Fig. 1.

Fig. 2.

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METHOD OF CONVERTING KEROSENE INTO LOWER BOILING POINT HYDROCARBON LIQUIDS

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The object of this invention is to provide a method of converting kerosene into hydrocarbon liquids of lower boiling points. The invention is such that kerosene having an asphaltic base and recognized as one of the most difficult hydrocarbons to commercially convert into lower boiling point hydrocarbons, may readily be converted, commercially, into hydrocarbons having a boiling point within the accepted gasoline range.

By “kerosene” I include, of course, “kerosene stock” which is the unrefined kerosene cut. The process is unaffected by the fact that the kerosene is mixed with hydrocarbons having a higher boiling point range, as, for example, stove distillate, and my claim is to be construed accordingly.

I have discovered that when kerosene in the presence of water vapor is passed through a heating element, in the absence of pressure, or below cracking pressure, wherein the vapors are brought to a temperature range below the recognized “cracking” temperatures for such hydrocarbon, conversion is effected.

The conversion appears to be aided by passing the hot vapors into contact with a metallic, or other body which has the thermal effect of maintaining a temperature different from that of the surrounding vapors.

While the process is entirely operable in the absence of pressure, that is to say below five pounds, pressure as a factor in the process has no great bearing, except as affecting velocity of the vapors. The vapors should not be retarded by back pressure in order to secure the best results.

In the drawings I have diagrammatically illustrated the various elements of a complete apparatus constructed in accordance with the invention, the various parts being legended.

Fig. 1 is a view in elevation of the elements showing the kiln and coil in detail, together with the associated elements including the dephlegmator, condenser, condenser tank, gas holder as well as the feed oil and water tanks, feed being effected, in this instance, by air pressure instead of by pumps.

Fig. 2 is a diagrammatic view of a form of catalyzer, the major turns or coils being shown at 1 and the minor turns or coils being shown at 2.

Reference to Fig. 1, for example, will show that the generating coil is of such spiral form as to offer no substantial obstruction to the free passage of the vapors and the vapors pass into the dephlegmator permitting their expansion and passage, without restriction, to the condenser, this arrangement preventing any substantial back pressure.

For example: a perpendicular wrought iron coil 104 feet in length with an internal diameter of 2½ inches, a wall thickness of approximately one-fourth inch, comprising the heating element, is subjected to a temperature of the combustion gases at the base of the coil of 1400° F., at a point midway of its length to a temperature of 800° F. and at the top of the coil 600° F. The temperature of the coil itself will, of course, be lower than these temperatures and the vapors lower than the temperatures of the coil. The stated variations in temperature are due to the fact that the combustion takes place at the base of the coil, the hot vapors passing upwardly into contact with the coil throughout its length and gradually losing heat unitily. In the upper turn of this coil I inject kerosene in finely divided state, in the presence of water vapor in the proportions of 83% kerosene and 17% water, with a rate flow through the coil of two and one-half gallons per minute. The water should be injected in heated state. For this purpose the feed water may be treated by the water heater, not shown, exterior of the kiln, or may be passed to a heater 3, within the kiln and thence led to any suitable form of injector 4 to which oil is fed by pipe 5, the injector atomizing the liquid co-mingled oil and water into the generating coil at 6, through the mechanical atomization thus effected.

Within the coil and practically at its outlet end, or within a chamber communicating with the outlet end of the coil, which chamber may be a continuation of the coil itself, I place a body of attenuated metal. For example: within the coil at its outlet end, I place a body of alloy treated nichrome wire preferably in the form of turns or coils of wire, the body being 2 inches in diameter and...
24 inches in length, this wire such as shown in my Patent No. 1,530,587, being known as Wade alloy treated nichrome. The wire may be formed with major coils 2 inches in diameter and minor coils or bends 2 extending inwardly, the whole anchored to a rod by means of which the device may be handled.

The vapors, as they leave the outlet of the coil, are passed through a conduit, leading either directly to a condenser or to a condenser via an expanding and separating chamber, such as a dephlegmator. The condensate may then be distilled to obtain the cuts within the gasoline boiling point range, and the recovery within that range is very high.

It will be seen from the above example that the characteristic of my process is the treatment of kerosene in the presence of water vapor under temperatures below the recognized cracking temperatures for such hydrocarbon, and pressures below the recognized cracking pressures. The recognized cracking point for kerosene having an asphaltic base is approximately 1200° F. in the vapor in the absence of pressure. Under pressure of 250 pounds, the vapor temperature has been somewhat reduced in commercial cracking processes.

Thus, it is possible in my process to substantially vary the temperatures and proportionate rate of flow of the kerosene and water vapor and obtain conversion of the kerosene to the Navy specification boiling point range of gasoline (140° F. to 420° F.), the best condition I have found being the subjection of the vapors to temperatures below the recognized cracking temperatures and in the absence of gauge pressure of more than one or two pounds within the heating element.

The metallic element above described as being placed within the coil at its outlet end, or in the chamber which may communicate with but be separate from the coil, or a continuation of the latter, has the thermal effect of suddenly reducing the temperature of the vapors. It may have a catalytic or other reaction effect and initiate or accelerate hydrogenation of the oil vapors through decomposition of a proportion of the water vapor, or it may institute other, as yet unrecognized, reactions in the vapors. Its use, however, aids conversion of the oil vapors and the reaction may be recognized by the thermal action of said metallic element in reducing the temperature of the vapors, their temperature prior to meeting the metallic element being less than their temperature after leaving said element.

The proportion of water vapor to the oil vapor I have stated in the example above to have been 17% of the total volume. However, it is possible in the process to increase or decrease the proportion of the water vapor.

Beyond that proportion which may be decomposed in a hydrogenating or other chemical reaction, the water acts merely as a carrier or conveyor for the oil vapor. The relative proportions given in the example are desirable to secure proper velocity of the vapors in their passage through the coil, under no pressure or very low pressure. It is entirely possible, however, to reduce the percentage of water vapor to 5% of the total volume of vapors passing through the heating element, provided the oil and water vapors are intimately commingled at the point of admission to the coil and both oil and water elements are, in their commingled condition, very finely atomized or broken up, so that the vapors will pass through the coil wholly or substantially without separation of part thereof into liquid forms. Any separation of the vapors into liquid causes retardation of the treatment and the absorption of undue heat.

In the example given, the water was injected into the upper turn of the coil at a temperature less than its normal boiling point and under pressure through an atomizer, the pressure being sufficient to atomize the water into finely divided mist-like form. The oil also was atomized into the upper turn of the coil along with the atomized water so that the two were thoroughly commingled. Any desirable mechanical elements may be employed for securing this atomization of the oil and the water, as will be understood by those skilled in the art.

Having described my invention, what I claim and desire to secure by Letters Patent is:

A method of converting kerosene into a hydrocarbon product of lower boiling point, which consists in commingling kerosene and water both in finely divided form, and passing the same into a heating element wherein they are subjected to a temperature below 1200° F., and are vaporized, the vapors being led in a spiral path under heat treatment below 1900° F., the heating element being open to a condensing point to avoid creation of pressure, and passing the vapors as they leave the heating element through a zone containing a metallic catalyst whereby free hydrogen is evolved, the free carbon combining with a supply of said hydrogen, and condensing the vapors.

In testimony whereof, I have signed my name to this specification.

HENRY CLAY WADE.