

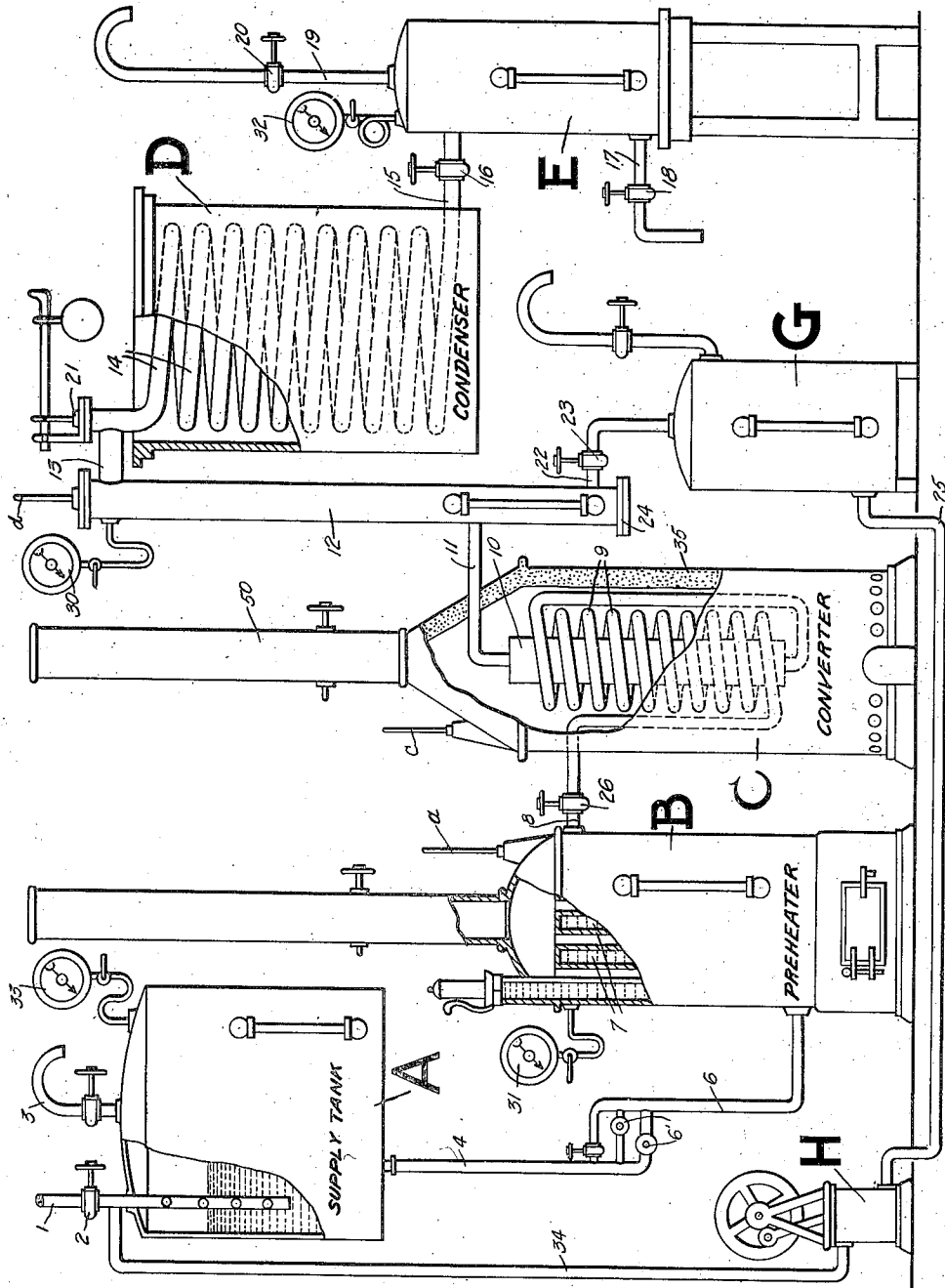
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PROCESS FOR THE CONVERSION OF OILS

Original Filed June 15, 1916



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UNITED STATES PATENT OFFICE.

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PROCESS FOR THE CONVERSION OF OILS.

Original application filed June 15, 1916, Serial No. 103,725. Divided and this application filed June 28, 1923. Serial No. 648,240.

This invention relates broadly to the art of converting fluids such as oils into products of dissimilar character from the original untreated oils, by heating the oils, vaporizing them under pressure, then cracking and transforming such oily vapors while under vapor pressure into lighter vapors which, as converted and when condensed under pressure, will result in lower boiling products from original high boiling oils.

In its more intense aspects the invention consists in a thermal and vapor pressure method of converting the vapors of semi and more or less refined mineral oils as those of the kerosene, non-viscous, neutral, gas, fuel and coal tar oils into more volatile and lower boiling hydrocarbons such as gasolines, naphthas, benzines, benzol, toluol and other light oils and oily spirits of both the aliphatic and aromatic series.

This application is a division of my co-pending application, Serial No. 103,725, filed June 15, 1916.

One object of the invention is to formulate a process of a commercial nature for transforming higher boiling oils into lower boiling products by vaporizing the oil, cracking and condensing the vapors while maintaining the whole system under pressure of the generated vapors.

Another object of my invention is to provide a simple and commercial process of cracking or converting high boiling hydrocarbon oil in the vapor phase into lower boiling products, and particularly to insure an efficient and effective conversion process by preliminarily heating the oil to substantially its boiling or vaporization point under superatmospheric pressure and then discharging or expanding it into vaporous form and cracking it in the vapor phase under superatmospheric pressure and cracking temperature, after which the evolved vapors are condensed and collected.

The invention is clearly distinguished from methods of fractional distillation by which hydrocarbon oils are commonly separated into distillates according to the respective boiling points thereof, inasmuch as by the practice of my invention the molecular construction of the higher boiling hydrocarbons is transformed so as to produce lower boiling point products.

It has been my purpose to effect this con-

version in the least expensive and most practical manner and to that end my process and method embodies broadly some or all of the steps of first heating, then vaporizing the oil, then cracking and transforming the vapors at elevated temperatures while the oils and oily vapors are maintained under superatmospheric vapor pressures, and condensing the vapors under like pressures, the condenser being preferably in free communication with the converter.

In carrying out my invention in its preferred form, the oil is preheated to approximately its boiling or vaporization point under sufficient superatmospheric pressure to maintain it in liquid form. The highly preheated liquid oil in which the latent heat of vaporization has been supplied, in a state of incipient vaporization, is then discharged or released into an enclosed cracking chamber, which is maintained at a cracking temperature and at a superatmospheric pressure somewhat less than that under which the oil is preheated, whereupon the liberated oil expands and breaks into vaporous form in which it is subjected to the full cracking heat of the chamber and effectively cracked or converted in the vapor phase. The cracked vapors pass to a condenser which is maintained at substantially the same pressure as that of the converter, the desired pressure being maintained by controlling the discharge of liquid and gases from the apparatus. By properly controlling the oil supply and the discharge of the generated products the process may be operated continuously.

Other objects and features of the invention will become apparent to those skilled in the art from the following description of a preferred illustrative embodiment of the invention.

The description of the process is facilitated by means of the single figure of the accompanying drawing showing an illustrated embodiment of apparatus adapted for carrying out the invention.

Referring to the simple form of apparatus shown in the figure, the reference character A represents an oil supply tank from which the oil is supplied to the apparatus for the conversion process.

The oil passes from this tank A, through pipe 4, precision feed valves 6', and pipe 6, to preheater B, in the coils or pipes 7 of

which the oil is heated, then through pipe 8, to the tubes 9 and chamber 10 of converter C, where the hot oil breaks into spray or mist like vapor so that in such gaseous form it may come in contact with cracking heat within the tube coil 9 and chamber 10.

The preheater B, is of any preferred construction as a feed water heater, a small boiler or other form of heater, whereby the oil may be heated by suitable means in order to raise it in temperature substantially to, or approaching, the boiling or vaporizing point under the particular pressure employed, so that when admitted or sprayed into the cracking chamber or tubes it will break into vaporous form.

The converter C, embodies an outer casing 35, of heat enduring and insulating material for confining the heat and any suitable means may be provided for heating this chamber, such as oil, or gas burners or other economical means of fuel consumption. I prefer making the converter itself in tubular form so that there will be a large heating surface presented as compared to the volume of vapor undergoing conversion passing through the converter; and in the form shown in the figure, the converter C comprises a pipe coil 9 and an enlarged chamber 10. The oil preheated under pressure to substantially its vaporization point at the pressure in the preheater B, is delivered through valve 26 in a thin stream into the bottom of the coil 9 through which it rises and is then admitted into the enlarged chamber 10. Both the coil 9 and the chamber 10 are heated to intense cracking temperatures which are in excess of the temperature of the preheater. Therefore, as the oil, in a state of incipient vaporization, rises through the pipe 9 and into the enlarged chamber 10, the relation of heat to pressure is such that the oil in transit will break into and maintain a vaporous form in which it is cracked.

The vapors, after being subjected to the high temperature in the coils 9 and the enlarged chamber 10, pass out through pipe 11, to separating chamber 12, where the lighter converted vapors rise and flow through pipe 13, to condenser D, where, in the coils 14, the vapors are passed down and condensed to liquid; and, together with the fixed gases generated during the process, are drawn off through pipe 15 and valve 16, into running trap tank E, which is provided with a draw off pipe 17, controlled by valve 18.

It will be understood that the supply tank A, can be refilled from time to time through the inlet pipe 1, and that the supply of oil from that tank to the converter C, may be augmented by air pressure which is applied over the surface of oil in the tank in order to force it into the preheater B, and so on into the converter C, the valve 2, being closed

as well as the valve in vent pipe 3, and the air pressure being registered on pressure gauge 33.

The compressed air may be supplied from any suitable source (not shown) and may conveniently be introduced through the pipe 3 if desired. Sufficient pressure is thus maintained upon the supply of oil to force it through the preheater against the back pressure of the converter and to hold the heated oil in liquid form while being raised to substantially its corresponding boiling point and until it is introduced by releasing or spraying it into the converter in which it immediately vaporizes and is cracked.

The preheater B, is intended only to heat the oil sufficiently to cause its easy vaporization, when admitted to the converting chamber or coils 9, through pipe 8, and is not intended to perform any cracking operation; the heated oils at the time of admission to the said chamber then being at a temperature sufficient to immediately vaporize and expand them for the vapor conversion process.

The temperature of the converter C, is raised to such a point as will crack or convert the oily vapors into lower boiling products or convert them into products having essentially different natures.

By reason of the preheating of the oil to substantially its vaporization point, the heat of the converter is fully expended in effectively cracking the oil in the vapor phase.

It will be seen that the condenser D, is in open communication with the converter C, through pipe 11, and separator 12, and therefore any pressure in the converter will extend to and through the condenser.

The continual feeding of new quantities of hot oil to the apparatus will build up or raise the vapor pressures in the converter; and consequently throughout the condenser, so that the vapors undergoing the cracking operation will at all times be under superatmospheric pressures while being subjected to cracking heats. This pressure is of course the result of the expansion due to the vaporization and heat, and is somewhat less than that utilized to force the oil through the preheater and hold it in liquid form.

This pressure maintained in the converter and through the condenser may be regulated by controlling the discharge of the fixed gases which are always generated to a more or less extent in the converter.

The condensation of vapors also tends to reduce the pressure and thus control of the escape of fixed gases is sufficient to enable the operator to maintain the pressure desired.

The fixed gases pass out with the con-

densed vapors through the pipe 15, into the trap tank E, and their escape through the pipe 19, is controlled by valve 20.

When the process is in operation pressure in the converting system will be registered on gauges 30 and 32, which, under normal operative conditions, should both indicate the same uniform pressure, while for safety purposes in this high pressure system, comprising preheater B, converter C, condenser D, and the running trap tank E, the release blow off valve 21, is provided and may be located over the condenser D.

The gauges 30 and 32, register vapor pressures while in this form of apparatus gauge 31, on the preheater B, registers the oil pressure which in all cases should be below the pressure maintained over the oil in supply tank A, as registered on gauge 33.

Vapors which pass out from the expansion chamber 10, through pipe 11, and into the separator column 12, may there be separated into the lighter ones, which pass to the condenser D, and heavier partially or wholly unconverted vapors which will drop to the bottom of the column together with particles of coke or carbon.

The bottom of this chamber 12, is connected to overflow hot oil tank G, by means of pipe 22, the flow of oil through which is regulated and governed by valve 23, and this column 12, is also provided with a detachable plate 24, so that solid or semi-solid matter and deposit may be removed from time to time. The material collecting in the tank G may be returned to the supply tank for further treatment, the pump H serving to draw off the oil through the line 25 and return it to the tank A through the line 34.

Preferably the process is operated as a continuous one, oil being continuously supplied from tank A, through preheater B, to the converter C. The operation of forcing or spraying the hot oil into the converter where it immediately vaporizes and the generated self-imposed pressure of the vapors due to the cracking operation tend, of course, to raise the pressure in the converter but this is compensated for by the condensation of the vapors in the condenser and the regulated escape of fixed gases and thus, even in the continuous operation, the pressure may be maintained at the number of pounds desired throughout the continuous use of the process.

It will be understood by those skilled in the art that the temperature necessary in the preheater B, converter C, and the pressure of the vapors in the converter through the condenser will vary with the characteristics of the particular oil being treated and therefore it is not possible to state any definite figures which would be applicable to all oils. The operator may determine when he gets the proper temperature in the converter

by the character of the product coming from the condenser. As illustrating the adaptability of my process for use with oils of widely different boiling points and of widely different characters it may be said that a kerosene distillate with an initial boiling point of 300° F. can be converted into distillate having an initial boiling point below 100° F. and a heavy paraffine gas oil having an initial boiling point of 400 to 500° F. can be converted into a distillate having a boiling point of 100° F. or less.

If, in the use of my process, it is desired to secure the greatest yield of gasoline the operation should be so regulated as to obtain a converted product having an initial boiling point of 100° F. or less.

Subject to variations, in accordance with the particular oils and operating conditions, I now believe that the present process of oil conversion is preferably conducted at temperatures from 1000° to 1200° F. and at pressures of from 70 to 90 pounds in the cracking converter. The temperatures might in some cases run as low as, or even lower than 900° F. or as high as 1500° F., while the operating pressures might range between 50 and 100 pounds or even considerably higher. The process, however, is primarily a vapor phase process and, therefore, the operating temperatures preferably will be somewhat higher than those commonly employed in processes of oil conversion in the liquid phase.

While it is possible to bring about these changes and convert higher into lower boiling compounds it is impossible to broadly state specific pressures and temperatures applicable to oils in general, as the natures of crude hydrocarbons as well as the distillates of crude oils vary so greatly in their composition and qualities that it is impossible to apply a fixed rule to oils in general and particularly to those which as a matter of commercial advantage would be available for conversion by the application to them of this process.

The present invention relating to the process is, of course, not limited to the use of a specific apparatus and it may be performed in various ways. I believe the fundamental steps of the process above set forth to be broadly new and by the language employed in the following claims it is my intention to cover the process in its broadest aspect.

What I claim is:

1. A continuous method of converting high boiling hydrocarbon oil into lower boiling products, that comprises continuously heating a moving stream of liquid oil to a point of incipient vaporization, delivering the heated oil to and forcing it under super-atmospheric pressure through an extended cracking coil of restricted cross section main-

tained at a cracking temperature wherein the oil is partially cracked, and expanding the partially cracked oil into an enlarged cracking chamber maintained at substantially the same cracking temperature and superatmospheric pressure as in the coil and in which the oil is further cracked.

2. A continuous method of converting high boiling hydrocarbon oil into lower boiling products, that comprises continuously heating a moving stream of oil under superatmospheric pressure to a point of incipient vaporization while maintaining it in liquid form, delivering the heated oil to and forcing it under superatmospheric pressure through an extended cracking coil of restricted cross section maintained at a cracking temperature wherein the oil breaks into vaporous form and is partially cracked, expanding the partially cracked oil into an enlarged cracking chamber maintained at substantially the same superatmospheric pressure and cracking temperature as in said coil and in which further cracking of the oil is effected, and removing the cracked and uncracked oil from the chamber while condensing the cracked vapors under superatmospheric pressure.

In witness whereof I have hereunto set my hand this 21st day of June, 1923.

JOSEPH H. ADAMS.