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HIGH OCTANE NUMBER GASOLINE AND METHOD OF MANUFACTURE

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Fig. 1.

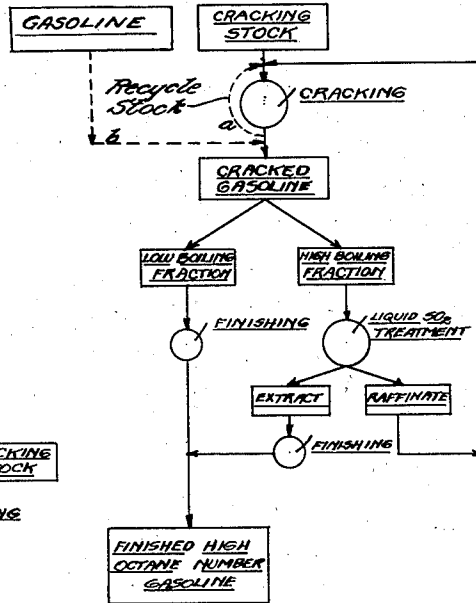
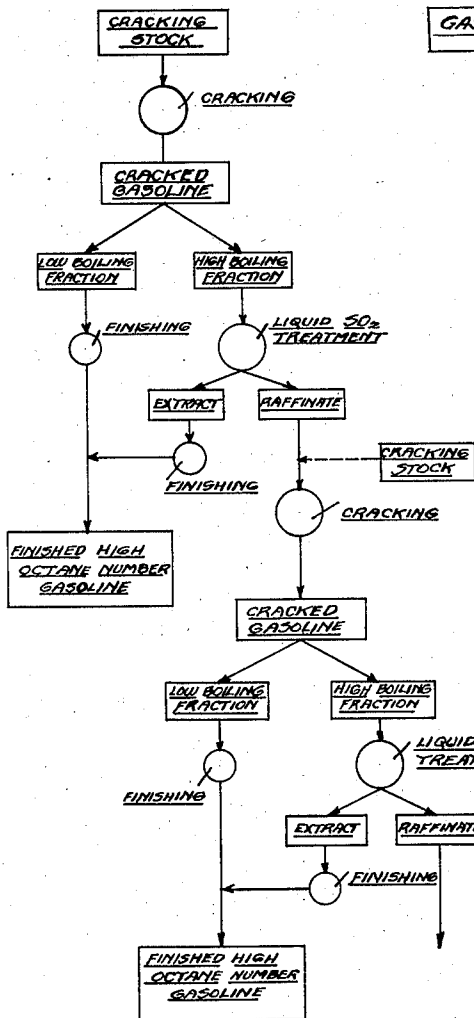


Fig. 2.

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HIGH OCTANE NUMBER GASOLINE AND
METHOD OF MANUFACTUREOsceola P. Cottrell, Scarsdale, N. Y., assignor to
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5 Claims. (Cl. 196—50)

This invention relates to the manufacture of a motor fuel characterized by an especially high anti-knocking quality and consequent high octane number.

More specifically, it relates to a process which combines steps of cracking and treating with selective solvents, such as liquid-SO₂, or others, such as are known in the industry, in such manner that a given amount of low boiling hydrocarbons of gasoline range may be completely converted into a finished gasoline of high octane number. The product has a higher octane number than could be produced by cracking alone, and the process not only avoids losses heretofore caused by inability to utilize the entire stock but permits of greatly improved cracking operations and finished product. Reference may be made to the patents to Edeleanu, Nos. 1,661,565 and 1,661,566, for a description of existing processes utilized in carrying out the present invention.

In the accompanying drawing, wherein I have shown several embodiments of my process for purposes of illustration,

Fig. 1 is a flow diagram showing a multi-stage system of treatment; and

Fig. 2 is a flow diagram showing a recycling system of treatment.

Referring to Fig. 1, a cracking stock is cracked so as to form a cracked gasoline. Any method of cracking, liquid phase or vapor phase, at any temperature and pressure may be used.

The cracked gasoline is then separated into a low boiling fraction and a high boiling fraction. This may be done by distillation of the condensed gasoline, or may be accomplished directly by taking the higher boiling fraction off the usual bubble tower of the cracking apparatus as a liquid side stream, while the lower boiling fraction is taken from the top of the bubble tower as a vapor and subsequently condensed. The cut may be made at any point, depending on the type of stock and the desired quality of the finished high octane number gasoline product, and is not restricted to any special temperature or gravity.

The high boiling fraction is then treated with a selective solvent, such as liquid-SO₂, or mixed solvent, in the well known manner. The liquid-SO₂, or like solvent, dissolves out the unsaturated and aromatic constituents and these are known as the extract, which is characterized by having a high octane number. The remainder, comprising substantially the saturated constituents, is known as the raffinate, and being knock producing is characterized by having a low octane num-

ber. Both portions will contain some of the solvent and this is removed by evaporation in the usual manner.

The extract from the high boiling fraction is subjected to a suitable finishing treatment for the removal of impurities—such as sulfur compounds, gums, etc.,—and is blended with the low boiling fraction which has been similarly finished. The blend is a finished high octane number gasoline, and constitutes a very high quality of motor fuel. As a modification of this method, the low boiling fraction and the extract may be first blended and then finished to produce the high octane number product.

Thus far the process is the same as that described in the patent to Edeleanu, No. 1,661,566, upon which it is an improvement. The present process, however, provides for converting the entire stock into high octane number motor fuel, that is, the raffinate from the high boiling fraction heretofore considered unsuitable for motor fuel because of its high boiling point and its knocking characteristic is also converted into a high octane number gasoline suitable for motor fuel. This is accomplished according to the following method.

The raffinate from the treatment with liquid-SO₂ or like solvent, applied to the high boiling fraction of the cracked gasoline is subjected to a cracking operation. This is readily and economically effected since the raffinate is comprised substantially of saturated hydrocarbons. The product, a cracked gasoline, is then subjected to the same process steps as was the original cracked gasoline stock. It is separated into a low boiling fraction and a high boiling fraction. The high boiling fraction is treated with liquid-SO₂ or the like, and the extract, after freeing from solvent and finishing, is blended with the finished low boiling extract to form a finished high octane number gasoline suitable for use as a high quality motor fuel. The raffinate is treated in the same manner as the raffinate from the original treatment, and so on over and over, until all of the original raffinate has been converted into high octane number gasoline.

The foregoing method illustrates my invention in its simplest form. In actual practice, however, instead of confining the successive stages of treatment to the successive raffinates, each successive raffinate would be mixed with a cracking stock and the admixture so treated. This method is shown in Fig. 1, by including the step of adding cracking stock represented by the dotted flow line. An advantage of this procedure is

that a full size unit can be employed for each stage, and furthermore the cracking stock itself is more readily and economically cracked by being mixed with raffinate. Lower gas losses, better yields and less corrosion result, and shut-downs of the cracking apparatus are less frequent. The raffinate has a very low sulfur content, due to the fact that the liquid-SO₂ treatment removes the sulfur therefrom, and hence the cracking of the admixture of raffinate and cracking stock results in a cracked low sulfur gasoline.

Example

A Midcontinent cracked gasoline was separated by distillation into two portions, a fraction boiling below 347° F., and a higher boiling fraction. The yield of the low boiling fraction was 64.0% and that of the higher boiling fraction was 35.2% (distillation loss amounting to 0.8%). The high boiling fraction was treated with liquid-SO₂, resulting in an extract yield of 42% and a raffinate yield of 58%. The extract was finished and blended with the low boiling fraction which was first finished. The blend resulted in a finished gasoline having a greatly improved distillation range and a 45% increase in octane number over the original cracked gasoline. The end point of the finished gasoline thus manufactured was 444° F. and its octane number was 83.

The raffinate, representing over 20% of the original cracked gasoline, was mixed with cracking stock and re-cracked together with such stock, and the resulting cracked gasoline was subjected to the same series of steps as was the original cracked gasoline; and this procedure was repeated with each successive raffinate.

In this manner substantially all of the original cracked gasoline was converted into finished high octane number gasoline, whereas if my improved method had not been used, over 20% of the original stock—the first raffinate—could have been marketable only as a burning oil or kerosene.

The usual procedure for obtaining high octane number gasoline is to produce a cracked gasoline of low end point, which necessarily means a low yield. The present invention results in a finished gasoline of such a favorable composition and distillation range that the end point may be considerably increased without adversely affecting its volatility in the motor or octane number. Previously it was necessary to produce cracked gasoline having an end point of 390°–400° F. to obtain a desired octane number which by the present method is obtained from a 437° F. or higher, end point gasoline.

Fig. 2 shows a continuous recycling method for carrying out my invention. This process results in substantially all of a cracked gasoline being converted into a high octane number gasoline, and all of the cracking stock employed is mixed with raffinate, so that cracking conditions are superior in all cracking operations.

As in the first described method, the cracking stock is cracked into gasoline which is then separated into a low-boiling fraction and a high boiling fraction. The high boiling fraction is treated with liquid-SO₂, or like solvent, and the extract blended with the low boiling fraction to produce the high octane number gasoline.

The distinguishing feature of this form of my invention is that the raffinate is led back and introduced into the original cracking stock entering the cracking step of the process. Thus the raffinate is continuously recycled and a given por-

tion is therefore gradually converted substantially in its entirety into high octane number gasoline as a result of the successive crackings, fractionations and selective solvent treatments to which it is subjected.

Fig. 2 also illustrates how the same principle may be used for converting either a cracked gasoline or a straight run gasoline into high octane number gasoline. In this case the raffinate is cracked and the resulting cracked raffinate mixed with the cracked gasoline or straight run gasoline entering the cycle (as shown by broken-line *b* in Fig. 2), the mixture then being separated into a low boiling fraction and a high boiling fraction which are disposed of in the manner already described. No cracking stock is made use of, although, if desired, cracking stock may be simultaneously converted into high octane number gasoline by mixing it with the raffinate to be cracked, as is evident from Fig. 2 and the foregoing description.

It will be apparent to those skilled in the art that my invention may be applied in many other ways. For example, in practically all cracking processes a recycle stock is obtained, being generally drawn off from the bottom of the bubble tower of the cracking plant. This recycle stock, containing such high boiling hydrocarbons as are not normally usable, is led back and re-cracked with raw cracking stock in order that it may be broken up into lower boiling hydrocarbons. As shown in Fig. 2, this procedure may be combined with the foregoing embodiments of my invention as follows: Instead of mixing the raffinate directly with new cracking stock and cracking the admixture, the raffinate is mixed with the recycle stock from the cracking plant (indicated by broken line *a* in Fig. 2) and this admixture is mixed with new raw cracking stock and the combined mixture subjected to cracking. The cracked gasoline product is then subjected to the same process steps already described.

My invention obviously is not restricted to the embodiments thereof illustrated and described, but what I claim is as follows:

1. A continuous process for converting substantially all of a straight run gasoline into high octane number gasoline, comprising the steps of separating the gasoline into a low boiling fraction and a high boiling fraction, treating the high boiling fraction with liquid-SO₂ or like solvent, separating the raffinate and extract, removing the solvent therefrom, cracking the raffinate, recycling the cracked raffinate by mixing it with the straight run gasoline stock entering the cycle and blending said extract with said low boiling fraction to produce the high octane number gasoline.

2. A process for the manufacture of high octane number gasoline comprising mixing the liquid-SO₂ insoluble hydrocarbons from the high boiling portion of a straight run gasoline with cracking stock containing both saturated and unsaturated hydrocarbons, cracking the mixture to form a cracked gasoline, dividing the latter into a low boiling fraction and a high boiling fraction, treating the high boiling fraction with liquid-SO₂ or like solvent, separating out the extract, removing the solvent therefrom, and blending said extract with said low boiling fraction.

3. A process for converting substantially the entirety of a straight run gasoline into a high octane number gasoline, comprising dividing the straight run gasoline into a low boiling fraction and a high boiling fraction, treating the high

boiling fraction with liquid-SO₂ or like solvent, separating the raffinate and extract, removing the solvent therefrom, blending said extract with said low boiling fraction to form a high octane number gasoline, mixing said raffinate with cracking stock containing both saturated and unsaturated hydrocarbons, cracking the mixture so as to form a cracked gasoline, subjecting the latter to the foregoing sequence of steps described for the straight run gasoline, and in like manner treating the successive raffinates resulting from continuing the process herein set forth.

4. A continuous process for converting substantially all of a straight run gasoline into high octane number gasoline, comprising the steps of separating the gasoline into a low boiling fraction and a high boiling fraction, treating the high boiling fraction with liquid-SO₂ or like solvent, separating the raffinate and extract, removing the solvent therefrom, mixing the raffinate with

cracking stock and cracking the mixture to form a cracked gasoline, mixing the latter with straight run gasoline entering the cycle, and blending said extract with said low boiling fraction to produce the high octane number gasoline.

5. A continuous process for converting substantially all of a straight run gasoline into high octane number gasoline, comprising the steps of separating the gasoline into a low boiling fraction and a high boiling fraction, treating the high boiling fraction with liquid-SO₂ or like solvent, separating the raffinate and extract, removing the solvents therefrom, cracking the raffinate in admixture with recycle stock from the cracking step to form a cracked gasoline, mixing the latter with straight run gasoline entering the cycle, and blending said extract with said low boiling fraction to produce the high octane number gasoline.

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