

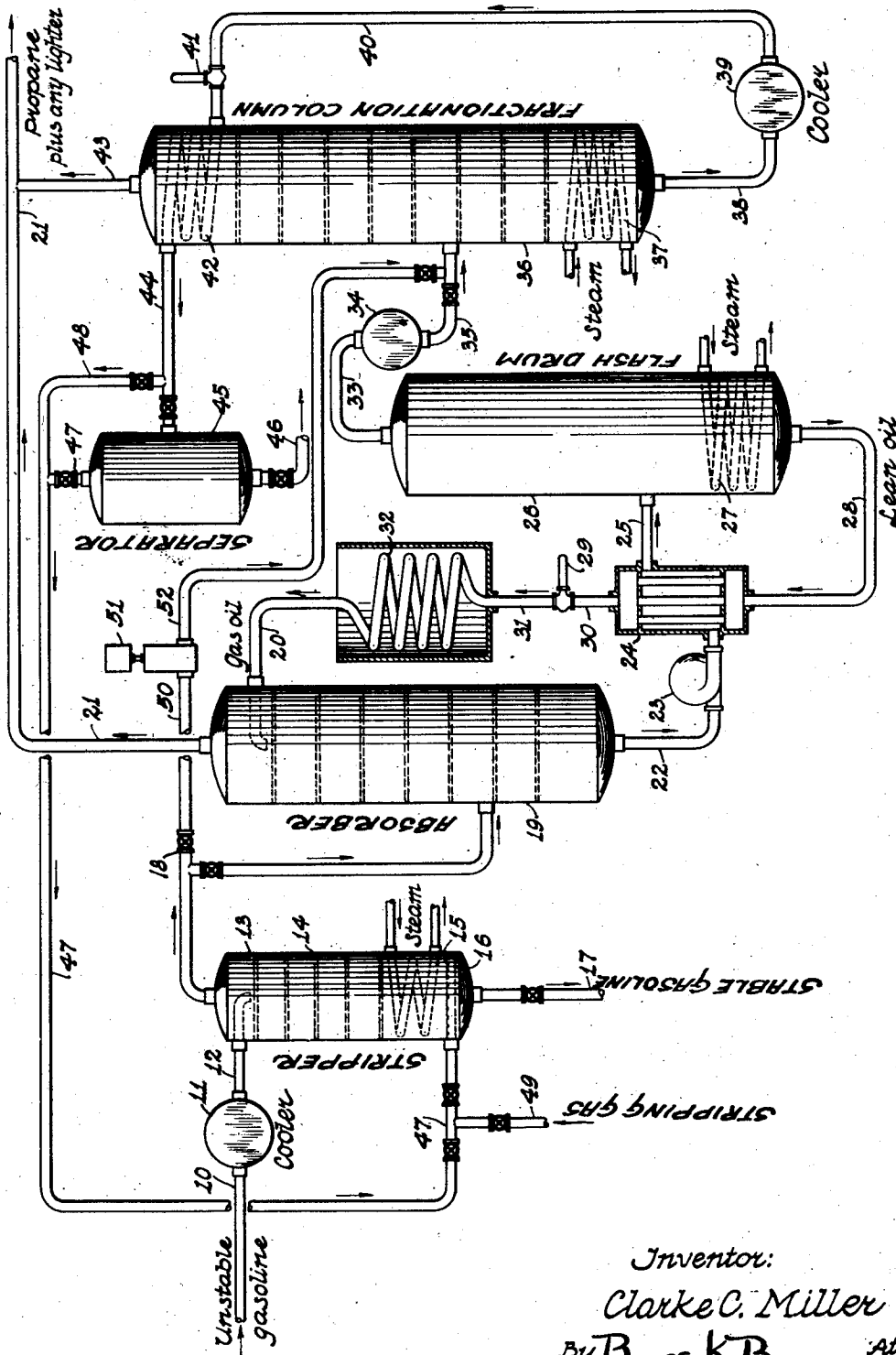
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STABILIZATION OF NAPHTHA

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STABILIZATION OF NAPHTHA

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This invention relates to a system for stabilizing light naphtha or gasoline.

In the refining of petroleum oils the light naphtha distillate usually contains relatively large amounts of undesirable dissolved gaseous hydrocarbons such as ethane and propane. The process of separating these hydrocarbons, the vapor pressures of which are higher than that of butane, is commonly referred to in the art as stabilization. It is necessary to prevent the gases from volatilizing and carrying away a valuable portion of the gasoline thereby decreasing volatility and increasing the fire hazard and it is desirable for the production of motor fuels which will not cause vapor lock.

Heretofore stabilization of light naphtha has involved fractionation under pressure and has therefore required expensive, special equipment and large operating costs. An object of my invention is to remove ethane, propane, etc. from light naphtha at substantially atmospheric pressure by means of a simple system which can be easily controlled and operated at low expense. A further object is to provide a stabilized motor fuel which will contain practically no dissolved hydrocarbons with vapor pressure higher than that of butane. Other objects will be apparent from the following detailed description.

In practicing my invention I replace the propane and other light gases with an unobjectionable gas such as butane or pentane. For instance, by stripping the unstable gasoline or light naphtha with gaseous butane, the butane replaces the propane in solution and the excess butane carries the propane gas out of the system leaving a stabilized gasoline of high quality. The butane is separated from the propane by a simple absorption system or by other suitable means and is returned to the stripper while the propane and light gaseous components can be discharged for use in other parts of the refinery. In the accompanying drawing which forms a part of this specification, I have diagrammatically shown an elevation of my improved system.

For the sake of convenience in the following description I will use the word "propane" to describe hydrocarbons having a vapor pressure higher than that of butane and I will use the word "butane" to include all normally gaseous hydrocarbons which are desirable components of finished or stabilized gasoline.

The unstable gasoline or light naphtha which may be produced by straight distillation or by cracking, hydrogenation or polymerization may be conveyed directly from the stills through pipe

10, cooler 11, and pipe 12 to the top plate 13 of stripper tower 14. The stripper tower is similar in design to conventional fractionating towers,—it contains a number of perforated plates, baffle or bubble trays, and is provided at the bottom with a closed steam coil 15 which may be used to reboil the gasoline or to supply the necessary heat for effective stabilization. Butane stripping gas is introduced at a point near the base of the stripper tower through perforated pipe 16 and the stabilized gasoline is withdrawn from the base through pipe 17. The pressure in the stripper is substantially atmospheric and it is not important that this pressure be accurately controlled. The temperature may also vary within relatively wide limits and it is preferably about 80° to 100° F. Ordinarily, little or no steam is required in the reboiling coil, but in special circumstances it may be desirable to heat the gasoline to 200° to 300° F. for the removal of low-boiling components.

The mixture of butane and propane from the stripper tower is conducted by conduit 18 to a point near the bottom of absorber tower 19 which is provided with perforated plates, baffles, bubble caps, or other means for obtaining effective counter-current gas-liquid contact. A petroleum oil such as gas oil is introduced as a scrubbing liquid at the top of absorber tower 19. This scrubbing oil is preferably a relatively narrow cut boiling between 400° and 600° F. and as the mixed gases flow upwardly in absorber 19 the butane and a part of the propane is absorbed in the scrubber oil and the balance of the propane is discharged from the top of the scrubber through pipe 21 which conducts it to another part of the refinery.

The enriched scrubber oil is withdrawn from the base of absorber tower 19 through pipe 22 and it is forced by pump 23 at a pressure of about 230 to 250 pounds per square inch through heat exchanger 24 and pipe 25 into flash drum 26. In this drum the propane and butane are boiled out of the scrubber oil by steam coil 27, the lean oil being recirculated through pipe 28, exchanger 24, pipe 30, reducing valve 29, pipe 31, cooler 32 and pipe 20 back to the top of the absorber tower. The temperature of the scrubbing oil in the absorber tower is preferably about 50° to 80° F. and the temperature in the base of the flash drum is about 300° to 350° F.

The propane and butane from the top of flash drum 26 are conducted by pipe 33 to cooler 34 wherein all of the butane and most of the propane components are liquefied. These liquids

which may contain some propane gases are introduced by pipe 35 into fractionating column 36 at a point between the center and the bottom of said column. The temperature in the base of the column is maintained at about 200° to 250° F. by steam coil 37 so that practically all of the propane is driven out of the butane which is removed from the base of the column by pipe 38. This butane is then cooled in cooler 39 and passed through pipe 40 and expansion valve 41 to reflux coil 42 wherein the vaporization and expansion of the butane is utilized to provide the necessary cooling to knock back a large amount of reflux liquid to the top plate of the fractionating column. By this expedient I prevent the loss of butane through pipe 43 which carries away the propane and lighter constituents to pipe 21.

The expanded butane from reflux coil 42 is introduced by pipe 44 into separator 45, liquids being removed from the base of the separator through pipe 46 and gases being returned by pipe 47 to the perforated pipe 16 in the base of the stripper tower. I may by-pass the butane gases around the separator through pipe 48. Make-up butane is introduced into the system through pipe 49.

In the system above described I avoid the use of gas compressors and I minimize the load on the fractionating column by eliminating part of the propane from the absorber tower. I may, however, pass the butane and propane from stripper tower 14 directly through pipe 50 to gas compressor 51, compress it to about 250 pounds per square inch whereby the propane and butane are liquefied, and inject the liquids by means of pipe 52 directly into fractionating column 36. This procedure eliminates the necessity of the absorption system but it places a heavier load on the fractionating column and it makes a gas compressor necessary.

The operation of my invention has been described along with the apparatus. It will be seen that I have provided an extremely simple means for stabilizing light naphtha or gasoline in a relatively small stripping tower operated at atmospheric pressure without the use of appreciable amounts of added heat. About 1,500,000 cubic feet of butane will saturate and strip the propane from about 10,000 barrels (42 gallon) of unstabilized light naphtha.

Heretofore, it has been common in the art to strip a petroleum distillate with steam, with an inert gas, or with a lighter hydrocarbon; my invention contemplates the removal of lighter hydrocarbons by the stripping action of heavier hydrocarbon gases, the heavier gases replacing the lighter gases in solution and further amounts of the heavier gases sweeping the lighter gases out of the system.

My improved system uses a high pressure system for separating propane from butane, but this apparatus will be very small and hence inexpensive and easily operated because the amount of propane is insignificant as compared with the amount of unstabilized gasoline undergoing treatment.

While I have described in detail a preferred embodiment of my invention, it should be understood that I do not limit myself to any of the details described except as defined by the following claims which should be construed as broadly as the prior art will permit.

I claim:

1. The method of removing dissolved gaseous hydrocarbons with a vapor pressure higher than that of butane from light naphtha which comprises replacing said dissolved hydrocarbons with a gas having a vapor pressure not higher than that of butane and removing said hydrocarbons by means of said gas.

2. The method of stabilizing light naphtha which comprises scrubbing said naphtha with an excess of hydrocarbon gas of about the vapor pressure of butane at substantially atmospheric pressure.

3. The method of stabilizing light naphtha which comprises stripping it with hydrocarbon gas having a vapor pressure not higher than that of butane whereby propane is removed from the unstabilized naphtha by butane, separating the propane and butane which are discharged from the stripping step and returning said butane in gaseous form to strip further amounts of propane from said naphtha.

4. The method of stabilizing light naphtha which comprises countercurrently contacting it at substantially atmospheric pressure with an excess of butane substantially free from lighter hydrocarbons whereby lighter hydrocarbons are replaced by butane in the naphtha and said lighter hydrocarbons are swept away by said butane.

5. The method of stabilizing naphtha which comprises stripping it with butane substantially free from lighter hydrocarbons, absorbing the gases from the stripping step in a scrubbing oil, subjecting said scrubbing oil to a pressure upwards of 200 pounds per square inch, boiling propane and butane gases from said compressed scrubber oil, fractionating said butane-propane mixture and returning said butane to strip further amounts of naphtha.

6. The combination of claim 5 wherein the expansion of butane is utilized to supply the cooling required by the fractionation step.

7. In a system of the class described means for countercurrently contacting unstabilized naphtha with gaseous butane substantially free from lighter hydrocarbons, means for condensing the butane together with lighter hydrocarbons removed from the naphtha, means for fractionating said butane and other hydrocarbons to separate the butane therefrom, and means for returning said butane in gaseous form to strip further amounts of unstable naphtha.

8. The combination of claim 7 including means for utilizing the vaporization and expansion of the butane in the fractionation of the butane and lighter hydrocarbons.

9. The process of removing propane and lighter hydrocarbons from gasoline, comprising subjecting said gasoline to a treatment with butane vapors substantially free from lighter hydrocarbons in an amount exceeding the solubility of the butane in the gasoline.

10. The process of claim 9 wherein the treatment with butane vapors is conducted in a countercurrent manner.

11. The process of claim 9 wherein the gasoline after treatment with butane vapors is subjected to a heating operation to expel a portion of the butane dissolved therein.

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