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TREATING HYDROCARBON OILS

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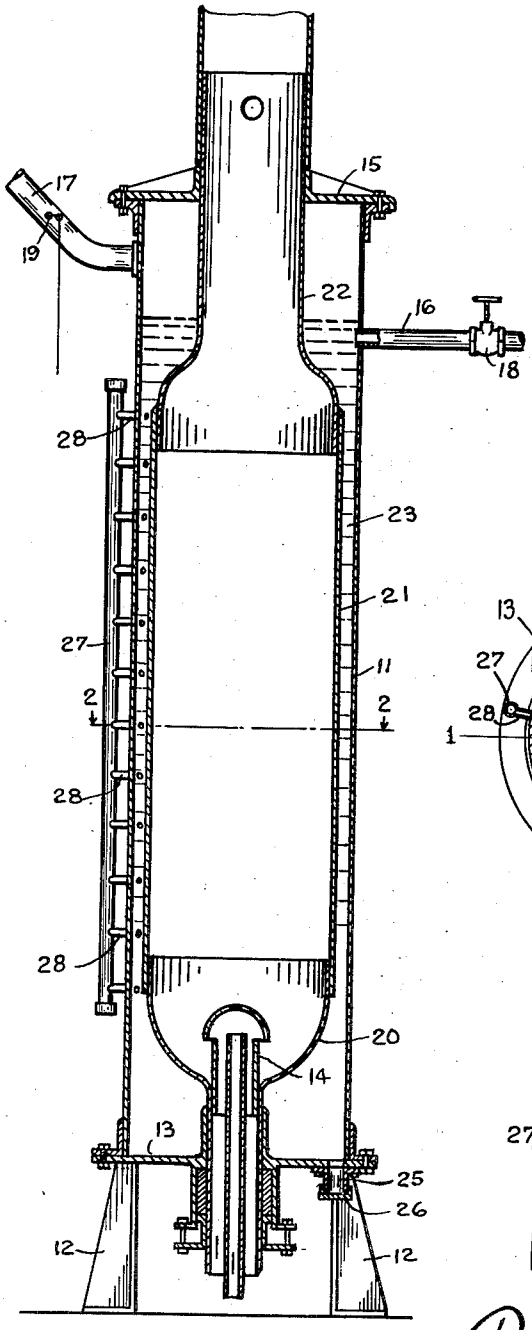

Fig. 1

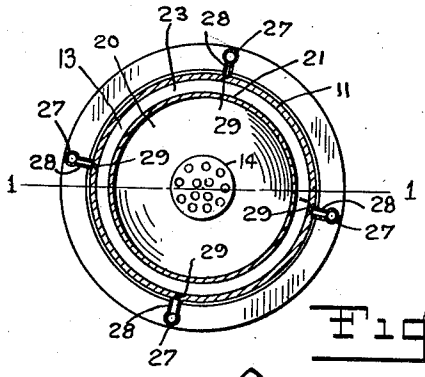

Fig. 2

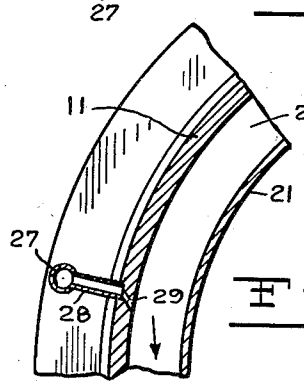

Fig. 3

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TREATING HYDROCARBON OILS

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11 Claims. (Cl. 196—63)

My invention relates to methods for treating hydrocarbon oils, and to apparatus for carrying out said methods, for the purpose of cracking or separating the said hydrocarbons into their component parts.

My invention also relates to methods of treating hydrocarbon oils, and to apparatus for carrying out said methods, for the purpose of enriching the products of cracking, separation or distillation, or some of the same, by combining therewith additional hydrogen, derived from steam injected into the apparatus and acting in accordance with the hereinafter set forth methods.

The invention relates particularly to methods and apparatus for treating heavy hydrocarbons, the distillation or cracking of which and the most efficient utilization of the products thereof, have heretofore presented serious difficulties, as will hereafter be pointed out.

The invention relates also particularly to methods and apparatus whereby steam may be cracked or dissociated in the presence of hydrocarbon oils which are being treated, and the oxygen of said steam allowed to combine with the carbon which is set free from the hydrocarbon oils being treated, and the hydrogen of said steam being applied to the enriching of products of the treatment of the oils, the gas formed from the oxygen of the steam being either CO or CO_2 according to circumstances, as will be well understood by those skilled in the art to which this invention relates, the CO resulting as above said being, if desired, utilized as a part of the fuel for heating the apparatus.

One of the principal objects of the invention is to provide an improved method and means for distilling or cracking hydrocarbon oils and the enriching of the products, or some of the same, resulting from such distillation or cracking, which shall be free from the objections which have applied to the methods and means which have heretofore been known in the art as applicable to the said purpose. Further objects and advantages of the invention will be in part set forth in the following specification, and in part will be obvious therefrom without being specifically pointed out, the same being realized and attained by means of the instrumentalities and combinations pointed out in the claims hereof.

In apparatus heretofore used for the purpose of cracking or distilling hydrocarbon oils, much difficulty has been experienced in the operation because of the deposition of carbon which tends to adhere to the walls of the furnace or still in which the hydrocarbon is being treated and which, unless frequently removed therefrom, will interfere with the conduction of heat through the walls to the substance being treated, and which will also, if allowed to collect to too great an extent, cause the failure of the metal composing the still. In my invention, however, the treatment of the hydrocarbon may be continued indefinitely with no lack of efficiency on account of the deposition of carbon above referred to, that is to say, until substantially all the volatile elements of the hydrocarbon have been removed and substantially only the non-volatile or carbonaceous residue remains.

With the above and other objects of the invention in view, the invention consists in the novel construction, arrangement and combination of various devices, elements and parts, as set forth in the claims hereof, one embodiment of the same being illustrated in the accompanying drawing and described in this specification, and also in the management of the material and the treatment of the same according to the successive steps constituting the process or method as fully set forth and described in this specification and in the claims hereof.

In the accompanying drawing,

Fig. 1 represents a vertical section of an apparatus constructed according to my invention, the section being taken transversely thereof along the line 1—1 of Fig. 2;

Fig. 2 is a horizontal section taken along the line 2—2 of Fig. 1; and

Fig. 3 is a portion of Fig. 2 on an enlarged scale, in order to show the steam inlet ports, and the deflection of the inner orifice of the same, as hereinafter more fully set forth.

In carrying into effect the improved method constituting a part of my invention, I provide an apparatus adapted to enable the oil to be treated according to said method. Such an apparatus may of course be of different forms according to circumstances. In the embodiment, however, which I have selected for illustration in the accompanying drawing and for description in this specification, I provide an apparatus constructed as follows: A suitable outer containing casing 11 is supported by feet 12. The bottom of the said casing, designated 13, is perforated to permit the insertion of a gas burner or other heating means 14, which may be of any suitable type and need not be particularly described here, and also open by a pipe 25, for drawing off the contents, which outlet may be closed by a cap 26 or other suitable means when desired. The casing is provided with

a covering 15 at its upper end, which is open to allow the passage of an outlet pipe for the products of combustion, and is also open laterally near its upper end to connect with an inlet pipe 16 for the hydrocarbon oils and an outlet pipe 17 for the vapors; these pipes may of course be provided with valves, as 18, 19 or the like.

Located inside of the casing 11 is an inner casing, which for convenience of manufacture may if desired be constructed in three parts, viz., a lower cup-shaped portion 20, through which the burner 14 extends into the interior of the inner casing, a cylindrical portion 21 which extends upward nearly to the top of the apparatus, and a contracted portion 22, which comprises a ventpipe for the products of combustion, extending up through the opening in the upper part 15 of the outer casing. It will be seen that between the cylindrical portion 21 of this inner casing and the adjacent portion of the outer casing 11 is located an annular space 23, which is adapted to contain the hydrocarbon oil which is to be treated, as shown in Fig. 1.

Outside of the outer casing 11 of the apparatus, are steam pipes 27, connected with a boiler in some suitable way, not shown in the drawing. Four of these steam pipes are shown in the drawing (see the horizontal section Fig. 2), only one of which pipes appears in Fig. 1. Short horizontal pipes 28 open up out of the main pipe 27 and pass through the outer casing 11 and into the annular space 23. The inner ends of these pipes, at the point of entrance into the annular space, are contracted and deflected at an angle with the rest of the pipe, as shown at 29 in Fig. 3, so that steam entering said annular space through said pipes is injected tangentially and thereby tends to set up a rotary motion of the liquid contents in said annular space, in the direction of the arrow in Fig. 3.

The operation of my invention, with the particular form of apparatus which has been above described, that is to say, the carrying out of my improved method by means of the apparatus herein shown and described, will now be described, it being understood that with other apparatus, while the essence of the invention remains the same, some differences of detail in the mechanism and in the exact method of operation, may come into use without departing from the spirit and scope of the invention.

A suitable source of steam, connected with the pipe 27, being provided, and the burner 14 or other means of heat being lighted so that the apparatus is brought to a suitably high temperature, and the space between the inner casing 21 and the outer casing 11 being filled to a suitable height with the hydrocarbon oil to be treated, steam is admitted through the pipes 28 and vents 29 into the annular space 23. The effect of this is to set the oil in the annular space 23 into rapid rotation. Owing to the centrifugal action, the steam and oil will not uniformly mix in this annular space, but the oil will occupy most of the circumferential or peripheral portion of this annular space, leaving the much lighter steam and oil vapors to circulate as a comparatively thin film on the inside, that is to say, immediately adjacent the inner casing 21 and lying between the same and the oil. This film will of course not be continuous and unbroken, inasmuch as the same will be broken up at each point of entry of the steam through the vents 29, and at these points disturbances or eddies will occur where the steam being injected with considerable force passes through the film of oil and abuts against the casing 21, and thus there will be normally more or less mixture and disturbance of the adjacent layers of oil and steam, at the same time the general tendency will be for the comparatively thick film of oil to be mostly in contact with the outer casing 11, and not so much in contact with the inner casing 21, being separated therefrom by an insulating curtain or film of steam and oil vapors. The outer casing 11 is of course raised to a high degree of heat from the hot oil, from the occasional contact of the superheated steam, and from the general presence of heat in the apparatus, but the inner casing 21 will be very much hotter than the outer casing, on account of the extremely hot vapors inside of said inner casing, arising from the burner 14, in addition to the steam, which is mostly in contact with said inner casing, as above described.

It is obvious that as the oil contained in the annular space 23 is maintained at a high temperature, there will be more or less ordinary distillation taking place, the vapors arising therefrom rising up and accumulating in the upper part of the annular space. It is also obvious that more or less cracking of the contained oil will occur, not only when, owing to the agitation of the rotary stream of oil in the neighborhood of the vents 29, a portion of the oil surges into contact with the intensely heated inner casing 21, thereby depositing upon said casing 21 carbon from said oil, but also in the heated space above the surface of the oil; and it is also obvious that some of the steam entering through the pipes 28 (which is preferably superheated steam) will, upon contact with the carbon on the intensely heated inner casing 21, react with said carbon with the formation of carbon monoxide and hydrogen.

The hydrogen resulting from the reaction of the carbon and the steam will, being in a nascent condition, unite with molecules of oil, thus hydrogenating and enriching the said oil, in a manner which will be well understood by those skilled in the art to which this invention relates.

There will thus be present in the upper part of the apparatus, and more or less mingled together, some steam, some carbon monoxide, some carbon dioxide, and a considerable quantity of hydrocarbon vapors of various specific gravities. These will pass out through the discharge vent 17 and be collected in some suitable receptacle for cendensation and separation by processes which are well known in the art and which form no part of my present invention.

The advantages of my invention will in the main be obvious from what has been above said with regard to the construction of the apparatus and the operation thereof in carrying into effect my improved method. By this new method, used in connection with either an apparatus such as shown in the accompanying drawing and described in this specification, or in connection with some other suitable apparatus, it is possible to treat hydrocarbon oils of comparatively high density and produce from them oils of a much lighter character, by a continuous process and in a remarkably simple and efficient manner. I believe that I am the first to accomplish these results by setting into rotational movement a body of hydrocarbon oil in a heated apparatus by means of tangentially directed jets of steam injected into said oil, whereby the heavier oil is by centrifugal force made to rotate outside of

the lighter steam and other vapors, so that the steam and oil vapors form a more or less continuous curtain between the heated surface of the containing receptacle and the outer layer of oil, and thereby affording the opportunity for the production of reactions which will hydrogenate or enrich the hydrocarbon vapors by means of hydrogen set free from injected and dissociated steam, and at the same time removing any deposit of carbon upon the heated surface by combining the same with the oxygen from said dissociated steam. Other advantages will be readily seen by those skilled in the art.

Having thus described the invention, what I claim as new and desire to secure by Letters Patent is as follows:

1. A process for converting liquid hydrocarbon oil into products of lower boiling points which comprises circulating the oil peripherally in a stationary annular chamber the inner wall of which is a heating member, the velocity of the liquid oil being such as to cause a higher pressure on the outside of the said annular chamber and a resulting film of lighter vapors between the liquid oil and the said inner wall.

2. A process for converting liquid hydrocarbon oil into products of lower boiling points which comprises introducing the liquid oil into a stationary receptacle containing a stationary annular chamber, applying heat to the inner wall of said annular chamber, rotating the liquid oil around the said heated inner wall at a sufficient velocity to cause a substantial degree of centrifugal force therein whereby a film or curtain of lighter vapors is formed between the liquid oil and the said inner wall, and withdrawing vapors from said receptacle.

3. A process for converting liquid hydrocarbon oil into products of lower boiling points which comprises introducing the oil into a stationary receptacle containing a stationary annular chamber, applying heat to the inner wall of said annular chamber, introducing steam into said annular chamber, imparting a sufficiently rapid rotary motion to the liquid oil in said annular chamber to cause a substantial degree of centrifugal action therein whereby a film of steam and vapors is formed between the liquid oil and the said heated inner wall, and withdrawing vapors from said receptacle.

4. A process for converting liquid hydrocarbon oil into products of lower boiling points which comprises introducing the oil into a stationary annular chamber, applying heat to the inner wall of said annular chamber, introducing steam into said annular chamber, imparting a sufficiently rapid rotary motion to the liquid oil within the annular chamber to cause a higher pressure on the outer wall of said annular chamber than on the inner wall thereof and a resulting film of steam and oil vapors between the liquid oil and the heated inner wall, cracking molecules of the oil, and drawing off the vapors.

5. In a process for the distillation of liquid hydrocarbon oils, the steps of propelling the liquid oil around the inner wall of a stationary annular chamber, said inner wall being a heating member, at sufficient velocity to cause a higher pressure on the outer wall of said annular chamber than on the inner wall thereof and concurrently interposing a film of steam and oil vapors between the moving oil and the said inner wall.

6. A process for cracking hydrocarbon oil which comprises rotating the liquid hydrocarbon oil in a stationary annular chamber the inner wall of which is a heating member, interposing a film of vapors between the liquid oil and said inner wall, and cracking molecules of the hydrocarbon oil.

7. A process for converting hydrocarbon oil into products of lower boiling points which consists in introducing the same into a suitable receptacle of annular shape, applying heat to the inner side of the central wall of said annular receptacle, and introducing steam through the wall of said annular receptacle in a tangential direction, whereby a sufficiently rapid rotary motion is imparted to the contents of said receptacle to cause a substantial degree of centrifugal action therein.

8. A process for converting hydrocarbon oil into products of lower boiling points which consists in introducing the same into a suitable receptacle of annular shape, applying heat to the inner side of the central wall of said annular receptacle, introducing steam through the wall of said annular receptacle in a tangential direction, whereby a sufficiently rapid rotary motion is imparted to the contents of said receptacle to cause a substantial degree of centrifugal action therein, and drawing off the vapors from said receptacle.

9. In an apparatus for converting hydrocarbon oils into products of lower boiling points, the following elements in combination: A heating chamber; means for applying heat thereto; an annular chamber surrounding said heating chamber but having no direct communication therewith; means for introducing hydrocarbon oil into said annular chamber; and means for introducing steam into said annular chamber in a tangential direction, whereby oil contained therein is set in rotary motion.

10. In an apparatus for converting hydrocarbon oils into products of lower boiling points, the following elements in combination: A heating chamber; means for applying heat thereto; an annular chamber surrounding said heating chamber but having no direct communication therewith; means for introducing hydrocarbon oil into said annular chamber; means for introducing steam into said annular chamber in a tangential direction, whereby oil contained therein is set in rotary motion; and means for permitting the escape of vapors arising from said oil.

11. In an apparatus for the conversion of liquid hydrocarbon oils into products of lower boiling points, the following elements in combination: A cylindrical receptacle, a cylindrical heating member placed therein and forming a stationary annular chamber between the wall of said receptacle and the wall of said heating member, means for introducing liquid oil into said annular chamber, means to circulate the said liquid oil in said chamber around said heating member, an upper outlet for the removal of vapors, and a lower outlet for the removal of oil from the apparatus.

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