This invention relates to the production of high quality motor fuel. In one aspect it relates to a method for the production of high octane number motor fuels. In another aspect it relates to a method for the production of high octane number motor fuels in increased yield over conventional methods of producing such fuels.

An object of this invention is to provide a method for producing high quality motor fuels. Another object of this invention is to provide a method for producing high octane number motor fuels. Yet another object of this invention is to provide such a method for the production of high octane fuels which is simple and easy to operate.

Other objects and advantages of this invention will be realized upon reading the following description, which, taken with the attached drawings, form a part of this specification.

The drawings illustrate, in diagrammatic form, one arrangement of apparatus parts for carrying out the process of this invention.

This invention provides a distinct advantage over prior art methods for improving octane numbers of hydrocarbon fuels by modifying conventional processes. Modifying a conventional process to our improved process requires only a minimum of apparatus change.

One prior art method of improving octane numbers of motor fuel stocks involves fractionalization of a low octane value feed stock to produce a low boiling fraction and a high boiling fraction, catalytically converting the high boiling fraction in the presence of a platinum containing catalyst and then after removing, for example, butane and lighter, from the conversion effluent, combining the remainder of the effluent with the originally separated low boiling fraction and converting this combined material in a second conversion step in the presence of a platinum containing catalyst. Both of these conversions are in the presence of free hydrogen.

We have found that not only is it not necessary but in fact it is disadvantageous to convert in a second conversion zone the entire liquid product, free from butane and lower boiling materials, of the first conversion zone because a substantial proportion of the liquid effluent of the first conversion zone possesses a very high octane number and obviously such high octane number material need not be removed. Retreating such high octane material ordinarily yields little if any further octane increase, but with a volume loss, and even may produce a product of lowered octane number with a volume loss. Accordingly, we fractionate the liquid product of the first conversion zone and from this fractionation we remove the high boiling fraction as a high octane product of the process and we then combine the low boiling fraction from the effluent of the first conversion from the original feed stock and convert this combined material in the presence of a second platinum containing catalyst. Both conversion steps of course are in the presence of free hydrogen. Based on 19,200 barrels of feed stock we are able to produce 16,500 barrels of 96 octane number gasoline.

In contrast to the production of only 16,200 barrels of 96 octane number gasoline with 3 cc. TEL per gallon by the Research Method, in contrast to the production of only 16,200 barrels of 96 octane number gasoline with 3 cc. TEL per gallon by the Research Method, the above mentioned prior art method. At first thought it might be considered that 16,500 barrels in contrast to 16,200 barrels is not a very great increase in yield, but when one considers that this material with 3 cc. TEL per gallon possesses an octane number of 96 (by the Research Method) the value of 300 barrels per day of such a high octane number gasoline stock is appreciable.

Specifically we have discovered a method for upgrading the octane rating of a low octane rating gasoline comprising separating said gasoline into a first low boiling fraction and a first high boiling fraction, contacting the first high boiling fraction in the vapor phase and under Reforming conditions with a first platinum containing catalyst, from the effluent of this first vapor phase contacting operation separating the second boiling fraction and a second high boiling fraction, combining said first low boiling fraction with said second low boiling fraction, contacting this combined material in the vapor phase under Reforming conditions with a second platinum containing catalyst, combining the effluent of this second vapor phase contacting operation with the effluent of the first vapor phase contacting operation, and removing said second high boiling fraction as an upgraded octane number gasoline product.

Furthermore we upgrade low octane value gasoline stocks by contacting in the vapor phase and under first Reforming conditions a low octane value gasoline stock with a first platinum containing catalyst, withdrawing effluent from this first operation, fractionating said effluent into a low boiling fraction and a high boiling fraction, contacting said low boiling fraction in the vapor phase and under second Reforming conditions with a second platinum containing catalyst, combining effluent from this second operation with the effluent from the first operation and withdrawing said high boiling fraction as the upgraded octane value product of the process. The platinum containing catalyst which we use in the conversion steps of our invention is made by any suitable process. A specific method for preparing such a catalyst is disclosed in U.S. Patent 2,479,109. This disclosed method, briefly stated, involves precipitation of a salt of aluminum, such as aluminum chloride, with for example, ammonium hydroxide to form aluminum hydroxide, which is then washed to remove soluble impurities. The aluminum hydroxide is filtered thereby producing a wet cake which is slurried with water and a halide, for example, a fluoride. After the aluminum hydroxide and halide are thoroughly mixed, platinum in the form of aqueous chloroplatinic acid is added. Hydrogen sulfide is then introduced into the mixture at room temperature. Alternatively, hydrogen is added to the aqueous chloroplatinic acid and then the mixture slurried with the halide containing aluminum hydroxide. The hydrogen sulfide apparently reacts with the chloroplatinic acid to form one or more complex chemical compounds which are easily retained by the aluminum hydroxide upon filtration of the mixture. The platinum containing mixture is dried at a temperature of about 200° to 400° F. for a period of 4 to 24 hours. The catalyst can be formed into a uniform size or into other shapes as desired after which it is calcined at a temperature about 800° to 1200° F. for about 2 to 8 hours or more. After this calcining treatment the catalyst is ready for use.

After such a catalyst has been used and deposition of...
3 carbonaceous matter thereon has diminished its catalytic activity, the catalyst is regenerated by heating to a temperature not exceeding about 1200°F. in the presence of free-oxygen containing gas, such as air.

The catalyst prepared as above outlined promotes aromatization, cyclization, isomerization and other reactions characteristic of hydrocarbons.

The general rule found applicable in the practice of our invention is that the low boiling material is susceptible to octane number improvement by Platforming without undue loss whereas high boiling Platformate material is not susceptible to octane number improvement by further Platforming without undue volume loss. The volume loss by Platforming a high boiling Platformate material is usually sufficiently great as to make uneconomical further treatment of the higher boiling materials.

Material or feed stock susceptible of treatment according to our herein disclosed method includes straight run and/or cracked naphthas by the term "low boiling fraction" as used throughout this specification and claims is meant that relatively low boiling Platformate material which is susceptible to further octave number improvement by a subsequent Platforming operation without undue volume loss whereas the term "high boiling fraction" as used throughout this specification and claims includes Platformate material of boiling range higher than the boiling range of said low boiling fraction and is used in blending spark ignition engine fuels for automotive and aviation use and is not susceptible to further octave number improvement by Platforming without undue volume loss.

By the term "cut point" is meant the temperature intermediate the low boiling fraction and the high boiling fraction and is actually the temperature at which the cut is made to produce the low boiling fraction and the high boiling fraction.

The cut point of the Platformate as in Platformate splitter or fractionator 14 depends upon several factors; first, the source of the crude oil providing the straight run and/or cracked naphtha feed to the prefractionator 2; second, the specific operating conditions maintained in the Platforming reactors 8 and 23; third, the desired octane number of the final product, and on such other conditions as hydrogen recycle, degree of stabilization or fractionation carried out in columns 2 and 13, etc. Those skilled in the art understand the adjusting and regulation of the operating conditions in order to produce a product with the desired octave value.

As illustrative of the operation of our process, a feed stock, such as a naphthenic gasoline, from a source, not shown, is passed through pipe 1 into a fractional distillation zone 2 in which it is fractionated into a low boiling overhead fraction, a high boiling fraction, and a residuum. The high boiling fraction is passed from the fractionation zone 2 through a pipe 4 is vaporized in furnace 7, and is then passed into a reactor vessel 8 containing a quantity of the above mentioned platinum containing catalyst. Free hydrogen, as subsequently produced, is introduced from a pipe 6 into the stream of high boiling gas oil prior to its entry into furnace 7. This furnace 7 is operated in such a manner as to vaporize without heating the gasoline so that it can be introduced in a vapor phase into the reactor 8. This reactor 8 is maintained at a temperature of from about 800°F. to 975°F. at a pressure of from 300-700 p.s.i.g. The rate of introduction of the feed stream into the reactor is such as to provide a flow rate of from 2 to 8 liquid volumes of feed per volume of catalyst per hour. The rate of introduction of hydrogen into this feed stream is about 2.1 to 10.1 mol of high boiling gasoline feed.

The effluent from the reactor 8, partially condensed in a condenser 9, flows into a separator 10. In separator 10 hydrogen and hydrocarbons not condensed in condenser 9 are removed in pipe 6 and are compressed by a compressor 26 prior to introduction into the feed stream in pipe 4. This hydrogen containing gas is rich in hydrogen and is the free hydrogen as subsequently produced, mentioned above. Excess of hydrogen not required in reactor 8 is removed from the system through a pipe 27 for such disposal as desired.

The liquid phase from separator 10 is removed therefrom through a pipe 11 and is passed into a stabilizer 13 from which butane and lower boiling materials are removed through a pipe 28. The stabilizer bottoms (or Platformate) is passed through a pipe 34 into a Platformate splitter column 14. In this splitter column the Platformate is fractionally distilled and the low boiling fraction is removed through a pipe 15 and the kettle material is removed through a pipe 33 as a portion of the high octane Platformate product of the process. The low boiling fraction passing through pipe 15 is combined with the low boiling fraction of the original feed stock from pipe 5 and this combined material passes through a pipe 32 into a selective charge splitter column 16. The use of this splitter column 16 is not essential to our process, but if desired it can be used to distill a low boiling fraction or cut which is removed through a pipe 17, an intermediate boiling fraction which is removed through a pipe 18 and a high boiling fraction which is removed through a pipe 19. According to local requirements, any one or two of these three cuts or fractions from splitter column 16 can be removed as additional products of the process while the third one, which can be any one of the three cuts, can be passed on through pipes 29, 30, or 31, as the case may be, and pipe 20 into the second stage of our operation.

However, under some conditions it may not be desired to remove any fraction of the combined stream flowing through pipe 32 as product, and in this case a valve in pipe 32 (feed line to splitter 16) is closed and a valve in pipe 36 is opened and the combined feed material passes directly through pipe 36 into pipe 20 for our second stage of operation.

The material passing through pipe 20 is vaporized in a heater 22 and in the vapor form it is passed into a reactor vessel 23 which contains a quantity of, for example, the same platinum containing catalyst as is employed in reactor 8. Reactor 23 is maintained at a temperature of approximately 1200°F. under a pressure of about 250 to 600 p.s.i.g. or about 250 to 600 p.s.i.g. The volume of the catalyst in reactor vessel 23 is such that the feed stock in the vapor form is passed through the reactor at a feed rate of about 2 to 8 liquid volumes of feed per volume of catalyst per hour.

Effluent from reactor vessel 23 is passed through a line 37, is at least partially condensed in condenser 24, and liquid is separated from gas in a separator tank 25. The liquid separated in tank 25 is passed by way of a pipe 42 and is combined with the liquid from separator tank 10 flowing in pipe 11 and it is this combined stream which is passed into stabilizer 13. A portion of the liquid from separator 25 is introduced in the high octane number high boiling portion separated in splitter 14 and removed as product through pipe 33. The gases separated in separator 25 consist largely of free hydrogen along with a minor amount of gaseous hydrocarbon and this hydrogen-rich gas is passed through a pipe 21 and is compressed by a compressor 38 and is introduced into the charge stock flowing through pipe 20 prior to its entry into furnace 7. The rate of addition of this hydrogen-rich gas to the feed in pipe 20 is such as to maintain a mol ratio of hydrogen to feed between the approximate limits of 2:1 to 10:1 on a mol basis preferably from 4:1 to 9:1. Any excess of hydrogen-rich gas over that required to maintain this recycle ratio is removed from pipe 21 through a pipe 35 for such disposal as desired.

When the system is treating a naphthenic base gasoline,
we operate splitter 14 so as to take approximately 40 percent of the material charged to this splitter overhead through pipe 15 so that it is only about 40 percent of the stabilized effluent from reactor 8 which is reprocessed in the subsequent reactor 23. In this manner the high boiling fraction separated in splitter 14 is not retreated, as is done in the aforementioned prior art, with possible deterioration of its normally high octane rating. In the example given herebelow this high boiling fraction withdrawn through pipe 33 had an octane number of 96. While subsequent treatment might under some conditions not adversely affect the octane rating of this material subsequent treatment does not further improve its octane number and such retreatment would merely increase the load on furnace 23 and reactor 23.

In the following tabulation are given data on a run in which a Platformate stock was fractionally distilled to produce a 40% by volume overhead product and a 60% bottom product by volume less a volume loss of about 0.6%. The octane number values are illustrative of the difference in properties of a low boiling fraction and a high boiling fraction of a Platformate stock:

<table>
<thead>
<tr>
<th>Platformate charge to still</th>
<th>Distillation overhead product</th>
<th>Distillation bottoms product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume percent.</td>
<td>Octane No.</td>
<td>Clear</td>
</tr>
<tr>
<td>40</td>
<td>92.6</td>
<td>71.2</td>
</tr>
<tr>
<td>Approx. 60</td>
<td>91.8</td>
<td>90.1</td>
</tr>
<tr>
<td>85</td>
<td>81.3</td>
<td>89.6</td>
</tr>
<tr>
<td>100</td>
<td>66.8</td>
<td>66.3</td>
</tr>
</tbody>
</table>

1 Vol. loss on distillation 0.6%.

As an example of the operation of our process, a naphthenic type gasoline was fractionated in a fractionator corresponding to fractionator 2 with the high boiling fraction being catalytically treated in the presence of a platinum containing catalyst and the liquid effluent therefrom fractionated in a splitter corresponding to splitter 14. Approximately 40 percent of the charge to splitter 14 was removed as overhead product and combined with the low boiling fraction of the original gasoline and this combined material was vaporized and treated in the presence of the second platinum containing catalyst in a vessel corresponding to reactor 23. Condensate liquid separated from the effluent of this latter reactor was combined with the liquid separated from the effluent of the first stage reactor. In the following tabulation are given the flow rate in terms of barrels per day and the octane number of the streams of product in various stages of an operation illustrated in the drawing.

<table>
<thead>
<tr>
<th>Stream No.</th>
<th>Present invention</th>
<th>Prior art</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+66.9 TEL Method</td>
<td>+66.9 TEL Method</td>
</tr>
<tr>
<td>5</td>
<td>3,200</td>
<td>3,200</td>
</tr>
<tr>
<td>6</td>
<td>14,000</td>
<td>14,200</td>
</tr>
<tr>
<td>7</td>
<td>5,600</td>
<td>5,600</td>
</tr>
<tr>
<td>8, 9, 10, 11</td>
<td>4,500</td>
<td>4,500</td>
</tr>
<tr>
<td>12 (TML product)</td>
<td>8,000</td>
<td>8,000</td>
</tr>
<tr>
<td>12 (TML product)</td>
<td>8,000</td>
<td>8,000</td>
</tr>
<tr>
<td>13 (TML product)</td>
<td>16,000</td>
<td>16,000</td>
</tr>
<tr>
<td>14 (TML product)</td>
<td>17,480</td>
<td>17,480</td>
</tr>
<tr>
<td>15 (TML product)</td>
<td>16,000</td>
<td>16,000</td>
</tr>
</tbody>
</table>

1 Feed to first conversion zone.
2 On butane and lighter-free basis.
3 Feed to second conversion zone.

Under the heading "Stream number" is given the reference numerals identifying the various pipes and vessels in the drawing containing the products described. Under the heading "Prior art" in the tabulation are given the flow rate in terms of barrels per day and octane of the corresponding streams of the prior art process as hereabove described. It should be noted that the final product of our process as removed through pipe 33 is 16,500 barrels based on a feed volume of 19,200 barrels (pipes 5 and 4) and having an octane number of 96 (±3 cc. TEL) in contrast to the prior art fractioned product of 16,200 barrels of 96 octane gasoline (±3 cc. TEL) based on the same volume of feed stock. Thus, our process produces 300 barrels of 96 octane gasoline (±3 cc. TEL) more per 19,200 barrels of charge stock than does the prior art.

In one particular case when a naphthenic type of gasoline was treated according to our process, fractionation cuts numbers 1, 2, and 3 withdrawn from splitter 16 through pipes 17, 18, and 19, respectively, consisted largely of C₁₀, C₁₁, and C₁₂ hydrocarbons, respectively.

In the fractionator 2, it is ordinarily desired to separate out and to withdraw from the system such high boiling material as would tend to coke up the Platforming catalyst in the reactor 8. The fraction removed overhead from the vessel is in general mainly the low boiling material which would not be appreciably converted under the relatively mild conditions maintained in the Platforming reactor 8 for converting the higher boiling portion of the feed taken off as a product via pipe 4. The material taken overhead from fractionator 2 acts largely as a diluent of the more easily converted higher boiling material in reactor 8 thereby reducing the Platforming capacity of this reactor. However, this overhead material is suitable as Platforming charge stock to reactor 23 which is maintained under suitable conditions to convert this low boiling less easily converted stock to a high octane value stock.

In the example given herein, approximately 40% of the feed to Platformate splitter 14 was taken overhead as the low boiling fraction for subsequent treatment in reactor 23. As mentioned hereinbefore the cut made in the splitter is largely dependent on the desired results, and accordingly more than 40% by volume or less than 40% by volume can be taken overhead for retreatment dependent upon the octane value of the portion not taken overhead, that is the bottoms withdrawn via pipe 33. The volume percentage taken overhead rarely exceeds 70%.

It will be obvious to those skilled in the art that operational details such as reactor temperatures, pressures, stock flow rates, hydrogen recycle rates, composition of cuts 1, 2, and 3 from splitter 16, and many other details will need to be changed in view of the partial feed stock being treated and the ultimate results desired. Such changes in operational details will be well understood by those skilled in the art.

Such auxiliary apparatus as valves, temperature and pressure indicating, recording and control apparatus and the like are not shown on the drawing or described in the specification for purposes of brevity. The need for such auxiliary equipment, its installation and use are well understood by those skilled in such art.

While certain embodiments of the invention have been described for illustrative purposes, the invention is obviously not limited thereto.

I claim:

1. A method for upgrading the octane rating of low octane rating gasoline stocks comprising the steps of contacting in the vapor phase and under first Platforming conditions of about 800° to 975° F. and about 300 to 700 p.s.i.g. a low octane value gasoline stock with a first platinum containing catalyst, withdrawing effluent from this first operation, fractionating said effluent into a low boiling fraction which is susceptible to further octane number improvement; and a high octane number high boiling fraction which is not susceptible to further octane number improvement without undue volume loss, contacting said low boiling fraction in the vapor phase and under second Platforming conditions of about 850 to 1000° F. and about 300 to 600 p.s.i.g. with a second...
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platinum containing catalyst, combining effluent from this second operation with the effluent from the first operation prior to the fractionation step and withdrawing said high boiling fraction as the upgraded octane value product of the process.

2. A method for upgrading the octane rating of low octane rating gasoline stocks comprising the steps of contacting in the vapor phase and under first Platforming conditions of about 850° to 1000° F. and about 300° to 700° p.s.i.g. a first low octane value gasoline stock with a first platinum containing catalyst, withdrawing effluent from this first operation, fractionating said effluent into a low boiling fraction which is susceptible to further octane number improvement; and a high octane number high boiling fraction which is not susceptible to further octane number improvement without undue volume loss, to this low boiling fraction adding a low boiling low octane value gasoline stock, contacting this latter combined material in the vapor phase and under second Platforming conditions of about 850° to 1000° F. and about 300 to 600 p.s.i.g. with a second platinum containing catalyst, combining effluent from this second contacting operation with the effluent from the first operation prior to the fractionation step, and withdrawing said high boiling fraction as the upgraded octane rating gasoline stock.

3. A method for upgrading the octane rating of a low octane rating gasoline, comprising fractionally distilling said gasoline into a low boiling material which is not easily converted in a subsequent step and a high boiling material more easily converted in said subsequent step, contacting said high boiling material in the vapor phase at a temperature within about 800° to 975° F. under superatmospheric pressure of about 300 to 700 p.s.i.g. with a first platinum containing catalyst, as said subsequent step at a flow rate of 2 to 8 liquid volumes of said high boiling material per volume of catalyst per hour, from the effluent of this first vapor phase contacting operation separating a first vapor phase from a first liquid phase, from this first liquid phase separating a low boiling fraction which is susceptible to further octane number improvement; and a high boiling fraction which is not susceptible to further octane number improvement without undue volume loss, combining the aforesaid low boiling material with said low boiling fraction, contacting this combined material in the vapor phase at a temperature within about 850° to 1000° F. under superatmospheric pressure of about 250 to 600 p.s.i.g. with a second platinum containing catalyst at a flow rate of 2 to 8 liquid volumes of said combined material, the temperature of the contacting with said second catalytic step being lower than the temperature of contacting with said first catalyst, the pressure maintained in the second catalytic step being lower than the pressure maintained in the first catalytic step, from the effluent of this second vapor phase contacting operation separating a second vapor phase from a second liquid phase, combining this second liquid phase with the aforesaid first liquid phase, and withdrawing said high boiling fraction as an upgraded octave number gasoline product.

4. In the method of claim 3 cycling at least a portion of said first vapor phase into the first vapor phase contacting operation as a hydrogen recycle and at least a portion of said second vapor phase into the second vapor phase contacting as a second hydrogen recycle the hydrogen recycled being from about 2 to 10 mols hydrogen per mol of feed to each vapor phase contacting.

5. A method for upgrading the octane rating of a low octave rating gasoline comprising fractionally distilling said gasoline into a low boiling material which is not easily converted in a subsequent step and a high boiling material more easily converted in said subsequent step, contacting said high boiling material in the vapor phase at a temperature within about 800° to 975° F. under superatmospheric pressure of about 300 to 700 p.s.i.g. with a first platinum containing catalyst as said subsequent step, from the effluent of this first vapor phase contacting operation separating a first vapor phase from a first liquid phase, from this first liquid phase separating a second vapor phase from a second liquid phase, combining this second liquid phase with the aforesaid first liquid phase, withdrawing said high boiling fraction as an upgraded octave number gasoline product, and withdrawing the remaining of said second low boiling fraction, said first intermediate fraction, and said second intermediate boiling fraction as additional products.

6. A method for upgrading the octane rating of a low octave rating gasoline, comprising fractionally distilling said gasoline into a low boiling material which is not easily converted in a subsequent step and a high boiling material more easily converted in said subsequent step, contacting said high boiling material in the vapor phase at a temperature within about 850° to 1000° F. under superatmospheric pressure of about 250 to 600 p.s.i.g. and in the presence of from 2 to 10 mols free hydrogen per mol of said high boiling material with a first platinum containing catalyst as said subsequent step, from the effluent of this first vapor phase contacting operation separating a first vapor phase from a first liquid phase, from this first liquid phase separating a low boiling fraction which is susceptible to further octane number improvement; and a high boiling fraction which is not susceptible to further octane number improvement without undue volume loss, combining the aforesaid low boiling material with said low boiling fraction, contacting this combined material in the vapor phase at a temperature within about 850° to 1000° F. under superatmospheric pressure of about 250 to 600 p.s.i.g. with a second platinum containing catalyst at a flow rate of 2 to 8 liquid volumes of said combined material, the temperature of the contacting with said second catalytic step being lower than the temperature of contacting with said first catalyst, the pressure maintained in the second catalytic step being lower than the pressure maintained in the first catalytic step, from the effluent of this second vapor phase contacting operation separating a second vapor phase from a second liquid phase, combining this second liquid phase with the aforesaid first liquid phase, and withdrawing said high boiling fraction as an upgraded octave number gasoline product.

7. A method for upgrading the octane rating of a low octave rating gasoline comprising fractionally distilling said gasoline into a low boiling material which is not easily converted in a subsequent step and a high boiling material more easily converted in said subsequent step, contacting said high boiling material in the vapor phase at a temperature within about 800° to 975° F. under superatmospheric pressure of about 300 to 700 p.s.i.g. with a first platinum containing catalyst as said subsequent step, from the effluent of this first vapor phase contacting operation separating a first vapor phase from a first liquid phase, from this first liquid phase separating a second vapor phase from a second liquid phase, combining this second liquid phase with the aforesaid first liquid phase, withdrawing said high boiling fraction as an upgraded octave number gasoline product, and withdrawing the remaining of said second low boiling fraction, said first intermediate fraction, and said second intermediate boiling fraction as additional products.
octane rating gasoline, comprising fractionally distilling said gasoline into a low boiling material which is not easily converted in a subsequent step and a high boiling material more easily converted in said subsequent step, contacting said high boiling material in the vapor phase at a temperature within about 800° to 975° F. under superatmospheric pressure of about 500 to 700 p.s.i.g. with a first platinum containing catalyst as said subsequent step at a flow rate of 2 to 8 liquid volumes of said high boiling material per volume of catalyst per hour, from the effluent of this first vapor phase contacting operation separating a first vapor phase from a first liquid phase, from this first liquid phase distilling a low boiling fraction which is susceptible to further octane number improvement and a high boiling fraction which is not susceptible to further octane number improvement without undue volume loss, combining said low boiling material with said low boiling fraction, fractionating this combined material into a second low boiling fraction, a first intermediate boiling fraction and a second intermediate boiling fraction as charge at least one of said second low boiling fraction, said first intermediate boiling fraction and said second intermediate boiling fraction in the vapor phase at a temperature within about 850° to 1000° F. under superatmospheric pressure of about 250 to 600 p.s.i.g. with a second platinum containing catalyst at a flow rate of 2 to 8 liquid volumes of said charge, the temperature of the contacting operation separating said second vapor phase from a second liquid phase, combining said second liquid phase with the aforesaid first liquid phase, withdrawing said high boiling fraction as an upgraded octane number gasoline product, and withdrawing the other two of said second low boiling fraction, said first intermediate boiling fraction, and said second intermediate boiling fraction as additional products.

8. In the method of claim 6 cycling at least a portion of said first vapor phase into the first vapor phase contacting as the first mentioned 2 to 10 moms of free hydrogen and cycling at least a portion of said second vapor phase into the second vapor phase contacting as the second mentioned 2 to 10 moms of free hydrogen.

9. A method for upgrading the octane rating of a low octane rating gasoline, comprising fractionally distilling said gasoline into a low boiling material which is not easily converted in a subsequent step and a high boiling material more easily converted in said subsequent step, contacting said high boiling material in the vapor phase at a temperature within about 800° to 975° F. under superatmospheric pressure of about 300 to 700 p.s.i.g. with a first platinum containing catalyst as said subsequent step, contacting said high boiling material in the vapor phase at a temperature within 850° to 1000° F. and about 300 to 700 p.s.i.g. with a first platinum containing catalyst as said subsequent step, withdrawing the aforesaid first liquid phase, combining this second liquid phase with the aforesaid first liquid phase, and withdrawing said high boiling fraction as an upgraded octane number gasoline product.

10. A method for upgrading the octane rating of a low octane rating gasoline, comprising fractionally distilling said gasoline into a low boiling material which is not easily converted in a subsequent step and a high boiling material more easily converted in said subsequent step, contacting said high boiling material in the vapor phase at a temperature within about 800° to 975° F. under superatmospheric pressure of about 500 to 700 p.s.i.g. and in the presence of from 2 to 10 mol of free hydrogen per mol of said high boiling fraction with a first platinum containing catalyst as said subsequent step, from the effluent of this first vapor phase contacting operation separating a first vapor phase from a first liquid phase, from this first liquid phase distilling a low boiling fraction which is susceptible to further octane number improvement and a high boiling fraction which is not susceptible to further octane number improvement without undue volume loss, combining said low boiling material with said low boiling fraction, contacting this combined material in the vapor phase at a temperature within about 850° to 1000° F. under superatmospheric pressure of about 250 to 600 p.s.i.g. and in the presence of from 2 to 10 mol of free hydrogen per mol of combined low boiling materials with a second platinum containing catalyst, the temperature of the contacting with said second catalyst being at a higher temperature than the temperature of contacting with said first catalyst, the pressure maintained in the second catalytic step being lower than the pressure maintained in the first catalytic step, from this second vapor phase contacting operation separating a second vapor phase from a second liquid phase, combining this second liquid phase with the aforesaid first liquid phase, and withdrawing said high boiling fraction as an upgraded octane number gasoline product.

11. A method for upgrading the octane rating of a low octane rating gasoline, comprising fractionally distilling said gasoline into a low boiling material which is not easily converted in a subsequent step and a high boiling material more easily converted in said subsequent step, contacting said high boiling material in the vapor phase at a temperature within about 850° to 975° F. and about 300 to 700 p.s.i.g. with a first platinum containing catalyst as said subsequent step, withdrawing the aforesaid first liquid phase, combining this second liquid phase with the aforesaid first liquid phase, and withdrawing said high boiling fraction as an upgraded octane number gasoline product.
mols of free hydrogen per mol of said high boiling fraction with a first platinum containing catalyst as said subsequent step, withdrawing contacted effluent from this operation, from this first effluent fractionally distilling a low boiling fraction which is susceptible to further 5 octane number improvement; and a high boiling fraction which is not susceptible to further octane number improvement without undue volume loss, combining said low boiling material with said low boiling fraction, contacting this combined material in the vapor phase under Platforming conditions of about 850° to 1000° F. and about 250 to 600 p.s.i.g. and in the presence of from 2 to 10 mols free hydrogen per mol of combined low boiling materials with a second platinum containing catalyst, the temperature of the contacting with said second catalyst 15 being at a higher temperature than the temperature of contacting with said first catalyst, the pressure maintained in the second catalytic step being lower than the pressure maintained in the first catalytic step, withdrawing contacted second effluent from this second contacting operation, combining effluent of this second vapor phase contacting operation with effluent of said first vapor phase contacting operation, withdrawing said second high boiling fraction as an upgraded octane number gasoline product.

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<thead>
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<th>Date</th>
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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,905,621

September 22, 1959

Robert D. Bauer et al.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 7, lines 9 and 10, for "300° to 700°" read -- 300 to 700 --; column 10, line 3, for "products" read -- product --; line 55, for "Platforming" read -- Platforming --; line 70, after "low" insert -- boiling --.

Signed and sealed this 14th day of June 1960.

(SEAL)
Attest:
KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents