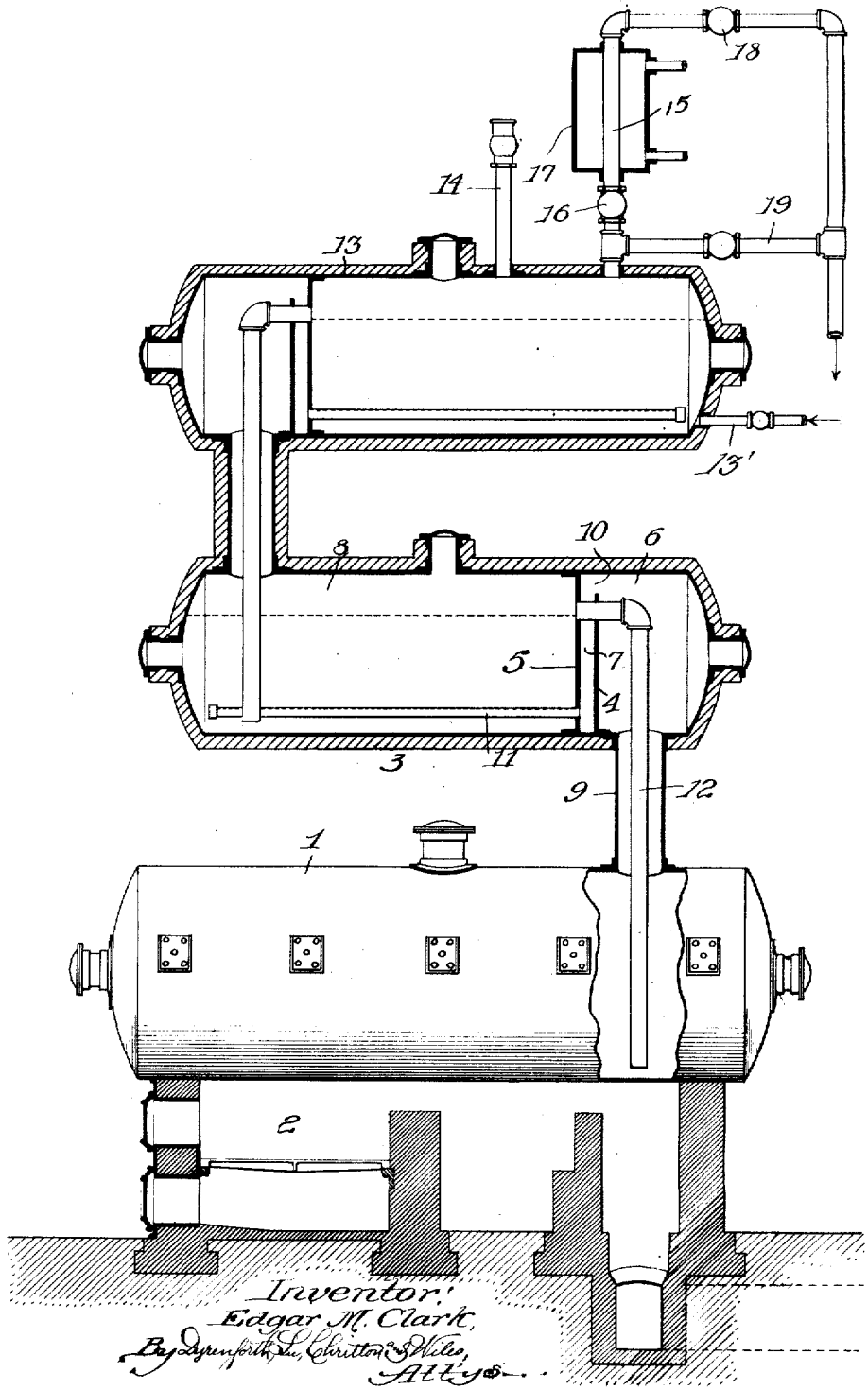
March 30, 1926. 1,578,802

E. M. CLARK

PYROGENESIS OF PETROLEUM

Filed July 3, 1919



Patented Mar. 30, 1926. 1,578,802

UNITED STATES PATENT OFFICE.

EDGAR MILTON CLARK, OF NEW YORK, N. Y., ASSIGNOR TO STANDARD DEVELOPMENT COMPANY, A CORPORATION OF DELAWARE.

PYROGENESIS OF PETROLEUM.

Application filed July 3, 1919. Serial No. 308,644.

To all whom it may concern:

Be it known that I, EDGAR MILTON CLARK, a citizen of the United States, residing at New York city, in the county of New York and State of New York, have invented a new and useful Improvement in Pyrogenesis of Petroleum, of which the following is a specification.

The present invention relates to the pyrogenesis of petroleum and will be fully understood from the following specification taken in connection with the accompanying drawing which illustrates diagrammatically and in vertical section a form of apparatus suitable for the practice of the invention.

Referring more particularly to this drawing, the numeral 1 designates a horizontal cylindrical digester capable of withstanding a considerable pressure. This digester is arranged to be heated by a furnace 2 located beneath the same, according to the ordinary fashion of boiler construction. Superimposed upon the digester 1 there is a displacement receptacle 3 in the form of a horizontal cylindrical drum having a pair of transverse heads 4 and 5 near one end, thus dividing the drum into chambers 6, 7 and 8. The chamber 6 directly communicates with the digester 1 by a conduit 9. The chamber 7 is in communication with the chamber 6 through an orifice 10 in the upper portion of the head 5. A series of horizontal perforated pipes 11 let into the lower portion of the head 5 form communication between the chamber 7 and the chamber 8. Direct communication between the chamber 8 and the digester 1 is formed by a conduit 12 which passes through the head 4 and is fastened into the head 5. This conduit 12 extends centrally through the communication conduit 9 and terminates near the bottom of the digester 1.

Superimposed upon the first displacement drum 3 there is a second displacement drum 13 identical in construction with the drum 3 and bearing to the latter the same relationship which the drum 3 bears to the digester 1. A safety valve 14 is located on top of the displacement drum 13. There is also a vertical vapor pipe 15 controlled by a valve 16 connected with the top of the drum 13, this pipe having a water jacket 17, so that it may serve as a reflux condenser. A valve 18 is located at the top of the jacketed section of the pipe. A valved by-pass 19 joins the base of the pipe 15 with the downturned extension thereof which leads to the condenser, the latter not being shown. The detailed construction of the displacement drums 3 and 13 is illustrated and described in my prior application, Serial No. 286,263, filed March 31, 1919.

In the practice of the present invention the apparatus above described is operated in the following manner:

A charge of heavy petroleum oils, for example, the cut or fraction known to the trade as fuel oil or gas oil, and boiling between 500 and 700° F. or thereabouts, is pumped into the upper drum 13, as by the feed pipe 13′ shown as entering the same. When the level of liquid in this drum reaches the overflow conduit thereof, the infed oil will pass downwardly into the lower displacement drum 3, will fill the latter up to the overflow connection 12 thereof, and by this means enter and fill the digester 1 up to the predetermined level, for example, three-fourths of the vertical height of this digester. The capacities of the digester and drums 3 and 13 may be as follows—13,000 gallons for the digester and 6,000 gallons each for the drums 3 and 13. The apparatus having been charged with oil as described, the furnace 2 is fired and the contents of the digester 1 thereby heated. Preferably the valve in the by-pass 19 will be left open during the initial heating of the apparatus, in order that air or other dissolved gas driven out of the oil by the initial heating thereof, as well as any traces of water which may be present, may be freely driven off. The furnace-fire is preferably so regulated that the contents of the drums 3 and 13 become heated simultaneously with the heating of the digester itself, although of course these drums will lag behind the digester in temperature to a very considerable extent.

When the temperature in the digester has reached approximately 500° F., the displacement drum 3 being at that time at or about 350° F. and the drum 13 at or about 200° F., the valve in the line 19 is closed and the firing of the digester 1 continued at a more rapid rate. As the temperature within this digester increases, decomposition of the oil contained therein begins and the lighter fractions resulting from such pyrogenesis begin to pass out of the digester

1 as vapors to an increasing extent. These vapors issuing from the digester pass through the body of oil in the first displacement drum 3 and to a large extent are condensed therein. The lighter constituents of the vapors which may escape condensation in the drum 3 pass upwardly into the drum 13 and are there condensed by contact with the liquid body of oil in that drum. The condensation of vapors within the drums 3 and 13 tends to add to the liquid volume in these drums and thus by displacement serves to cause the liquid to drain from the drum 13 into the drum 3 and from the latter back to the digester 1.

When the temperature reaches approximately 750° F. in the digester 1, the fires in the furnace 2 are regulated so as to cause no further increase in temperature, and the apparatus comes to its stable condition, the vapors being continuously formed in the digester 1 passing out of the latter to be condensed in the drums 3 and 13 and thus by displacement causing the contents of these drums to overflow back into the digester. During this stable condition the temperature of the drum 3 may be 600° F. and the drum 13 450° F. These temperatures may be controlled by controlling the cooling of the surfaces of the drums, as by partially or wholly lagging them with insulating material.

As the operation of pyrogenesis proceeds, there will be formed a considerable quantity of permanent gas which will accumulate within the apparatus and continously raise the pressure therein. Since this gas, however, tends to concentrate itself in the upper drum 13 which is relatively cool, the rise in pressure is not nearly so marked as in the use of a simple digester. When the pressure has reached the limit for which the apparatus is designed, for example, 300 pounds per square inch, the operation may be discontinued by ceasing to fire the furnace 2.

An examination of the contents of the displacement drums and of the digester will then show that an exceedingly high proportion of the contents of the upper drum 13 will consist of petroleum hydrocarbons boiling below 450° F., that is hydrocarbons suitable for use as motor fuel. A somewhat lower percentage of such low-boiling-point constituents will be found in the drum 3, while the digester 1 will contain only a relatively small proportion of low-boiling-point hydrocarbons. For example, the digester may contain seven per cent of hydrocarbons boiling below 450° F., the drum 3 may contain 30 per cent, and the drum 13 60 to 70 per cent of such low-boiling-point constituents.

According to the above described method of operation, I find it possible to obtain a considerable and substantial conversion of heavy petroleum oil, such as the fuel oil described, into gasoline within a closed system in which nothing enters or leaves the system during the process. I further find that it is possible to attain a considerably higher percentage of conversion than by the use of the known digesting processes without resorting to impractical pressures.

As a variant of the above-described digestion process I may open the valve 16, and release gases from the apparatus through the valve 18, either intermittently or continously. By reason of the water jacket surrounding the pipe 15, the latter will be maintained at a low temperature, thus effecting the condensation of substantially all condensable constituents entering the pipe. If the valve 18 be opened only intermittently, or to a small extent, therefore, the major portion of the permanent gases accumulating in the drum 13 as the operation of cracking proceeds may be released without carrying away any substantial quantity of condensable hydrocarbons. In this manner the digestion process may be carried out under a relatively low pressure, thus avoiding the greatest objection to the practical use of this process for cracking operations conducted on a large scale.

It will likewise be apparent that the process of digesting with simultaneous release of permanent gases through a reflux condenser, as above described, is capable of merging into a distillation process. Thus as the valve 18 is opened more widely, the percentage of condensable hydrocarbons issuing from the pipe 15 with the permanent gases increases progressively, owing to the heating of the surfaces of the pipe, and unless the condensing capacity of the pipe be very great it will be possible to take off through it substantially a light distillate mixed with permanent gases. Should it be desired to obtain a heavier distillate the flow of cooling water to the jacket 17 may be reduced or stopped, or vapors may be discharged directly from the drum 13 by opening the valve in the by-pass 19.

If it is desired to employ the digesting apparatus as a still to fractionate off the lighter components of the charge at the end of the digesting operation, this may be done as described above, the distillation being effected in part by the superheat of the oil body confined under pressure, supplemented by continued firing as the pressure falls off. If it is desired to cause the digesting process itself to merge into a pressure distillation process, it will be apparent that vapors may only be released and condensed at such a rate as to permit the maintenance of the required pressure within the apparatus. This control of pressure may be effected by

regulating the valves 18 or 19, as the case may be, or by operating the condenser, into which the pipe 15 discharges, under pressure as described in the patent to William M. Burton 1,049,667, controlling the pressure in such case by control of the escape of incondensable gas from the condenser, as is fully described in the said patent.

While I have described in considerable detail one specific embodiment of my invention, together with some variants thereof, it will be understood this is illustrative only and that the invention is not limited to the details set forth, except in so far as the latter form a part of the accompanying claims, in which it is my intention to claim all novelty inherent in the invention, as broadly as is permissible in view of the prior art.

What I claim as new and desire to secure by Letters Patent is:

1. The process of digesting petroleum oils for the pyrogenesis thereof which consists in confining under pressure two separated bodies of relatively heavy oil within a digester, applying heat to one of said oil bodies, taking vapors from the latter over into the second body, abstracting heat from said last named body to cause condensation of the vapors of the desired products of pyrogenesis therein, and feeding to the first named body the oil displaced by vapor condensation in the second body, continuing the said operation until said second named body becomes of substantially lower boiling point than said first named body, whereby a substantial conversion may be effected without distillation and at a relatively low pressure.

2. The process of digesting petroleum oil for the pyrogenesis thereof which consists in confining under pressure a series of separated bodies of relatively heavy oil, applying heat to only one of said bodies at the end of the series, causing the vapors evolved from said body to pass in succession into contact with the remaining oil bodies of the series, said bodies maintained progressively at lower temperatures in the direction of flow of the vapors whereby the desired products of pyrogenesis are condensed in said bodies, causing oil to feed from one oil body to the next in a direction opposite the flow of vapors, and maintaining all of said oil bodies and said vapors under the same pressure substantially above atmospheric.

3. The process of subjecting petroleum oils to pyrogenesis which consists in heating a body of relatively heavy oil to a decomposing temperature, maintaining such temperature for a sufficient time to effect a substantial conversion of the oil body into lighter hydrocarbons, and relieving the pressure within the apparatus by withdrawing therefrom the generated permanent gases, substantially free of condensable components while maintaining the oil body at decomposition temperatures.

4. The process of subjecting petroleum oils to pyrogenesis which consists in heating a body of relatively heavy oil to a decomposing temperature, permitting the evolved vapors to pass into contact with a separated body of oil maintained at a lower temperature, whereby condensation is effected, feeding to the first oil body the oil displaced by condensate in the second oil body, and regulating the pressure within the whole apparatus by releasing permanent gases substantially free from condensable components from the vapor space above the second oil body through a reflux condenser draining into said second oil body.

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2. The process of digesting petroleum oil for the pyrogenesis thereof which consists in confining under pressure a series of separated bodies of relatively heavy oil, applying heat to only one of said bodies at the end of the series, causing the vapors evolved from said body to pass in succession into contact with the remaining oil bodies of the series, said bodies maintained progressively at lower temperatures in the direction of flow of the vapors whereby the desired products of pyrogenesis are condensed in said bodies, causing oil to feed from one oil body to the next in a direction opposite the flow of vapors, and maintaining all of said oil bodies and said vapors under the same pressure substantially above atmospheric.

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CERTIFICATE OF CORRECTION.

Patent No. 1,578,802. Granted March 30, 1926, to

EDGAR MILTON CLARK.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, line 68, claim 3, after the word "temperatures" insert the words "and retaining the condensable component in the vapor space of the apparatus"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 6th day of March, A. D. 1928.

M. J. Moore,
Acting Commissioner of Patents.

Seal.

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