cycle oil stream prior to being introduced into said stripping zone.

4. The process of claim 2 wherein the rate of flow of said light oil into said stripping zone is maintained at a preselected rate.

5. A process which comprises cracking a hydrocarbon oil in a cracking zone; passing the effluent from the cracking zone to a fractionation zone to separate the effluent into a plurality of streams including a gasoline stream, a light cycle oil stream, a heavy cycle oil stream and a kettle product stream; removing a residual oil from the kettle product stream; thermally cracking a hydrocarbon feed to produce an effluent stream containing unsaturated gaseous hydrocarbons; contacting said effluent stream in a first quench zone with a stream of said residual oil; removing a gaseous stream containing a light oil and cracked gases from said first quench zone and passing same to a second quench zone; introducing a stream of water into said second quench zone; removing a liquid stream containing water and said light oil from said second quench zone and passing same to a separation zone; removing a stream of said light oil from said separation zone; and returning the stream of light oil removed from said separation zone to said fractionation zone.

6. The process of claim 5 wherein the rate of flow of said light oil into said fractionation zone is regulated in response to a measurement of the interface level in said separation zone so as to maintain a preselected interface level in said separation zone.

* * * * *

55

60

65