

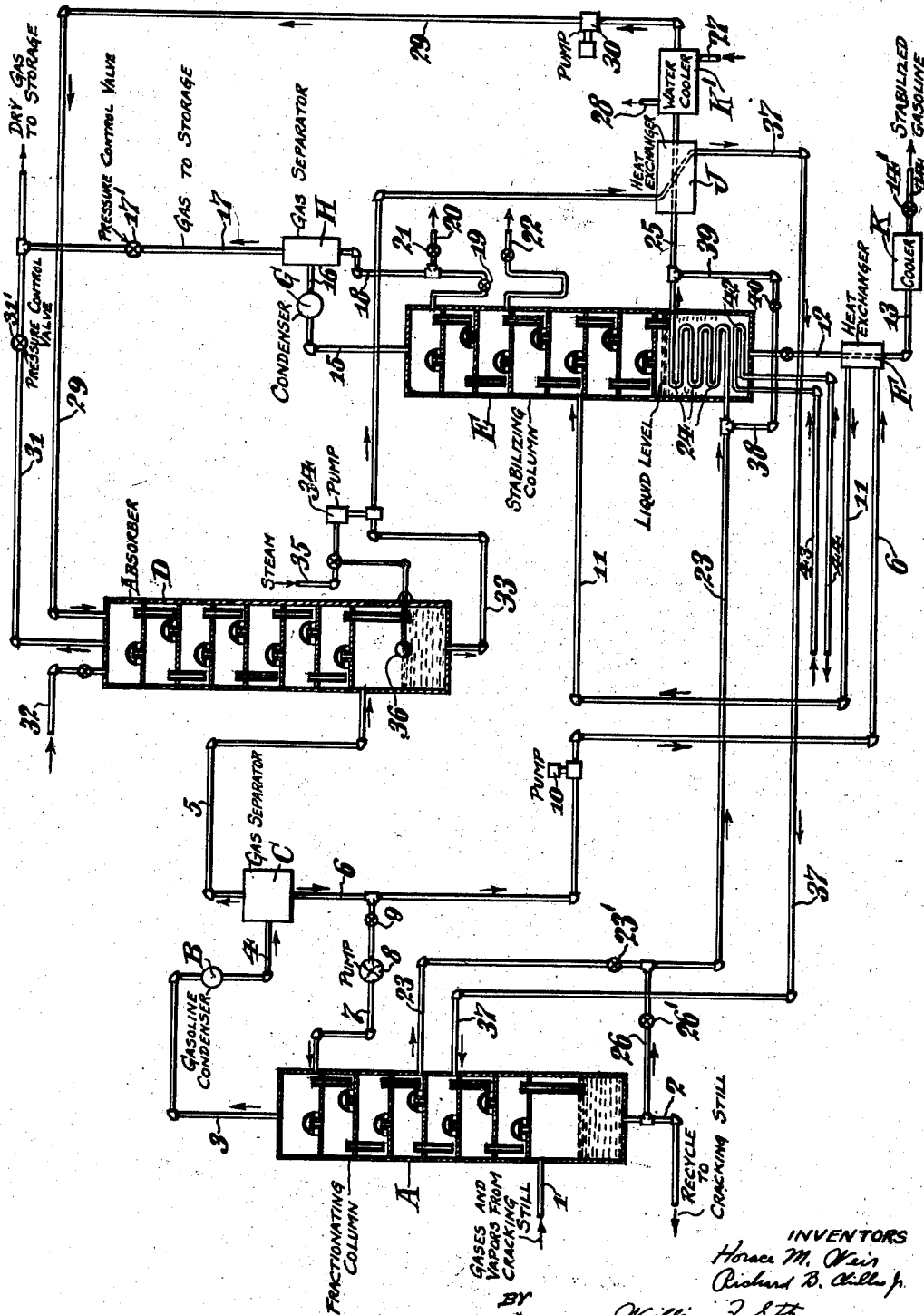
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TREATMENT OF HYDROCARBONS

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## TREATMENT OF HYDROCARBONS

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Our invention relates to the treatment of gasoline and other volatile hydrocarbons to produce liquid fractions substantially free from components of excessively high volatility and gas relatively free from vapors of normally liquid hydrocarbons.

When gasoline, particularly that produced by the thermal decomposition of higher boiling oils, is condensed in the presence of the gas which is incident to the gasoline production, equilibrium is established between the two phases, whereby a portion of the gas is present in the condensate while the uncondensed gas is saturated with vapors of the liquid. The presence of excessively volatile hydrocarbons in gasoline is undesirable because of the resultant high vapor pressure which causes large evaporation losses and may also cause difficulties in the operation of internal combustion engines.

Since petroleum gas is for the most part used as low grade fuel, it is desirable to separate from it the normally condensable hydrocarbons associated therewith to prevent their loss.

Among the objects of our invention are, the provision of a unitary system associated with a cracking process for the stabilization of the gasoline or other light distillates and the recovery of gasoline-like components from the gas formed in the cracking process. A further object of our invention is to effect these results with a maximum economy of fuel by using in our process excess heat from the cracking system. A further object is to carry out the steps of stabilization and recovery of liquid components from the gas under conditions entirely independent of the cracking conditions and under complete control.

In accordance with our invention the unstabilized gasoline produced by a cracking process followed by fractional distillation is heated sufficiently, while under pressure independent of the pressure of cracking and fractionating, to vaporize the undesired components by passing in indirect heat exchange relationship therewith a high temperature liquid fraction withdrawn from the fractionating zone of the cracking process. More particularly in accordance with our invention the liquid fraction which serves as a heating medium is thereafter utilized as absorbent oil for scrubbing the gas previously separated from the gasoline, to recover from the gas normally liquid hydrocarbons which occur therein as vapors, whereupon the enriched absorbent oil is returned to the fractionating zone following the cracking process to effect revaporization of the absorbed vapors by waste heat of the

cracking step which otherwise would be dissipated.

The invention will be further described with reference to the accompanying drawing in which the single figure represents diagrammatically a form of apparatus suitable for carrying out our process.

The operating conditions of our stabilizing and stripping process are independent of the conditions existing in the cracking stage so that the gasoline and gas from any cracking process may be subjected to treatment according to our invention. The mixture of gases and vapors from the cracking unit is introduced through the line 1 into the lower end of the fractionating column A, equipped with bubble plates or other suitable liquid-vapor contacting devices, in which the vapors of components less volatile than gasoline are condensed in a series of pools of liquid of increasing volatility. The column may be maintained under the operating pressure of the cracking system or may be at a lower pressure, for example, 40 lbs. per square inch. From the lower portion of the column A through the line 2, the least volatile components are removed as liquid and are returned to the cracking system for further heat treatment, or are otherwise disposed of, while from the upper end the mixture of uncondensed vapors of gasoline and compounds more volatile than gasoline passes through the line 3 to the condenser B wherein the major portion of the gasoline is liquefied and passes with the uncondensed portion of the mixture through the line 4 into the gas separator C. The condensation of the gasoline in the presence of the gaseous reaction products results in establishing equilibrium between the liquid and gas whereby a portion of the otherwise condensable components of the condensate remain in the vapor phase and a portion of the gas is contained in the condensate. To prevent the loss of the valuable portion of the gasoline contained in the gas, the latter is conducted through the line 5 to the absorber D wherein the gasoline-like constituents are separated from it as hereinafter described. For the separation of the gases contained in the gasoline the latter is withdrawn from the separator C through the line 6 from which a portion is forced by the pump 8 through the line 7 to serve as reflux in the fractionating column A, while the remainder is conducted by means of the pump 10 to and through the heat exchanger F and the line 11 to an intermediate point in the stabilizing column E. By means of the pump 10 the "wild" gasoline may be forced

into the stabilizing column under any pressure which it is desired to maintain therein. It is generally advisable to conduct the stabilization under a higher pressure than exists in the fractionating column of the cracking stage in order that proper separation of gas and vapors may be effected. Our process is particularly adapted to such independent operation.

In this stabilizer the gasoline, containing the more volatile components, passes downwardly countercurrent to and in direct heat-exchange relation with rising vapors produced from the gasoline at the base of the column by passing a heating medium through the coil 24 as herein-after described. From the base of the column, stabilized gasoline, freed in the column of its more volatile components, is withdrawn through the line 12 and is cooled in the heat exchanger F and the water cooler K and is then conducted through the line 14, controlled by valve 14', to storage.

The vapors and gases evolved from the gasoline in the stabilizer are fractionated in its upper portion by contact with reflux obtained by passing the residual vapors and gases from the top of the column to the condenser G. Pressure, for example 175 lbs. per sq. in., is maintained on the stabilizer E by means of the valve 17' in the line 17. This pressure should be such that, with the particular gasoline under treatment, the available cooling medium, generally water, will condense enough of the hydrocarbons removed from the gasoline during the stabilization process to form sufficient reflux to fractionate the gases and vapors in the stabilizing column closely enough so that the gas will be substantially free from components which are desired in the gasoline. Gasoline produced by cracking gas oil from a Mid-continent crude at about 925° F. under a pressure of approximately 850 lbs. is satisfactorily stabilized by heating in the base of the stabilizer to about 350° F. while maintaining a pressure of 175 lbs. per sq. in. on the system.

The gas which passes uncondensed through the condenser G is conducted from the gas separator H through the line 17 to the line 31 and through it to storage. If desired, a portion of the reflux returned to the stabilizer E may be withdrawn, as for example, through the lines 20 or 22, and used as fuel in the form of liquefied gas.

The heating of the gasoline in the stabilizing column is effected by withdrawing from the fractionating column A through the line 23 for example, a high temperature liquid fraction of suitable characteristics for later use as absorbent oil and passing the liquid so removed through the coil 24 in the base of the column E. The withdrawal of liquid from the fractionating column is controlled by valve 23'. The heating medium which may be, for example, at 500° F., transmits heat to the gasoline in the base of the column and is itself correspondingly reduced in temperature, for example to about 360° F. The oil fraction utilized as a source of heat then passes through the line 25 to the heat exchanger J wherein it is further cooled and finally, by means of the water cooler K', it is reduced to a temperature suitable for use as absorbent oil in the absorber D to the upper end of which it is introduced through the line 29. The absorbent oil passes through the absorber D countercurrent to, and in direct contact with, the rich gas from the separator C and absorbs from the gas the components of gasoline-like characteristics, with

the result that the gas leaving the top of the absorber D through line 31 is substantially free from these components and is termed "dry" gas. Valve 31' controls pressure on the absorber.

From the bottom of the absorber D the enriched absorbent oil is conducted by pump 34 through the line 33 to and through the heat exchanger J, wherein it serves to cool the partially cooled stream of lean absorbent oil leaving the heating coil 24 and is itself preheated. It is then introduced through the line 37 into the fractionating column A above the vapor inlet 1. The temperature at which cracking occurs is so greatly in excess of the vaporizing temperature of gasoline that considerable quantities of excess heat are available. Advantage is taken of this surplus heat by introducing the rich absorbent oil into direct contact with the cracked vapors in the column A, thereby vaporizing the absorbed low boiling hydrocarbons which commingle with the gases and vapors introduced from the cracking system through the line 1 into the fractionating column A. If necessary, additional absorbent oil, for example, charging stock for the cracking still, may be introduced into the top of the absorber through the line 32 and also additional heat may be introduced into the base of the stabilizing column E by passing any suitable heating medium, for example, residual oil from the cracking still or superheated steam through the coil 42 by means of the inlet and outlet lines 43 and 44 respectively. The lines 38 and 39 permit bypassing the coil 24.

Thus it will be seen that we have provided a process whereby the volatile gasoline produced in a cracking process is freed from the undesirable gases and low boiling components without the loss of any of such constituents, while at the same time the gas normally occurring in cracking processes is freed from its content of gasoline-like constituents. These results, moreover, are accomplished without requiring the use of any heat other than that which occurs in the cracking process and would be otherwise lost in the cooling water, thereby effecting a saving of fuel.

It is to be understood that although a single side-stream drawoff is shown for removing a liquid fraction from the column to serve as heating medium in the coil 24 and as absorbent oil, the process is not to be limited to any particular oil for this purpose, but our invention comprehends even the use of a portion of the recycle stock for this purpose, conducting it through line 26, controlled by valve 26', to line 23.

It is characteristic of our process that the stabilization step and the cracking and fractionation of the cracked products are entirely independent of each other insofar as pressure is concerned. As a result, the cracking operation may be conducted under any pressure conditions most favorable for the cracking process and these conditions, as well as the pressure under which the vapors are fractionated, may be changed without varying the stabilizer pressure; at the same time, if it is desired to change the volatility of the stabilized gasoline by varying the pressure on the stabilizer, this may be done without affecting the cracking or fractionating conditions.

This process is primarily intended for use with the products of cracking petroleum or other hydrocarbons since such processes normally produce considerable quantities of gas

and since the cracked vapors in the fractionating tower contain large quantities of excess heat. However, it is also applicable to the products resulting from distilling hydrocarbon oils including coal tar, by means of a pipe still and fractionating column or other distillation equipment in which excess heat is available.

In the appended claims the terms "stabilizing" and "stabilization" are used to designate the process in which liquid condensate containing gas and low boiling liquids is subjected to controlled heating under regulated pressure to remove therefrom undesired quantities of low boiling constituents; also the term "stripping" is used to designate the process in which gas containing vapors of constituents desired in the liquid condensate is scrubbed with an absorbent oil.

What we claim is:

1. The process of refining petroleum products which comprises introducing into a fractionating zone a mixture of gas, vapors of gasoline and vapors of hydrocarbons less volatile than gasoline, fractionally condensing therein the vapors less volatile than gasoline, passing the mixture of gas and gasoline vapors from the fractionating zone to a condensing zone wherein the major portion of the gasoline is liquefied, conducting uncondensed portions of the gas-vapor mixture to an absorbing zone, introducing the liquefied gasoline into a stabilizing zone, withdrawing from the fractionating zone a liquid fraction less volatile than gasoline, passing it without previous substantial reduction in temperature through the stabilizing zone in indirect heat-interchange relation with the gasoline to distill therefrom volatile components and to cool said liquid fraction, thereafter further reducing the temperature of said liquid fraction and passing it into direct contact with the uncondensed portions of the gas-vapor mixture in the absorbing zone, withdrawing therefrom said fraction enriched with that portion of the gas-vapor mixture absorbed therein and returning the enriched fraction to an intermediate point in the fractionating zone aforesaid above the vapor inlet.
2. The process of refining petroleum products which comprises introducing into a fractionating zone a mixture of uncondensable gas, vapors of gasoline and vapors of hydrocarbons less volatile than gasoline, fractionally condensing therein the vapors less volatile than gasoline, passing the mixture of gas and gasoline vapors

from the fractionating zone to a condensing zone wherein the major portion of the gasoline is liquefied, conducting uncondensed portions of the gas-vapor mixture to an absorbing zone, introducing the liquefied gasoline into a stabilizing zone, withdrawing from the fractionating zone a liquid fraction less volatile than gasoline, passing it without previous substantial reduction in temperature through the stabilizing zone in indirect heat interchange relation with the gasoline to distill therefrom volatile components and to cool said liquid fraction, thereafter further reducing the temperature of said liquid fraction and passing it into direct contact with the uncondensed portions of the gas-vapor mixture in the absorbing zone, withdrawing therefrom said fraction enriched with that portion of the gas-vapor mixture absorbed therein and returning the enriched fraction to an intermediate point in the fractionating zone aforesaid while maintaining in the stabilizing zone a pressure independent of that maintained in the fractionating zone.

3. The process of refining petroleum products which comprises introducing into a fractionating zone a mixture of gas, vapors of gasoline and vapors of hydrocarbons less volatile than gasoline, fractionally condensing therein the vapors less volatile than gasoline, passing the mixture of gas and gasoline vapors from the fractionating zone to a condensing zone wherein the major portion of the gasoline is liquefied, conducting uncondensed portions of the gas-vapor mixture to an absorbing zone, introducing the liquefied gasoline into a stabilizing zone, withdrawing from the fractionating zone a liquid fraction less volatile than gasoline, passing it without previous substantial reduction in temperature through the stabilizing zone in indirect heat-interchange relation with the gasoline to distill therefrom volatile components and to cool said liquid fraction, thereafter further reducing the temperature of said liquid fraction and passing it into direct contact with the uncondensed portions of the gas-vapor mixture in the absorbing zone, withdrawing therefrom said fraction enriched with that portion of the gas-vapor mixture absorbed therein and vaporizing the absorbed constituents by heat contained in the mixture of gas, vapors of gasoline and vapors of hydrocarbon less volatile than gasoline.

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