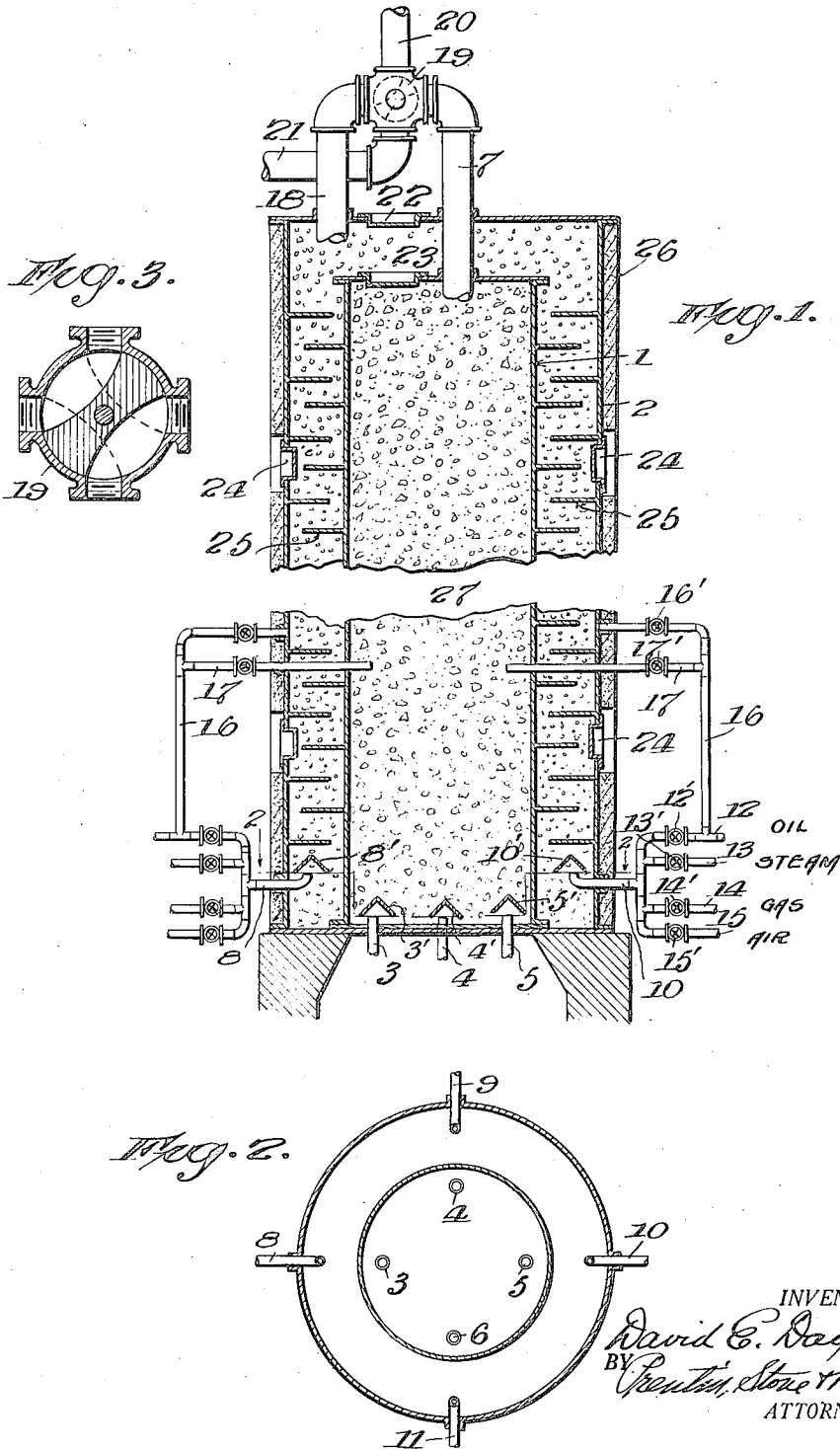


D. E. DAY,
OIL CRACKING PROCESS AND APPARATUS THEREFOR.
APPLICATION FILED APR. 5, 1920.

1,386,768.

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UNITED STATES PATENT OFFICE.

DAVID E. DAY, OF SANTA MARIA, CALIFORNIA.

OIL-CRACKING PROCESS AND APPARATUS THEREFOR.

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Specification of Letters Patent.

Patented Aug. 9, 1921.

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To all whom it may concern:

Be it known that I, DAVID E. DAY, a citizen of the United States, residing at Santa Maria, in the county of Santa Barbara and State of California, have invented certain new and useful Improvements in Oil-Cracking Processes and Apparatus Therefor, of which the following is a specification.

The object of my invention is to produce a process and apparatus for cracking oils as set forth in detail herein.

A further object of my invention consists in utilizing the carbon which is formed in my cracking process by burning the same in the chamber where it is formed, the heat evolved being transferred to the adjacent chamber in which oil is cracked. By my process therefor, which is a continuous one, I not only rid the chambers of the objectional carbon formed but I also utilize the heat of combustion of this material.

A further object of the invention, consists in the sequence of steps of operation, and the details of invention hereinafter set forth and claimed.

The apparatus employed in carrying out my process is illustrated in the accompanying drawings, in which—

Figure 1 is a vertical sectional view of the apparatus.

Fig. 2 is a plan view of the same taken on the section line 2—2.

Fig. 3 is a cross section of the four-way valve hereinafter described.

As is well known a great deal of difficulty has been experienced in handling carbon which is produced by the cracking of oils in processes to produce low boiling from high boiling hydrocarbons. It is generally necessary to interrupt the cracking process after a few days' run to clean out the separated carbon produced in cracking, thereby losing time and also wasting fuel because of the necessity of allowing cooling to take place until a temperature is reached which will permit of cleaning the apparatus. In a horizontal oil still for instance, it is the general practice after making a run to draw the fires and drain off the oil content of the still, then to scrape off carbon from the still bottom and walls by means of scraping tools. It is generally necessary for the operator to enter the still in carrying out this carbon removing process. In the multitubular form of still the inconvenience of having to enter the still is avoided but a great deal

of time is required in removing separated carbon from the tubes of the still and furthermore the fuel consumption in operating the still is very high on account of the necessity of shutting down at intervals to remove carbon.

By the process and apparatus which I have invented, I avoid the shutting down of the still for the removal of carbon and have, therefore, produced a continuous process and apparatus for obtaining low boiling hydrocarbons from high boiling ones.

In the following description of my apparatus, I employ similar numerals to designate similar parts in the various views.

Referring to Fig. 1 of the drawing, the numeral 1 indicates a vertical cylinder preferably of steel although cast iron, cast steel, fire brick or other suitable material may be used. Surrounding this cylinder is an outer cylinder 2 of similar material and so spaced from the first cylinder that the volume between the cylinders is equal to the volume or space within the first cylinder. Leading to the bottom of the inner cylinder 1 are pipes 3, 4, 5 and 6 each for the admission of gas and air or oil and steam, or a combination of oil, air or steam, as will be further described. Leading from the upper end of the cylinder 1 is a pipe 7 of large capacity which serves for the withdrawal of oil vapors or combustion gases, as will be further described.

At the lower portion of the outer cylinder, pipes 8, 9, 10 and 11 serve to admit oil and steam, or gas and air, etc., to the space between chambers 1 and 2. Connecting each of the pipes 3, 4, 5, 6, 8, 9, 10 and 11 are pipes 12 containing valves 12' for the admission of oil, pipes 13 containing valves 13' for the admission of steam which may be either saturated or superheated, pipes 14 containing valves 14' serving for the admission of gas, and pipes 15 containing valve 15' serving for the admission of air. In order not to produce clogging of the pipes 3, 4, 5, 6, 8, 9, 10 and 11, supporting members over the pipe ends, as indicated at 3'—10' in Fig. 1, may be employed to hold or support the spreading material in the interior of chamber 1 and the space between chambers 1 and 2. The supporting members may be cone shaped or other form suitable for the purpose. Leading from the oil pipes 12 are branch oil pipes 16 containing valves 16' which serve to admit oil to the

space between cylinders 1 and 2. Leading from pipes 16 are pipes 17 containing valves 17', which pipes serve to admit oil to the space within the inner cylinder 1 when desired.

Leading from the upper portion of the cylinder 2 is a pipe 18 which also serves for the removal of either oil vapors or combustion gases depending upon the way in which the process is being carried out. Both pipes 7 and 18 connect with a four-way valve 19 which serves to lead off combustion gases to a stack by means of pipe 20 or to lead oil vapors to a condenser by means of pipe 21. Fig. 3 of the drawings shows the cross section of the four-way valve, which is old in the art and need, therefore, not be further described.

On the top of chamber 2 is a manhole 22 which serves to gain access to cylinder 1 or to the space between the cylinders. Similarly on the top of cylinder 1 is a manhole 23 serving to permit access to the interior of cylinder 1. In the walls of chamber 2, I employ hand holes 24 which serve to gain access at different points of the cylinder 2 to the space between the cylinders. Between the cylinders 1 and 2, I preferably employ baffle plates 25, which serve as shelves to hold catalytic material thereon, as will be further described. On the outside of the chamber 2, I preferably employ a non-conducting material so as to lag the chambers and prevent loss of heat. This material designated by numeral 26 may be either magnesia, or other commercial non-conducting material.

In carrying out the process of cracking, I employ a catalytic, absorbent or spreading material designated by 27, which may be either a metal, as cast iron or nickel, or may be refractory material, such as porous fire clay, fire brick, fullers' earth, or other porous or solid material. This material may be either in lump, granular or powder form as may suit the particular oil treated. I have used porous fire brick with satisfactory results and have found that the process gives a very desirable product and the process may be employed for a considerable length of time without change.

The way in which the process is carried out will now be described. I first start the burners in the chamber between cylinders 1 and 2, by admitting gas and air from pipes 14 and 15 in suitable proportions. The combustion gases from this source heat the material upon the shelves or baffles and heat is conducted through the walls of cylinder 1 into the inner chamber. The combustion gases are taken off at the top of chamber 2 by means of pipe 18 and pass through the four-way valve 19 to the pipe 20, leading to a stack. When a suitable temperature is reached, the oil is passed onto the catalytic material in chamber 1 either by means of

pipes 3, 4, 5 and 7 or pipes 17 which conduct the oil to the mid-portion of the inner chamber. The oil is absorbed into the porous catalytic material, if such porous material is employed, and cracking takes place within the pores of this material or within the interstices between the particles of the catalytic material. As cracking takes place, oil vapors are formed which pass through the catalytic material and are thereby purified or washed, the catalytic material removing the heavier hydrocarbons, tarry matter or carbon therefrom. The vapors in passing up through the heated catalytic material may be further cracked. In this way, therefore, I obtain both a liquid phase and vapor phase cracking, which serves to produce a larger proportion of light hydrocarbons than is produced by the use of a single phase cracking process.

The oil vapors which are evolved after being filtered by the material in chamber 1 pass by the pipe 7 through a passage of the four-way valve 19 into the pipe 21 which leads to a condenser, not shown. This part of the process which has been described is continued until the accumulation of carbon upon the spreading or catalytic material becomes so great as to interfere with the operation of the apparatus by reducing the yield, or changing the nature of the product, thus indicating to the operator the time at which a reversal of the process should be made. At this stage of the operation the admission of oil to the chamber 1 is stopped, burners heating the chamber between walls 1, 2 are cut off, and the four-way valve 19 is turned so as to connect the pipe 7 to the pipe 20, and the pipe 18 to the pipe 21. Burners at the bottom of the chamber 1 are then started by the admission of air and gas from pipes 14 and 15 in suitable proportions. The supply of air will be greatly in excess in order to burn out the carbon and tarry matter separated upon the catalytic material and in its pores, thus utilizing such combustible material and furnishing heat to the process. Oil is now admitted into the chamber between cylinders 1 and 2 by means of either pipes 12 (through pipes 8, 9, 10 and 11) or pipes 16 leading to the middle portion of the space between chambers 1 and 2 as shown in the drawing. The oil so admitted is partly absorbed by the catalytic material as in the first part of the process, the heat now being transmitted from the inner chamber through the walls of cylinder 1 to the oil and catalytic material. Cracking takes place in the same way as is described in connection with the admission of oil to cylinder 1, the oil vapors produced passing up through the catalytic material upon baffles 25 and are further cracked and purified. The oil vapors evolved at the top of the chamber pass by the pipe 18 through the passage of a four-way valve 19 through the pipe 21 and to the condenser. Combustion

tion gases which pass through the inner chamber pass by the pipe 7 through the valve 19 to the pipe 20 leading to the stack. This part of the process is continued until accumulation of carbon on the catalytic material on the baffles 25 takes place to such an extent that it becomes necessary to reverse the process again. The process of cracking as described is essentially, therefore, a continuous process and utilizes the carbon separated out by the cracking of oil and avoids the necessity of shutting down the apparatus for cleaning purposes.

I desire to have it understood that I may operate the process either with or without pressure, and may feed oil to the chambers either in a stream or in spray form and with or without steam to suit the needs of the particular oil undergoing treatment.

What I claim is:

1. The process of producing low boiling hydrocarbons from high boiling hydrocarbons which comprises passing high boiling hydrocarbons into a zone containing spreading material, heating the said zone to a cracking temperature, whereby high boiling hydrocarbons are cracked and produce low boiling hydrocarbons together with carbon in the said zone, leading off vapors of low boiling hydrocarbons and condensing the said vapors, terminating the passage of high boiling hydrocarbons to the said zone, burning away the said carbon produced in the said zone, passing high boiling hydrocarbons into a second zone containing spreading material in heat transferring relation to the first zone, whereby low boiling hydrocarbons are produced, and passing the said low boiling hydrocarbons to a condenser.

2. The process of producing low boiling hydrocarbons from high boiling hydrocarbons which consists in passing high boiling hydrocarbons into contact with a mass of catalytic material, passing combustion gases into a zone containing a second mass of catalytic material, the said zone being in heat transferring relation to the first mentioned mass of catalytic material, whereby the said high boiling hydrocarbons are cracked and produce thereby low boiling hydrocarbons, together with carbon, continuing the process until the accumulation of carbon interferes with the production of low boiling hydrocarbons, then reversing the process by passing combustion gases through the first mentioned mass of catalytic material and passing the said high boiling hydrocarbons into contact with the said second mass of catalytic material, drawing off the vapors produced and condensing the same.

3. The process of producing low boiling hydrocarbons from high boiling hydrocarbons which consists in passing high boiling hydrocarbons into contact with a mass of catalytic material in one zone, passing com-

bustion gases into a second zone containing a second mass of catalytic material, the said second zone being in heat transferring relation to the first mentioned zone containing a mass of catalytic material, whereby the said high boiling hydrocarbons are cracked and produce thereby low boiling hydrocarbons, together with carbon, continuing the process until the accumulation of carbon interferes with the production of low boiling hydrocarbons, then reversing the process by passing the combustion gases through the first mentioned mass of catalytic material in the first mentioned zone and passing the said high boiling hydrocarbons into contact with the said second mass of catalytic material in the said second zone, drawing off the vapors of the low boiling hydrocarbons produced and condensing the same.

4. The process of producing low boiling hydrocarbons from high boiling hydrocarbons which consists in passing high boiling hydrocarbons into contact with a mass of catalytic material in one zone, passing combustion gases into a second zone containing a second mass of catalytic material, the said second zone being in heat transferring relation to the first mentioned zone containing a mass of catalytic material, whereby the said high boiling hydrocarbons are cracked and produce thereby low boiling hydrocarbons together with carbon, continuing the process until the accumulation of carbon interferes with the production of low boiling hydrocarbons, then reversing the process by passing combustion gases capable of burning out carbon, through the catalytic material in the first zone and passing the said high boiling hydrocarbons into contact with the catalytic material in the said second zone, drawing off the vapors of the low boiling hydrocarbons produced and condensing the same.

5. The process of producing low boiling hydrocarbons from high boiling hydrocarbons which consists in passing high boiling hydrocarbons into contact with a mass of spreading material in one zone, passing a gaseous heating medium into a second zone containing a second mass of spreading material, the said second zone being in heat transferring relation to the first mentioned zone, whereby the said high boiling hydrocarbons are cracked and produce thereby low boiling hydrocarbons together with carbon, continuing the process until the accumulation of carbon interferes with the production of low boiling hydrocarbons, then reversing the process by passing a gaseous heating medium capable of burning out carbon through the first mentioned mass of spreading material and passing the said high boiling hydrocarbons into contact with the said second mass of spreading material, drawing off the vapors of the low boiling

hydrocarbons produced and condensing the same.

6. The process of producing low boiling hydrocarbons from high boiling hydrocarbons which consists in passing high boiling hydrocarbons into the middle portion of a zone containing a mass of spreading material, passing a gaseous heating medium into a second zone containing a second mass of spreading material, the said second zone being in heat transferring relation to the first mentioned zone, whereby the said high boiling hydrocarbons are cracked and produce thereby low boiling hydrocarbons together with carbon, continuing the process until the accumulation of carbon interferes with the production of low boiling hydrocarbons, then reversing the process by passing a gaseous heating medium capable of burning out carbon through the first mentioned zone containing spreading material, and passing the said high boiling hydrocarbons into the middle portion of the said second zone containing a second mass of spreading material, drawing off vapors of the low boiling hydrocarbons produced and condensing the same.

7. In an oil treating apparatus, an internal chamber, an external chamber concentric therewith, means for generating heat in the said chambers, means for feeding oil to the said chambers, an eduction pipe leading from each of the said chambers for removal of an aeriform material, means for cutting off the said oil supplying means from the said chambers, and means for regulating the generation of heat in each of the said chambers.

8. In an oil treating apparatus an internal chamber, an external chamber concentric therewith, heating means for the said chambers, oil feeding means leading to the said chambers, eduction pipes connecting with the internal and external chambers and with a four-way valve, a pipe connecting one port of said four-way valve to a stack, a second pipe connecting a second port of the said valve to a condenser, the said four-way valve being operable to lead combustion gases from either the internal or the external chamber to the said stack and simultaneously to lead oil vapors from the external or internal chamber to the said condenser.

9. In an oil treating apparatus, an internal chamber, gaseous heating means communicating with the lower portion of said chamber, oil feeding means communicating with the said chamber, an exit pipe leading from the top of said chamber to a port of a four-way valve; a second chamber external to the said internal chamber; heating means communicating with the lower portion of said second chamber, oil feeding means communicating with the said external chamber,

an outlet pipe connecting the upper portion of the said external chamber with a second port of the said four-way valve; a pipe connecting a third port of said four-way valve and leading to a stack; a pipe connecting a fourth port of the said valve and leading to a condenser; the said valve being operable to conduct gases from the internal chamber to the stack and simultaneously to conduct oil vapors from the external chamber to the said condenser, and being also operable to conduct oil vapors from the internal chamber to the condenser and simultaneously to conduct gases from the said external chamber to the said stack.

10. In an oil treating apparatus, an internal chamber, gaseous heating means communicating with the lower portion of said chamber, oil feeding means communicating with the middle portion of the said chamber, an exit pipe leading from the top of said chamber to a port of a four-way valve; a second chamber external to the said internal chamber; heating means communicating with the lower portion of said second chamber, oil feeding means communicating with the said middle portion of the said external chamber, an outlet pipe connecting the upper portion of the said external chamber with a second port of the said four-way valve; a pipe connecting a third port of said four-way valve and leading to a stack; a pipe connecting a fourth port of the said valve and leading to a condenser; the said valve being operable to conduct gases from the internal chamber to the stack and simultaneously to conduct oil vapors from the external chamber to the said condenser, and being also operable to conduct oil vapors from the internal chamber to the condenser and simultaneously to conduct gases from the said external chamber to the said stack.

11. In an oil treating apparatus, an internal chamber, an external chamber concentric therewith, means for generating heat in the said chambers, means for feeding oil to the said chambers, means providing an oil spreading surface in said chambers, an eduction pipe leading from each of the said chambers for removal of an aeriform material, means for cutting off the said oil supplying means from the said chambers, and means for regulating the generation of heat in each of the said chambers.

12. In an oil treating apparatus, an internal chamber, an external chamber concentric therewith, filling material within said chambers serving as a distributing means for oil, means for generating heat in the said chambers, means for feeding oil to the said chambers, an eduction pipe leading from each of the said chambers for removal of an aeriform material, means for cutting off the said oil supplying means

from the said chambers, and means for regulating the generation of heat in each of the said chambers.

13. In an oil treating apparatus, an internal chamber, an external chamber concentric therewith, said chambers having oil distributing surfaces therein, means for generating heat in the said chambers, means for feeding oil to the said chambers, an eduction pipe leading from each of the said chambers for removal of an aeriform material, means for cutting off the said oil supplying means from the said chambers, and means for regulating the generation of heat in each of the said chambers.

14. In an oil treating apparatus an internal chamber, an external chamber concentric therewith, heating means for the said chambers, means providing an oil spreading surface in said chambers, oil feeding means leading to the said chambers, eduction pipes connecting with the internal and external chambers and with a four-way valve, a pipe connecting one port of said four-way valve to a stack, a second pipe connecting a second port of the said valve to a condenser, the said four-way valve being operable to lead combustion gases from either the internal or the external chamber to the said stack and simultaneously to lead oil vapors from the external or internal chamber to the said condenser.

centric therewith, heating means for the said chambers, means providing an oil spreading surface in said chambers, oil feeding means leading to the said chambers, eduction pipes connecting with the internal and external chambers and with a four-way valve, a pipe connecting one port of said four-way valve to a stack, a second pipe connecting a second port of the said valve to a condenser, the said four-way valve being operable to lead combustion gases from either the internal or the external chamber to the said stack and simultaneously to lead oil vapors from the external or internal chamber to the said condenser.

In testimony whereof I affix my signature.

DAVID E. DAY.