

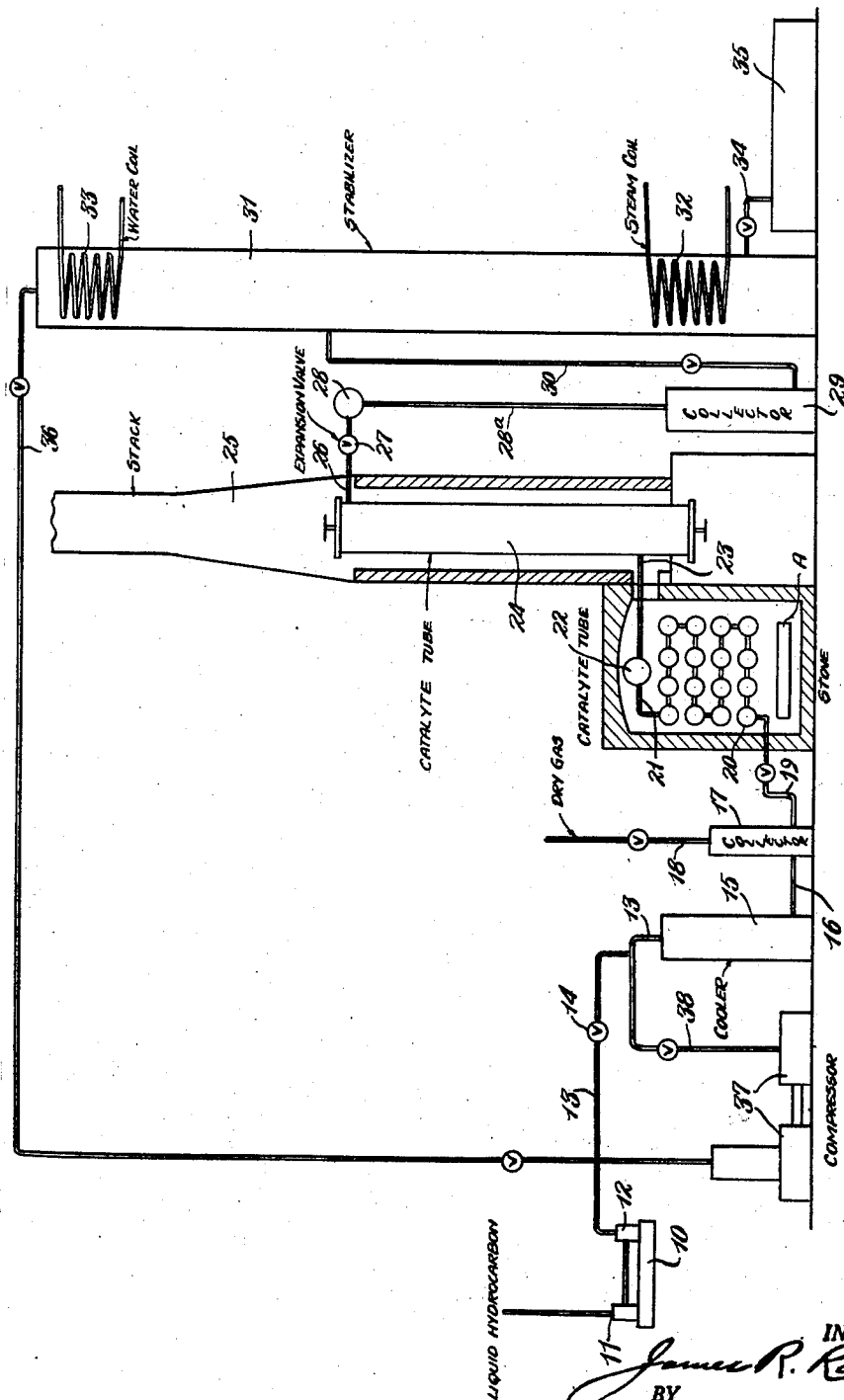
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J. R. ROSE

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MANUFACTURE OF LIQUID HYDROCARBONS SUITABLE FOR MOTOR FUEL

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INVENTOR.

INVENTOR.
James P. Rose,
BY

BY

Hull West,

ATTORNEYS

UNITED STATES PATENT OFFICE

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MANUFACTURE OF LIQUID HYDROCARBONS
SUITABLE FOR MOTOR FUEL

James R. Rose, Arlington, Va., assignor, by direct and mesne assignments, to Potomac Hydrocarbon Process Corporation, Washington, D. C., a corporation of Delaware

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This invention relates to the manufacture of liquid hydrocarbons suitable for motor fuel, and more particularly to the manufacture of high-octane gasolene.

The general purpose and object of the invention is to enable a large proportion of the hydrocarbon base employed in the practice of my invention to be converted into gasolene of the character referred to; also to enable this conversion to be accomplished economically and rapidly. I accomplish these objects in and through the use of the apparatus or system illustrated in the drawing, wherein the figure is a flow diagram illustrating my preferred apparatus or system and showing the relations of the various parts of such apparatus or system to one another.

Describing the apparatus or system shown in the aforesaid drawing, 10 denotes a pump having an inlet 11 for liquid hydrocarbon and an outlet 12 communicating by a pipe 13 and through a valve 14 with a cooler 15, the lower portion of which in turn is connected by a pipe 16 with a collector 17 provided with a valved outlet pipe 18 extending from the upper portion thereof.

A valved pipe 19 communicates at one end with the lower portion of the collector and at its opposite end with the first cracking element 20 in the bottom row of several vertically spaced rows of such elements, the said elements being shown as of the usual tubular form and the tubes in different rows being connected in series and the final tube in each row being connected with the first receiving tube in the row next thereabove. Four such rows are shown, the same being arranged within a cracking stove, and the final tube in the uppermost row communicates by means of a pipe 21 with a catalyte container tube 22 which is shown as extending horizontally of the stove and as located adjacent to the top and preferably about midway between the sides of the stove.

The container tube 22 communicates through a pipe 23 with the lower portion of a large vertically arranged catalyte container tube 24 located within the stack 25. A pipe 26 communicates at one end with the upper portion of this catalyte container tube and at its other end with a cooler 28, the pipe being provided with an expansion valve 27 intermediate of the container tube 24 and the said cooler 28. From the cooler 28, a pipe 28^a extends to the top of a collector 29; a valved pipe 30 communicates at its lower end with the lower portion of the collector 29 and at its upper portion with a stabilizing tower 31, preferably substantially midway of the height of the latter. This tower is packed with suitable re-

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fractory material, such as "Berl saddles" or "Raschig rings." A steam coil 32 is located at the lower portion of the tower and a water circulating coil 33 within the upper portion of the tower. A valved pipe 34 communicates at one end with the lower portion of the tower and at its other end with a tank 35 in which the finished product is collected.

A valved pipe 36 extends from the top of the tower to the top of a compressor 37; and a valved pipe 38 extends from said compressor to the cooler 15, conveniently through a portion of the pipe 13.

In operating the apparatus or system just described, a liquid hydrocarbon base element, such as crude oil and/or low octane gasolene, is introduced into the pump 10, where it is subjected to a pressure of from 700 lbs. to 1000 lbs. per square inch, the pressure varying in accordance with the nature of the particular liquid hydrocarbon used, but not being below 700 lbs. per square inch. From the pump, the liquid is delivered through the valved pipe 13 into the cooler 15 and thence into the liquid collector 17.

From the collector 17, the liquid flows, under the pressure imparted thereto by the pump, through the cracking tubes 20 in succession and thence into one end of the catalyte container tube 22 which preferably contains a catalyte composed of a mixture of carnotite and barium fluoride, preferably in the proportions of 16 parts by weight of carnotite to from 1 to 12 parts by weight of barium fluoride (as set forth in my Patent 2,126,284). The gaseous product resulting from the foregoing cracking operation passes from the opposite end of the tube 22 into the bottom of the vertical catalyte container tube 24. The catalyte which I use in this container tube is preferably that described and claimed in my Patent 2,173,376, issued September 19, 1939, and consisting of the following ingredients mingled in substantially the following range of proportions:

	Parts by weight
Natural phosphate rock	10 to 50
Floridan clay	10 to 50
Zinc phosphate	5 to 30
Barium halide (preferably chloride)	5 to 30
Fire bond	10 to 40
Carnotite	25% to 100% by weight of the total weight of all other ingredients.

The container tube 24, it will be noted, is arranged within the lower portion of the stack which receives the products of combustion from the cracking stove whereby the said container

tube, as well as the tubes 20 and 22, are subjected to a temperature of from 700° to 1200° F., the temperature being dependent upon the nature of the liquid hydrocarbon which is supplied to the said tubes.

From the top of the tube 24, the gaseous product resulting from the passage of the hydrocarbon through the cracker tubes and the catalyte container tubes is delivered to a pipe 26, provided with an expansion valve 27 where by the pressure on the gaseous product is quickly reduced to 150 lbs. per square inch, thereby setting up an intense cooling action, with resultant liquefaction, the liquefaction being facilitated by the cooler 28. From this cooler, the liquid is delivered through a pipe 28^a to the collection chamber 29; and from the collection chamber the liquid is delivered through the pipe 30 into the stabilizing tower, midway of the height of the latter, where it is diffused over the refractory material, being subjected to the heat of the steam coil 32 in the bottom of the tower, which serves to boil off the lighter gases and leave behind the heavier polymers, which are largely within the gasoline range of hydrocarbons.

The gases in the upper portion of the tower are subjected to the action of the coil 33 which serves to condense the heavier of the gases which reach this point, the condensate thus formed consisting of the heavier polymers which are largely within the gasoline range of hydrocarbons and which are collected in the bottom of the tower, whence all such polymers are delivered to the tank 35. The lighter gases, which consist of a mixture of hydrocarbons of the CH₄, C₂H₆, C₃H₈ and C₄H₁₀ series, are conducted by the pipe 36 to the compressor 37 where they are subjected to the same pressure as that imparted to the hydrocarbon liquid by the pump 10. The components that are condensable into liquid at this pressure are removed from the mixture while the uncondensable components may be delivered as "dry gas" from a collector 17 through the pipe 18 and may then be used as fuel for a burner A which serves to heat the tubes in the cracking stove and the tube 24 in the stack 25. The operation of the system or apparatus with the base hydrocarbon constituted by the mixture of the normally liquid hydrocarbon with that obtained by compressing the gaseous product from the stabilizer tower will proceed from this point in the manner described hereinbefore in connection with the liquid hydrocarbon from the pump 10.

As the flow of cracked material in a gaseous form is always toward a zone of less pressure, I have taken advantage of this fact to cause the mixture of liquid hydrocarbon delivered by the pump 10 with that resulting from the condensation of gases supplied to and delivered from the compressor 37 to move constantly upwardly from the time the mixture enters the first row of cracking tubes until it reaches the expansion chamber 28. Furthermore, the crude oil is introduced to the hottest cracking element or horizontal rows of cracking tubes, following which the stream flows upwardly through the cooler cracking tubes and toward the outlet. Due to this mode of introducing and circulating the hydrocarbons through the cracking and catalyte tubes, the formation of heavy bottoms is prevented to a large degree. It should be noted that the liquid hydrocarbon delivered by the pump 10 and that delivered from the compressor 37 are under a pressure of from 700 to 1000 lbs. per

square inch and that the mixture of the hydrocarbons from these two sources is subjected to this pressure until the gaseous product resulting from the cracking operation passes the expansion valve 27.

It will be noted further that the arrangement of the cracking and catalyte tubes within the cracking stove and the arrangement of the catalyte container tube 24 in the stack enables a most efficient utilization of the heating agent for the purpose of cracking the hydrocarbon mixture supplied thereto.

Having thus described my invention, what I claim is:

1. An apparatus or system for the purpose specified comprising pressure-creating means, means for supplying a hydrocarbon base fluid to said pressure-creating means, a cooler, a conduit for delivering the fluid from the pressure-creating means to the cooler, a cracking stove, a plurality of communicating cracking elements arranged one above another in said stove and a catalyte container of greater diameter than the cracking elements and located above the cracking elements in the said stove and communicating with the uppermost of said elements, a conduit for delivering fluid from the cooler to the lowermost of the said cracking elements, a burner in said stove below the said elements for heating the said elements and the catalyte container, a vertical stack extending above the stove and connected to the stove at a point adjacent to the upper portion of the latter, means for delivering thereto the products of combustion from the burner in said stove which have contacted the said elements and the said catalyte container, a vertically extending catalyte container in the said stack communicating at a point adjacent to its bottom with the first mentioned catalyte container and arranged to be exposed substantially throughout its entire length to the rising products of combustion in said stack, a delivery pipe communicating with the upper portion of the vertical catalyte container, an expansion valve in said pipe, a cooler with which the delivery end of said pipe communicates, a collector, a pipe connecting the second cooler and the collector, a stabilizing tower, a pipe communicating at one end with the said collector and at its upper end with said stabilizing tower substantially midway of the height of the tower, a heating device in the lower portion of said stabilizing tower, a condensing device in the upper portion of said stabilizing tower, a pipe communicating with the tower below the heating device, and a tank with which the delivery end of said pipe communicates.

2. In the apparatus or system as set forth in claim 1, a compressor, means for delivering non-condensed gases from the stabilizing tower to the said compressor, and means for delivering the fluid from the said compressor into the conduit which delivers fluid into the lowermost of the cracking elements.

3. The process of manufacturing liquid hydrocarbon suitable for motor fuel which comprises subjecting a hydrocarbon base fluid to a pressure of from 700 to 1000 pounds per square inch; cooling the fluid and conducting the same under such pressure in a constantly upward direction through a vertically arranged series of cracking elements and a catalyte container; subjecting the said cracking elements and the catalyte container to a heating medium contacting first the lowermost of the cracking elements and there-

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after contacting the cracking elements there-
above and the catalyte container whereby the
said elements are subjected to an initial tem-
perature, in the lowermost of said cracking ele-
ments, of from 700° to 1200° F.; delivering the
gaseous product from the said catalyte container
to a second catalyte container located above the
first catalyte container and heated by the heat-
ing medium which has first contacted the crack-
ing elements and the first catalyte container;
liquefying, by sudden reduction of pressure and
by cooling, the gaseous product produced within
and delivered from the second catalyte con-

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tainer; and subjecting the liquid thus obtained to
a stabilizing action thereby to evolve, from such
liquid, hydrocarbon gases and heavy liquid hy-
drocarbon polymers.

5 4. In the process set forth in claim 3, delivering
the hydrocarbon gases not condensed by the sta-
bilizing action into the hydrocarbon base fluid
under a pressure of from 700 to 1000 pounds per
square inch and together with said base fluid into
10 the vertically arranged series of cracking ele-
ments.

JAMES R. ROSE.