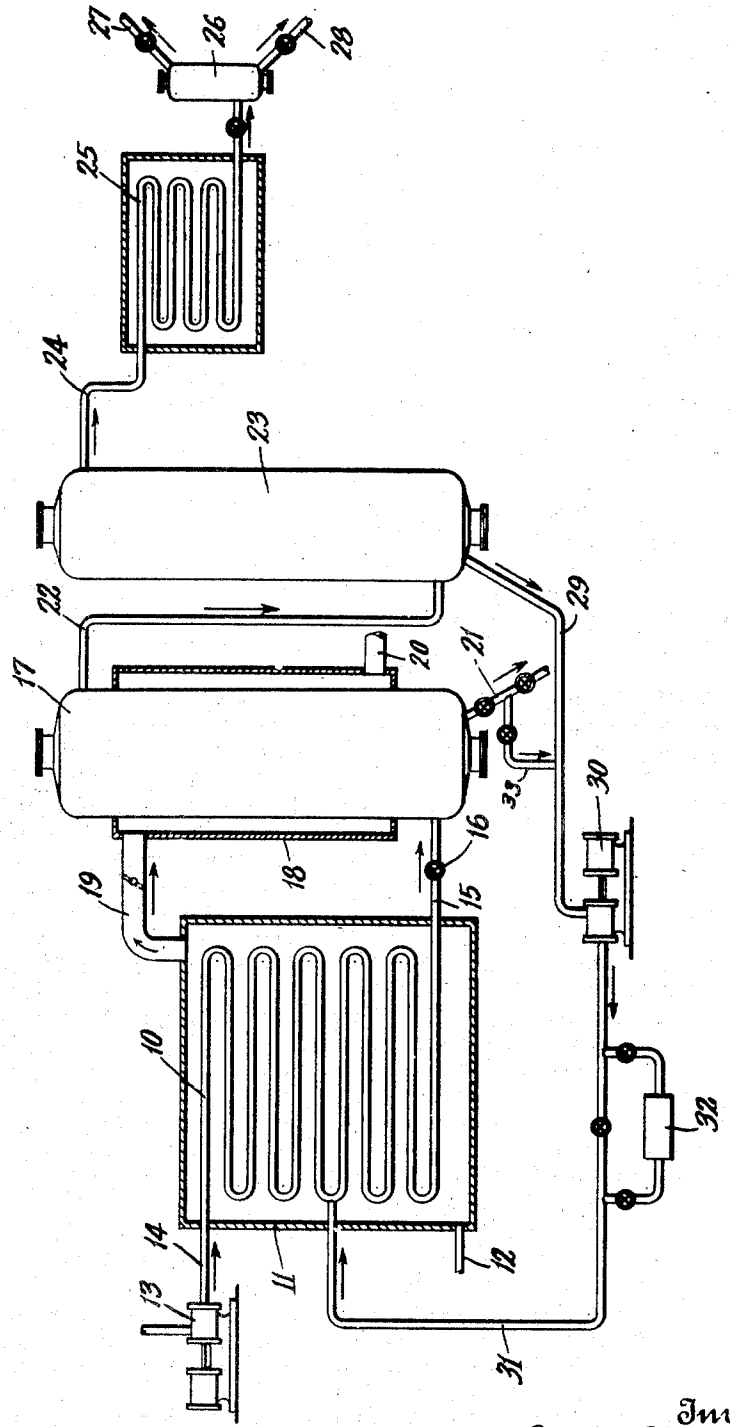
Nov. 6, 1934. O. BEHIMER 1,979,437

TREATING HYDROCARBON OILS

Filed Feb. 10, 1928



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Patented Nov. 6, 1934 1,979,437

UNITED STATES PATENT OFFICE

1,979,437

TREATING HYDROCARBON OILS

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Application February 10, 1928, Serial No. 253,257

4 Claims. (Cl. 196—60)

This invention relates to the conversion of higher boiling hydrocarbons into lower boiling ones for the production of gasoline and the like.

The invention relates essentially to the cracking or conversion of hydrocarbons in the vapor phase. It has been sought to crack hydrocarbons in the vapor phase but the equipment provided for the operation has consisted of pipes or tubes through which the vapors were passed and to which a relatively high temperature was applied, with the result that excessive quantities of carbon and permanent gas were produced thus reducing the production of the volatile liquid desired. The result has been that vapor phase cracking has not been practiced successfully on a commercial scale to any considerable extent, and liquid phase cracking, or at least combined liquid-vapor phase cracking, has been largely relied on for the production of cracked gasoline. It is an object of the present invention to provide a process by which cracking hydrocarbons in the vapor phase may be carried on successfully on a commercial scale. My invention enables the production of increased yields of gasoline or similar light hydrocarbon oil, with reduced quantities of carbon and permanent gas. Furthermore, my invention provides for the production on a commercial scale of a gasoline or motor fuel having superior anti-knock value and well adapted for use in high compression motors.

My invention contemplates a process wherein hydrocarbons may be converted in the vapor phase under lower temperatures as compared with the temperatures that it has been sought to employ in vapor phase cracking systems. In accordance with my invention, the oil to be converted is first passed through a coil or conduit of restricted cross section. A high degree of heat is applied to the coil so that the oil in transit therethrough may be raised to a cracking temperature. The oil is preferably charged through the coil at high pressure, and is raised to such a temperature therein that substantially all of the vaporizable constituents of the oil may be flashed into vapor upon a given reduction in pressure. The heated oil is discharged from the coil through a pressure reducing valve and introduced into an enlarged chamber wherein substantially all of the vaporizable constituents of the oil are vaporized. The enlarged chamber is maintained at a cracking temperature—that is, the volume of vapors therein is maintained at cracking temperatures so that conversion of higher boiling hydrocarbons into lower boiling ones occurs. The vapors may be removed from the converter to suitable dephlegmating or fractionating apparatus, from which an overhead distillate comprising the gasoline or other volatile product desired is taken off and from which a liquid condensate is withdrawn, which condensate is preferably returned to the heating coil for repassage through the cracking zone. The oil may be passed through the heating coil at a high rate of speed and the time element in the coil may be so regulated that even though the oil be heated therein to a cracking temperature no appreciable cracking takes place in the coil, although if desired a certain amount of cracking may be permitted to take place in the coil, but in any case it is preferable to have only a comparatively minor part of the cracking take place in the coil to which the high degree of heat is applied. The oil vapors in the enlarged chamber flowing at reduced velocity are maintained at a cracking temperature for a sufficient time to effect the desired conversion of higher boiling into lower boiling hydrocarbons. In prior methods of vapor phase cracking, it has been sought to crack the oil in pipes or tubes of insufficient volume, and with extremely high temperatures, but in my process the oil after having been brought rapidly to a vaporizing temperature in transit through a heating coil, is maintained in a large volume, and consequently at reduced velocity, and at cracking temperatures for a prolonged period of time. By reason of the increased time element allowable in the practice of my invention under which the oil vapors are maintained at a cracking temperature it is possible to operate at comparatively low temperatures.

In order to more fully describe the invention, reference will now be had to the accompanying drawing which is a diagrammatic sectional elevation of an apparatus constructed in accordance with the invention and constituting an embodiment thereof.

In the drawing 10 represents a heating coil mounted in a furnace 11 equipped with burner 12. A pump 13 is adapted to draw oil from a suitable source and introduce the oil through a charging line 14 to the coil 10. A transfer line 15 having a pressure reducing valve 16 conducts the oil from the coil 10 to an enlarged still or converter 17. The still is shown mounted in a heating chamber 18 provided with waste gases from the furnace 11 by means of a flue 19, and from which chamber the gases are removed by a flue 20. The still 17 is provided with a residue line 21 and with a vapor line 22. The vapor line communicates with a dephlegmator or frac-

tionating or rectifying column 23. The dephlegmator may be provided with suitable cooling means not shown for controlling the end point and character of the overhead distillate. A vapor line 24 is shown for conducting the vapors to a condenser coil 25, and a receiving drum 26 is indicated for collecting the resultant distillate, the receiving drum 26 being equipped with a gas outlet pipe 27 and a liquid condensate line 28. A line 29 conducts condensate from the dephlegmator 23 to a pump 30 by which the liquid is forced through a line 31 to the coil 10 for repassage therein to the still or converter 17. A filter 32 is shown connected to the line 31 so that the oil handled by the pump 30 may if desired, before being returned to the cracking zone, be filtered free of coke or carbon or other solids that may be contained in the oil. A line 33 is shown connecting the lines 21 and 29 so that if desired liquid from the still 17 may also be returned to the coil 10, although it is best after operating conditions have been established to remove from the system any liquid collecting in the still 17 and not circulate it back to the heating coil 10.

In practicing the invention the oil to be treated, which may be petroleum oil or other hydrocarbon oil, and which is preferably a petroleum distillate such as gas oil, kerosene or the like, is passed to the coil 10 wherein it is raised to a vaporizing temperature, that is, the oil is brought to a temperature such that upon a given reduction in pressure substantially all of the vaporizable constituents will be vaporized. It is desirable to heat the oil to a cracking temperature. The highly heated oil is then discharged through the transfer line 15 and pressure reducing valve 16 into the chamber 17 wherein the pressure is reduced and substantially all of the vaporizable constituents of the oil are vaporized. It is to be understood that a portion of the oil may be in vapor form before it leaves the coil 10, but that the pressure is so reduced in the chamber 17 that practically all of the oil is in vapor form therein. The vapors are maintained at a cracking temperature in the chamber 17 so that cracking occurs. It is to be understood that there is no large volume of liquid oil in the chamber 17, the greater portion of the space in the chamber being taken up with the vapors undergoing cracking, and with only a comparatively small amount of liquid or heavy tar that collects in the bottom of the chamber. Thus, the vapors removed through the line 22 ordinarily constitute about 85% to 90% of the charge introduced to the chamber 17, and the tar or residue drawn off about 10% to 15%. The gasoline vapors are taken off through the line 24 and collected as a condensate in the receiver 26, while the heavier constituents are withdrawn through the line 29 and returned by the pump 30 through the line 31 to the coil 10. Ordinarily the tar which is drawn off from the still 17 to the line 21 is removed from the system but in some cases it may be directed through line 33 to the line 29 and thus returned to the cracking zone by the pump 30. In some cases more or less carbon may be carried over in suspension in the evolved vapors from the still, and for this reason it is often desirable to filter the condensate being returned to the cracking zone, and if any residue from the still 17 is returned to the heating coil, it is desirable to filter it.

Ordinarily the oil in transit through the coil 10 is maintained under several hundred pounds pressure, for example, under 400 or 500 pounds or even 1000 or 2000 pounds, and the pressure is reduced through the pressure reducing valve 16 to around 200 or 300 pounds or even down to substantially atmospheric pressure. The oil in transit through the coil 10 is preferably heated to about 850° to 1000° F. the preferred temperatures for the most common charging stocks being about 900° F. The temperatures in the converter 17 are generally over 800° unless the pressure be reduced in the converter to atmospheric or thereabouts. Ordinarily the temperature under 200 or 300 pounds pressure in the converter will be about 850° to 900° F., although it may at times run as high as 1000° F. or thereabouts. It is to be understood that it is desirable to maintain the temperature in the converter 17 at as low a temperature as is consistent with a good commercial rate of cracking, and that by reason of the fact that the oil has been so highly heated in the coil 10 the hydrocarbons in the converter 17 may be held substantially in vapor form and at cracking temperatures without the application of excessive quantities of heat to the converter.

It is desirable to operate with a relatively large proportion of cycle products returned from the dephlegmator 23 to the coil 10 and converting chamber 17. Thus the amount of cycle products introduced to the coil 10 may be several times the quantity of the initial charge introduced to the charging line 14.

One of the advantages of the process is that by reason of the material drop in pressure through the pressure reducing valve 16 the tar or residue withdrawn from the converter 17 through the tar line 21 contains a minimum of gasoline constituents—that is, a much lower proportion of light constituents than the tar ordinarily withdrawn from liquid phase cracking stills.

Obviously many modifications and variations of the invention, as hereinbefore set forth, may be made without departing from the spirit and scope thereof, and therefore only such limitations should be imposed as are indicated in the appended claims.

What I claim is:

1. In the conversion of higher boiling hydrocarbon oils into lower boiling ones, the process that comprises passing the oil through a coil positioned in a furnace, applying furnace gases to the coil to heat the oil in transit therethrough to a cracking temperature of the order of 850° F.–1000° F. to effect cracking, passing the cracked products into the lower part of an enlarged reaction chamber wherein separation of vapors from liquid occurs, applying hot gases from said furnace to upper portions of said enlarged reaction chamber to maintain the separated vapors flowing at reduced velocity therein at a cracking temperature within the above temperature range and withdrawing the liquid from the unheated bottom portion of the chamber at a rate adequate to prevent the accumulation of liquid therein so that the cracking reaction is continued with respect to the vapor component while it is stopped with respect to the liquid component, separately removing the vapors from the upper part of said reaction chamber and passing them to a fractionating zone wherein they are subjected to fractionation to separate out a gasoline distillate.

2. In the conversion of higher boiling hydrocarbon oils into lower boiling ones, the process that comprises passing the oil through a coil wherein the oil is heated under superatmospheric

pressure to a temperature of the order of 850° F.–1000° F. to effect cracking, introducing the cracked products into the lower unheated portion of an enlarged reaction chamber wherein separation of vapors from liquid takes place, applying heat to the upper portions of said enlarged chamber above the point of introduction thereto of said cracked products to maintain the separated vapors flowing at reduced velocity therein within the above temperature range, maintaining a pressure of upwards of 200 pounds in the enlarged reaction chamber, withdrawing the liquid from the bottom of the enlarged reaction chamber at a rate adequate to prevent the accumulation of liquid therein so that while the cracking reaction is continued with respect to the vapor component it is stopped with respect to the liquid component, passing the cracked vapors to a fractionating zone and subjecting them to fractionation to separate out a gasoline distillate.

3. In the conversion of higher boiling hydrocarbon oils into lower boiling ones, the process that comprises passing the oil through a coil wherein the oil is heated to a temperature of the order of 850° F.–1000° F. to effect cracking, passing the cracked products into the lower unheated portion of an enlarged reaction zone wherein separation of vapors from liquid takes place, heating the separated vapors therein above the point of introduction of said cracked products thereto to maintain said vapors flowing at reduced velocity within the above temperature range and withdrawing the liquid from the bottom of the chamber at a rate adequate to prevent the accumulation of liquid therein so that the cracking reaction is continued with respect to the vapor component while it is stopped with respect to the liquid component, passing the cracked vapors to a fractionating zone and subjecting them to fractionation to separate out a gasoline distillate.

4. In the conversion of higher boiling hydrocarbon oils into lower boiling ones, the process that comprises passing the oil through a coil under a pressure of the order of upwards of 500 pounds and heating the oil therein to a cracking temperature of the order of 850° F.–1000° F. to effect cracking, passing the cracked products into the lower unheated portion of an enlarged reaction zone wherein separation of vapors from liquid occurs at a materially reduced pressure of the order of upwards of 200 pounds, heating the separated vapors therein above the point of introduction of said cracked products thereto to maintain said vapors flowing at reduced velocity within the above temperature range and withdrawing liquid from the bottom of the chamber at a rate adequate to prevent the accumulation of liquid therein so that the cracking reaction is continued on the vapor component while it is stopped on the liquid component, passing the cracked vapors to a fractionating zone and subjecting them to a fractionation to separate out a gasoline distillate.

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