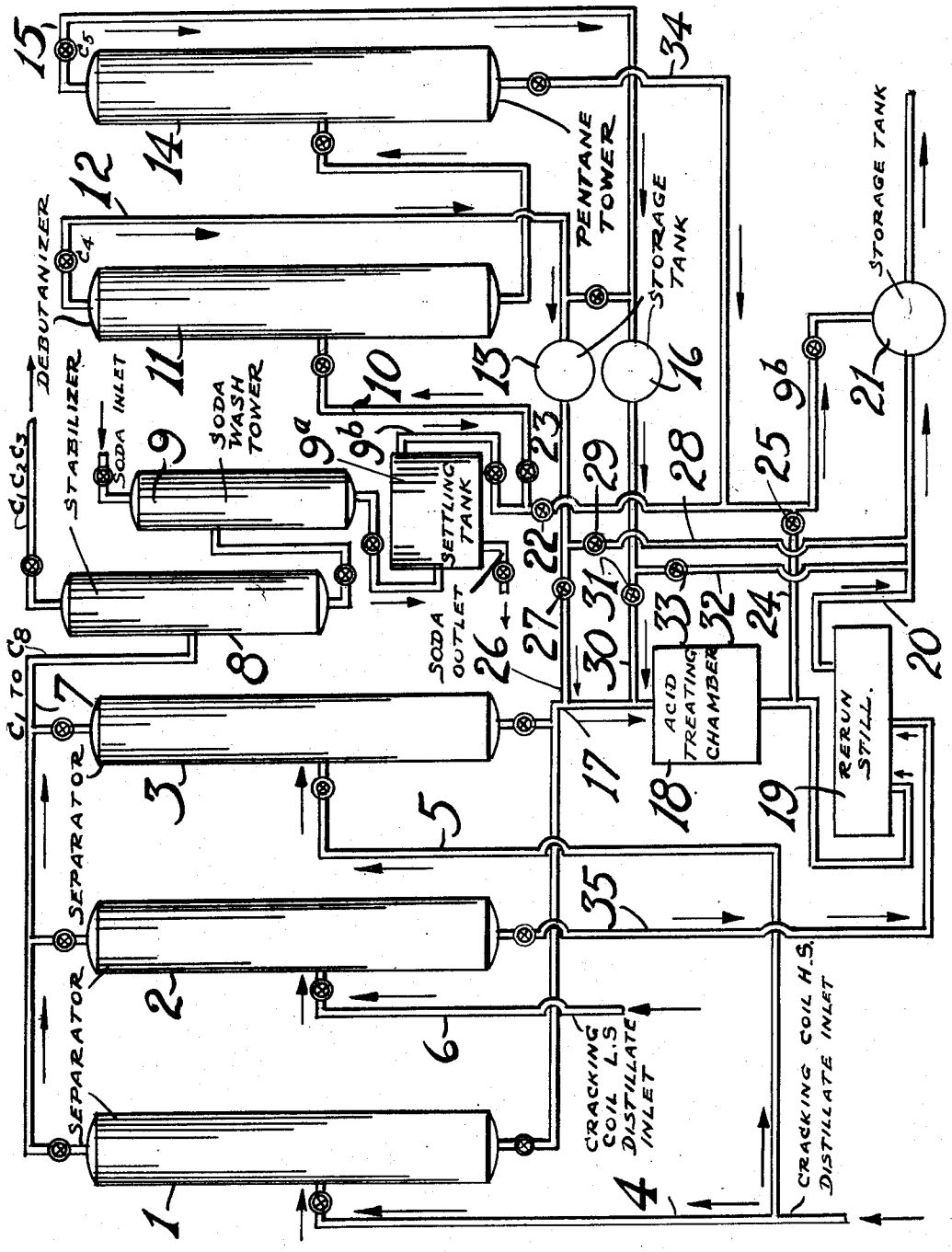
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PRODUCTION OF GASOLINE

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George L. Mateer Inventors
Henry Janney Nichols Jr.
By P. L. Young Attorney

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PRODUCTION OF GASOLINE

Henry Janney Nichols, Jr., Scotch Plains, and George L. Mateer, Roselle, N. J., assignors to Standard Oil Development Company, a corporation of Delaware

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The present invention relates to the stabilization and finishing of petroleum distillates for the production of gasoline, and resides in a method and apparatus for the performance of these operations.

The principal object of the present invention is the provision of a method whereby petroleum distillates of one or more origins may be finished to a hydrocarbon mixture having any type of distillation curve and vapor pressure and end point desired.

A further object of the present invention is the provision of a method and apparatus which make possible the preparation of feed stocks for two alcohol plants and one polymerization plant, while at the same time debutanizing and stabilizing petroleum distillates to finished gasolines.

A further object of the present invention is the provision of a method according to which a petroleum distillate of any character, particularly a cracked distillate, is divided into fractions in such a manner that only the fractions specifically requiring acid treatment are subjected to this refinement, and only the fractions requiring stabilization are stabilized, and a base stock and a mixture of C_4 hydrocarbons and a mixture of C_5 hydrocarbons from which a gasoline of any desired specifications can be blended are produced.

Further objects and advantages of the present invention will be apparent from the following detailed description of the accompanying drawing which is a front elevation in diagrammatic form of one embodiment of apparatus contemplated by the present invention as suitable for carrying out the process of the present invention.

Referring to the drawing in detail, 1, 2 and 3 represent separators. In its broad aspect, the present invention contemplates a process in which only one separator will be employed. The present description, however, is directed to a particularly desirable specific embodiment of the present invention and is to be so understood.

Cracking coil distillate, having a high sulfur content and having about a 400° end point, is fed thru lines 4 and 5, after being suitably preheated, to towers 1 and 3 from each of which an overhead, constituting from 30 to 40% of the feed, is taken off. This overhead includes from C_1 to C_8 hydrocarbons. With this type of stock only the heavier ends need to be acid treated.

A cracking coil distillate, having a low sulfur content and not requiring acid treating, is fed thru line 6, after being suitably preheated, into separator 2 which is so operated as to cause the separation, preferably of only C_1, C_2 and C_3 hydrocarbons and, in any case, not higher than C_5 hydrocarbons. The overhead from this tower joins the overheads from towers 1 and 3 and the mixed overhead is passed thru line 7 to a stabilizer 8 of conventional character provided with suitable fractionating equipment, the usual cooling coil and reflux arrangement at the top, and the customary reboiler or temperature controller at the bottom. This stabilizer is so controlled that C_1, C_2 and C_3, and the least practical amount of C_4, hydrocarbons are taken off at the top. This mixture constitutes a suitable feed for a plant manufacturing isopropyl alcohol. If desired, it may be fractionated in such a way as to isolate the C_3 hydrocarbons which are fed to the alcohol plant, leaving a mixture of C_1 and C_2 hydrocarbons as a highly satisfactory feed for a hydrogen production unit in which hydrocarbons are reacted with steam under known conditions.

The bottoms from tower 8 are scrubbed with soda in tower 9, then passed to settling tank 9*a* from which soda is drawn off at the bottom and stabilizer bottoms are drawn off at the top thru line 9*b*, and are passed thru line 10 into a debutanizer 11 which is provided with equipment similar to that listed for tower 8, and is so operated that mainly C_4 hydrocarbons are given off overhead thru line 12 by which they are conducted to a storage tank 13 or to a butyl alcohol or butane polymerization plant. The bottoms from debutanizer 11 is then introduced into a so-called pentane tower 14, which is equipped similarly to towers 8 and 11, and is so operated that C_5 and, if desired, C_6 hydrocarbons are taken off overhead thru line 15 by which they are conducted to storage tank 16 or to an alcohol plant for the manufacture of amyl and/or hexyl alcohols.

The heavy ends leaving the bottoms of towers 1 and 3 are joined in line 17 and introduced into chamber 18 in which they are acid treated in the conventional manner. The intensity of the acid treat will vary with the sulfur content of the hydrocarbon mixture. For purposes of illustration, it may be pointed out that a stock containing 0.25% of corrosive sulfur will be given a treat of 6 lbs./bbl. with 98% sulfuric acid. The acid treated stock is then passed to a still 19 which is so operated as to cause all hydrocarbons boiling up to 400° F. to pass overhead thru line 20 into a storage tank 21.

Line 9*b* is provided with a valve 22 and line 10 is provided with a valve 23 whereby the sta-

bilizer bottoms may be passed directly to storage tank 21 or to the debutanizer tower. In some cases it may be desirable to blend these bottoms with the acid treated stock before the latter is rerun to 400° end point, in which case they are conducted thru line 24 controlled by valve 25. A line 26, provided with a valve 27, connects storage tank 13 with line 17 whereby C_4 hydrocarbons may be blended with the heavy ends from towers 1 and 3 prior to the acid treatment thereof. A branch line 28, provided with a valve 29, connects line 26 with line 20 so as to enable the blending of the C_4 hydrocarbons with the rerun heavy ends on their way to storage.

Similarly, line 30, provided with valve 31, connects tank 16 with line 17 and line 32, provided with valve 33, connects line 30 with line 20 so that C_5 hydrocarbons may be blended with the heavy ends from towers 1 and 3 either before acid treatment thereof or after rerunning thereof.

The bottoms from tower 14 pass thru line 34 into line 9b, and thence into storage tank 21 where they are blended with the finished bottoms from towers 1 and 3. The bottoms from tower 2 are conducted thru line 35 to rerun still 19, or, if, desired, directly to tank 21.

Typical operating conditions for the procedure described above are as follows: Towers 1, 2 and 3 are held under a pressure of about 125 lbs./sq. in. Towers 1 and 3 have a bottom temperature between about 430 and 450° F. and a top temperature of approximately 230° F. Tower 2 has a bottom temperature between 380 and 400° F., the top temperature being so controlled as to eliminate hydrocarbons of more than three carbon atoms from the overhead as far as possible. Tower 8 is maintained under a pressure in the neighborhood of 225 lbs./sq. in. and has a bottom temperature of about 270° F. and a top temperature of about 100° F. Tower 11 is maintained under a pressure of about 50 lbs./sq. in. and has a bottom temperature in the neighborhood of 210° F. and a top temperature of about 100° F. Tower 14 is operated under atmospheric pressure with a bottom temperature of about 180° F. and a top temperature of about 130° F. All numerical values of pressure given designate gauge pressure.

It is to be understood that the procedure outlined above can be varied, to a large extent, without departing from the scope of the present invention. For example, where the initial stock is a low sulfur stock, such as that fed thru line 6 in the procedure described above, it can be cut into two fractions, the lower including up to the C_3 hydrocarbons, the lower fraction can be stabilized, debutanized and depentanized, and the upper fraction rerun to a 400° end point base stock to which is added, in suitable quantities, C_4 hydrocarbons, C_5 hydrocarbons, and the bottoms from the pentane tower, or, if desired, the entire feed stock can be fed to the stabilizer and then to the debutanizer, and then to the pentane tower, and the bottoms from the pentane tower blended with suitable quantities of C_4 and C_5 hydrocarbons to bring the final gasoline up to specifications.

It is well known that the specifications for gasoline change with the seasons of the year and with geographical location. The most important characteristics of a gasoline are its vapor pressure, generally designated as Reid vapor pressure, its volatility, for example, the per cent off at 158° F., and its end point. The effect of the content of butane and pentane in the gasoline on these characteristics has been recognized for some time, and is discussed at pages 88–95 of the May 23, 1928 issue of the National Petroleum News in a paper by G. C. Oberfell. Observation has indicated that for a gasoline of a certain pentane content there is a fairly lineal relation between the concentration of butane and the per cent off at 158° F. For a gasoline containing 8.5% by volume of pentane, 5% by volume of butane is required for a specification of 10% off at 158° F. The addition of pentane to gasoline causes an increase in the liquid fraction distilling below 140° F. equal to about 70% of the added pentane. No effect on the distillation loss occurs with an increase in pentane concentration. A greater increase in per cent off at 158° can be effected by increasing the pentane content for a given increase in vapor pressure than can be effected by increasing the butane content and vice versa.

For purposes of illustration of the effect of a change in the proportions of butane and pentane in gasoline, the following blends were made:

1. A summer gasoline was made by adding to a base stock containing no C_4 hydrocarbons 8.3% by weight of C_5 hydrocarbons, 91.7% of C_6 and higher hydrocarbons, and having an initial boiling point of 124° F., 5% off at 158°, a final boiling point of 398° F., a distillation loss of 1%, and a Reid vapor pressure of 3.2 lbs., sufficient C_4 hydrocarbons to change the weight composition of the blend to 6.5 C_4, 7.7 C_5, and 85.8 C_6 and higher. The blend had an initial boiling point of 94° F., a final boiling point of 398° F., a distillation loss of 2.5, 16.5% off at 158° and a Reid vapor pressure of 8.6 lbs.

2. A fall gasoline was made by adding to a base stock having a weight composition of 0.3% C_4, 10.9% C_5 and 88.8% C_6 and higher, and an initial boiling point of 115° F., 8% off at 158°, a final boiling point of 400° F., a distillation loss of 1%, and a Reid vapor pressure of 4.2 lbs., sufficient C_4 hydrocarbons to change the weight composition to 7.6% C_4, 10.1% C_5, and 82.3% C_6 and higher. The resulting blend had an initial boiling point of 92° F., 18% off at 158°, a final boiling point of 400° F., a distillation loss of 2%, and a Reid vapor pressure of 9.7 lbs.

3. A winter gasoline was made by adding to a base stock having a weight composition of 0.6% C_4, 12.4% C_5 and 87% C_6 and higher, and having an initial boiling point of 115° F., 11% off at 158°, a final boiling point of 399° F., a distillation loss of 1.5 and a Reid vapor pressure of 4.9 lbs., sufficient butane to change the weight composition of the blend to 8.8% C_4, 11.4% C_5, and 79.8% C_6 and higher. The resulting blend had an initial boiling point of 85° F., 23% off 158°, a final boiling point of 398° F., a distillation loss of 2.5, and a Reid vapor pressure of 11 lbs.

It will be noted that as the season becomes colder, the Reid vapor pressure and volatility are increased.

Thus, it can be seen that by suitably adjusting the relative proportion of butane and pentane to each other and to the total gasoline, the vapor pressure and the per cent off at 158° can be adjusted to meet any desired specifications. It is impossible to fix any limits within which these constituents shall be varied because the amount to be included will depend upon the relation desired between the vapor pressure and percent off at 158° F.

No novelty is alleged for any gasoline of cer-

tain specifications and containing certain definite quantities of pentane and butane, since the blending of such compositions to meet any designated specifications is conventional refinery practice. The novelty of the present invention resides in a process for expeditiously segregating hydrocarbon mixtures in such a manner as to simplify the blending operation and to restrict such refining steps as may be necessary to those fractions which particularly require them, and to an apparatus suitable for effecting these operations.

The nature and objects of the present invention having been thus described and illustrated, what is claimed as new and useful and desired to be secured by Letters Patent is:

1. A process for producing a gasoline of designated specifications from a hydrocarbon distillate containing lower boiling constituents than those desired in the final gasoline, including C_3, C_4 and C_5 hydrocarbons, which comprises preheating said distillate, injecting it into a separation zone, taking off overhead all hydrocarbons up to and including the C_4 and C_5 hydrocarbons, distilling the remaining hydrocarbon mixture to make a heavy overhead distillate of the desired end point, segregating the C_4 hydrocarbons and C_5 hydrocarbons from the overhead from the separator and from each other, and blending back C_4 and C_5 hydrocarbons to said overhead distillate of suitable end point in quantities appropriate to impart thereto the desired vapor pressure and the desired volatility.

2. A process for producing a gasoline of designated specifications from a hydrocarbon distillate containing lower boiling constituents than those desired in the final gasoline, including C_3, C_4 and C_5 hydrocarbons, and having an undesirably high sulfur content, which comprises preheating said distillate, injecting it into a separation zone, taking off overhead all hydrocarbons having not more than eight carbon atoms per molecule, subjecting the residual heavier hydrocarbons to a desulfurization treatment, passing the overhead hydrocarbons to a stabilization zone, taking off overhead from said zone C_1, C_2 and C_3 hydrocarbons, introducing the bottoms from the stabilization zone into a second separating zone from which C_4 hydrocarbons are taken off overhead, introducing the bottoms from this second separating zone into a third separating zone from which C_5 hydrocarbons are taken off overhead, blending the bottoms from this third separating zone with the desulfurized heavier ends, and blending C_4 and C_5 hydrocarbons with the resulting mixture in quantities appropriate to impart to the hydrocarbon mixture the desired vapor pressure and the desired volatility.

3. A process for producing a gasoline of designated specifications from a cracking coil distillate which comprises separating a hydrocarbon distillate containing lower boiling constituents than those desired in the final gasoline, including C_3, C_4 and C_5 hydrocarbons, and having an undesirably high sulfur content, and a hydrocarbon distillate of similar characteristics but having satisfactory sulfur content, which comprises preheating the high sulfur stock, introducing it into a separation zone, taking off overhead all hydrocarbons having not more than eight carbon atoms per molecule, subjecting the residual heavier hydrocarbons to a desulfurization treatment, preheating the low sulfur distillate, injecting it into a separation zone, taking off overhead all hydrocarbons of less than four carbon atoms, passing the combined overheads to a stabilization zone, taking off overhead from said zone C_1, C_2 and C_3 hydrocarbons, introducing the bottoms from the stabilization zone into a separating zone from which C_4 hydrocarbons are taken off overhead, introducing the resulting bottoms into a second separating zone from which C_5 hydrocarbons are taken off overhead, combining the bottoms from said last mentioned separator with the desulfurized stock and with the topped low sulfur stock, whereby a maximum yield of low sulfur hydrocarbons having more than 5 carbon atoms is obtained with minimum chemical treatment, and bringing the resulting mixture to specifications, with regard to vapor pressure and volatility, by adding thereto appropriate quantities of the isolated C_4 and C_5 hydrocarbons.

H. JANNEY NICHOLS, JR.
GEORGE L. MATEER.