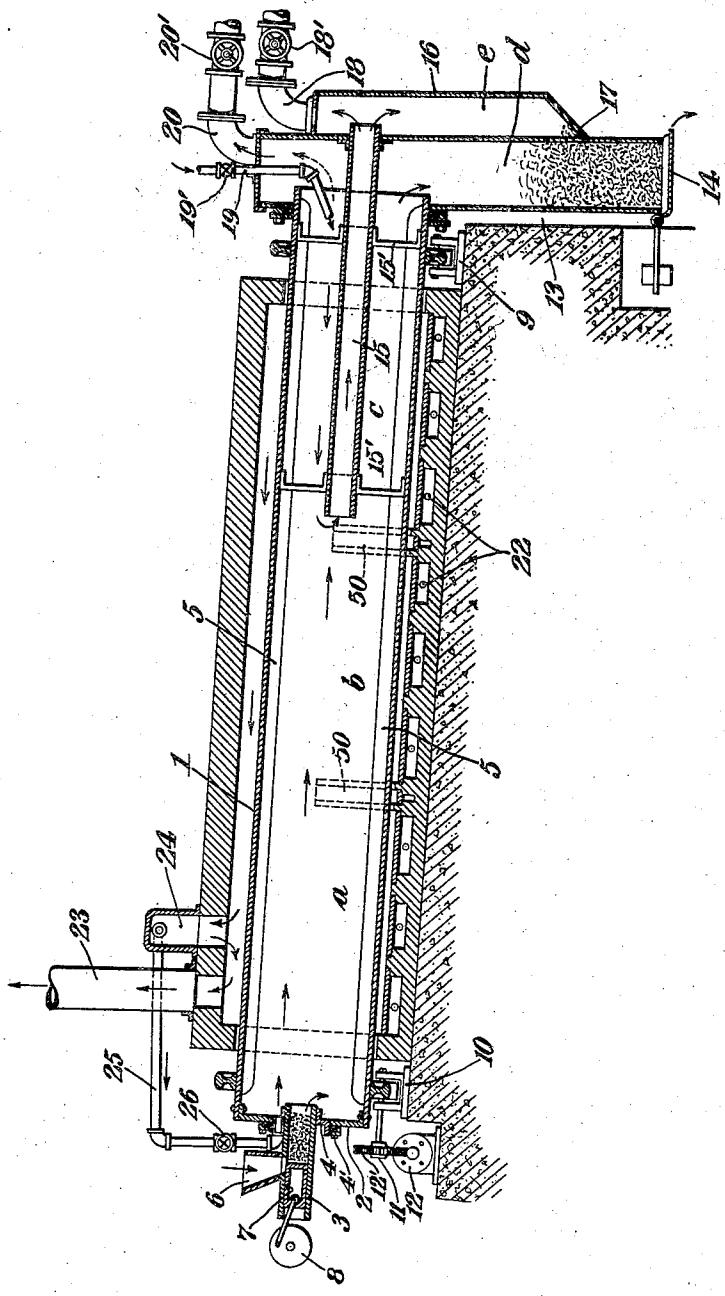
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APPARATUS FOR DISTILLING CARBONACEOUS MATERIAL

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APPARATUS FOR DISTILLING CARBONACEOUS MATERIAL

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7 Claims. (Cl. 202—131)

This invention relates to apparatus for distilling carbonaceous materials and more particularly to the construction of and method of operation of retorts for treating carbonaceous materials.

This application is a division of our co-pending application Serial No. 329,047 filed December 28, 1928 for Method and apparatus for treating carbonaceous material.

In practice, it has been found that in the treatment of carbonaceous materials such as bituminous coal, distilling coal, oil shale, cannel, lignite coal, brown coal, etc., in retorts subjected to heat of uniform intensity or varying intensity, there is a tendency for the material under treatment, when heated, to become agglomerated or caked and to thereby clog the retort to such an extent as to prevent operation of the same. We have discovered that such clogging and agglomeration can be prevented by subjecting the material under treatment to contact with either air or gas from which the oxygen has been removed in the early stages of heat treatment, whereby the material receives a surface similar to a skin hardening.

In our co-pending application Serial Nos. 253,479, filed Feb. 10, 1928 and 299,928, filed Aug. 16, 1928, issued as Patent No. 1,916,900, we have set forth apparatus and method for so treating the material to prevent this agglomeration and clogging, which apparatus and method consists in subjecting the material to air and flue gases at the point of low temperature in the retort and removing the gases from the retort at this point of low temperature to prevent the liability of combustion in portions of a higher temperature. Such a procedure was necessary to prevent the air from passing entirely through the retort.

An object of the present invention is to provide improved means for and method of preventing agglomeration, caking and clogging of material under treatment in a low temperature retort.

A further object of the invention is to provide means for and methods of cracking in the vapor phase hydrocarbon volatiles evolved in low temperature retorts.

A further object of the invention is to provide means for and methods of hydrogenation and cracking in the vapor phase of volatiles evolved at low temperature distillation retorts.

In order that the agglomeration and clogging of materials may be prevented, the present invention provides means for introducing into one end of the retort (the end of low temperature) gases from which the oxygen has been removed, permitting such gases to pass entirely through the retort and be drawn from the same along with the evolved hydrocarbon volatiles. Due to the fact that the oxygen has been removed from the gases before introduction into the retort, the passage of the same therethrough has no tendency to cause or support combustion within the retort. Moreover, in the present invention, apparatus is provided for permitting the evolved hydrocarbon volatiles to be cracked in the vapor phase within the retort itself. Such apparatus consists in a tube extending well into the retort at its point of highest temperature, upon which tube suction may be exerted to cause the removal of such volatiles. Steam may be introduced into the retort in such a location as to be decomposed in the presence of catalyst contained in the material treated, thus releasing hydrogen. This released hydrogen unites with the volatiles cracked in the vapor phase within the retort thereby more fully saturating the hydrocarbon vapors to effect the recovery of a maximum of low boiling point oils.

Other objects, and features of the invention will become apparent by reference to the following detailed description read in the light of the accompanying drawing wherein the figure is a side view in section of a retort embodying the features of the present invention.

Referring now to the drawing 1 indicates an inclined tubular retort rotating upon trunnion wheels mounted in blocks 9 and 10. Power to cause rotation of the shaft is furnished by means of a motor 12, gear 12' and shaft 11, which shaft 11 rotates the trunnion wheel mounted in block 10. To the upper end of retort 1 is affixed a plate 2 which rotates with the tubular retort. Positioned in such a manner that a portion thereof extends within the tubular retort is a feed pipe 3 which has secured thereto a stationary plate 4. In order that the retort at the junction point between the rotatable plate 2 and stationary plate 4 may be air-tight, there is provided a packing ring 4' co-extensive with the outer edge of plate 4. Material to be treated is introduced into a hopper 6 and from this hopper forcibly pushed into the retort by means of the piston 7 actuated by crank 8. Since it is desirable and necessary that the retort be sealed from intake of air and from outlet of vapors, the stroke of the piston 7 is so determined that the end thereof is some distance from the end of the feed tube so that there is always a sufficient quanity of material in the tube between the end of the piston and the discharge end of the tube to seal the retort from intake of air or loss of vapor through hopper 6. Fixed with the tube 1 are a number of angle or

channel irons 5 extending through the entire length of the retort 2 for the purpose of agitating and showering the material under treatment continuously to prevent to some degree the likelihood of the material becoming agglomerated or clogged after the application of heat thereto.

The discharge end of the retort tube 1 is substantially entirely open and leads into a column *d* which is provided with a counter-weighted valve 14 at the bottom thereof. To the top of the column *d* is an outlet pipe 20 provided with a valve 20' which outlet pipe may be connected to a blower (not shown), for the purpose of creating suction in the retort to aid in the removal of gases and volatile material therefrom.

Heat is applied to the retort tube by means of burners 22 of any suitable character designed to aid in the combustion of any desired type of fuel. The furnace surrounding the retort tube 1 is so shaped and designed that the burners are separated into three groups which are designated in the drawing as groups *a*, *b*, and *c*. Such separation is accomplished by means of partition walls 50 which extend around the tube slightly more than one half the diameter thereof. By separating the burners into zones, heat of increasing intensity can be applied to the retort to cause the gradual preheating of material in the low and intermediate temperature zones and complete eduction of volatiles therefrom in the maximum temperature zones.

In order that gases may be introduced into the retort for preventing agglomeration or clogging of the material therein, a head 24 in the nature of a trap is provided in the top of the surrounding walls and from this head or chamber 24 a pipe 25, controlled by valve 26 leads directly into and through the stationary plate 4. The gases which form the product of combustion are air and inflammable material with the air having about four or five times the volume of the remaining material and hence the inert gas is composed principally of nitrogen or nitrogenous gases. The remainder of the inert gas resulting from combustion in the furnace passes from the surrounding chamber through stack 23.

For the purpose of accomplishing cracking of hydrocarbon volatiles in the vapor phase, there is provided within the retort in the zone of highest heat a tubular member 15 secured to the walls of the retort by means of spider-like arrangements 15'. The end of the tubular member 15 removed from the retort proper enters a column *e* having side walls 16 and a sloping bottom so that any spent material discharged from the tube 15 will pass from column *e* through an opening 17 directly into column *d*. To the top of column *e* is connected an outlet pipe 18 controlled by valve 18' and this pipe may be connected to a blower for producing suction, whereby the gases in the retort may be removed from the same through the pipe 15. Steam for aiding the hydrogenation and the cracking of the hydrocarbon volatiles may be introduced into the retort through a pipe 19, controlled by valve 19'.

The operation of the device is substantially as follows:

If it be desired that the gases and volatiles evolved from the application of heat to the material under treatment be withdrawn from the retort without undergoing cracking treatment, the valve 18' is closed and the valve 20' opened. Valve 19' is likewise closed to prevent the entry of steam into the retort. Carbonaceous material is forced into the upper end of the retort by means of the piston 7 and as the tubular member 1 rotates, the material will travel slowly down toward the discharge end due to the slight inclination of the tube and due also to the agitation effected by means of the angle members 5 or channel bars.

Some carbonaceous materials when acted upon by heat tend to agglomerate, that is to coke, and subsequently to clog the retort, the present invention provides an arrangement for overcoming this difficulty. The spent or inert gases from which oxygen has been removed by combustion are introduced into the end of the retort through the pipe 25, such gases having been collected in the head or chamber 24. The passage of these inert gases from which oxygen has been removed serves to cause the formation on the surface of each particle of carbonaceous material, a film in the nature of a skin hardening whereby the particles, which would otherwise stick together, may pass through the retort without clogging the same. These inert gases are withdrawn from the retort through pipe 20 along with the evolved volatiles and can be separated from such volatiles by means of the usual condensing equipment (not shown). It is to be understood in this instance that this method may be advantageously used when a slight dilution of the inert gases driven from the carbonaceous material is not undesirable.

Should it be desired that the volatiles evolved from the carbonaceous material be cracked in the vapor phase, the valve 20' is closed, valve 18' opened and valve 19' opened to introduce steam into the retort. Suction being placed above tube 15, the volatiles in the zone column of highest heat will be sucked into this tube along with the steam and along with fine particles in the form of ash or substance comprising aluminum such as aluminum oxide, aluminum silicate, etc. from the spent oil shales or other carbonaceous material under treatment. These fine particles of ash or substance comprising aluminum act as a catalyst in an incandescent state to decompose part of the steam and to hydrogenate oil vapor. The steam decomposition is assisted by incandescent aluminum-containing particles of or resulting from oil shale or other treated carbonaceous material. By such action, cracking of the hydrocarbon vapors in the vapor phase is accomplished with the recovery of a larger volume of light oils more fully saturated. Such particles of ash or substance comprising aluminum pass through tube 15 due to the rotation of the same along with tube 1 and also to the inclination of tube 15 into the column *e* and thence into column *d* to opening 17. At this point, it should be noted that the counter-weight attached to valve 14 is of such size as to insure a column of distilled residue within column *b* of sufficient height to normally close the opening 17 thereby to prevent the escape of vapors from the retort in the column *e* or from column *e* into the retort. As soon as the column of distilled residue in the chamber *d* reaches a sufficient height, the valve 14 is automatically opened and automatically closed after some of the distilled residue has been discharged.

We claim:

1. Apparatus for distilling solid carbonaceous material, comprising an inclined longitudinally rotatable tubular member, an inlet for carbonaceous material to be distilled, a tubular member of smaller diameter than said first tubular member extending into the outlet end thereof

and held in position spaced from the walls of the first tubular member and having openings adjacent the ends thereof, adjacent columns at the outlet ends of the respective tubular members and adapted to receive solid distilled residue discharged therefrom, said columns being provided with separate gas and vapor outlets, one of said columns having an opening leading into the other above the bottom thereof, and means for maintaining solid distilled residue in the second column to a height sufficient to cover said opening.

2. In apparatus for carbonizing solid carbonaceous material, the combination comprising an inclined tubular retort mounted for rotation about its axis, means for charging material to be carbonized into said retort, a longitudinally rotatable horizontally extending cracking tube which is of smaller diameter than said retort, has an inlet opening adjacent an end thereof intermediate the ends of said retort, has an outlet opening adjacent the other end thereof and is substantially imperforate intermediate said inlet and outlet openings, means for heating said retort to a temperature at which said material will carbonize and evolve vapors therefrom and for heating said cracking tube to a temperature at which said vapors therein will be cracked, and means for withdrawing evolved vapors through said cracking tube and from said retort.

3. An apparatus for carbonizing coking coal and recovering a high percentage of condensable hydrocarbons which comprises a retort, means for charging coking coal into said retort, means for applying heat to said retort in a number of heat zones of different temperature, a cracking tube within the heat zone of highest temperature having one opening communicating with the interior of the retort and another opening communicating with a passage leading to the exterior of said retort and is free of any intermediate opening adapted for admitting a substantial quantity of gases and vapors into said tube, and means for withdrawing vapors evolved during carbonization of said coal in said retort through said cracking tube and passage and recovering the cracked products.

4. Apparatus for carbonizing solid carbonaceous material, which comprises an inclined retort having a tubular casing rotatable about its axis, means for charging material to be carbonized into the higher end of the retort, a tubular member of smaller diameter than said casing, rotatable about the axis of said casing, with openings adjacent the ends thereof, maintained in the outlet end of said casing spaced from the walls thereof, a chamber adapted to receive carbonized residue discharged from the lower end of said casing, a receptacle separated from said chamber adapted to receive solid residue discharged from the lower end of said tubular member, means for controlling the escape of gases and vapors from said chamber, and means for controlling the escape of gases and vapors from said receptacle.

5. In apparatus for distilling solid carbonaceous material having a substantially horizontally extending tubular retort, means for charging material to be distilled at one end of said retort, means for passing said material through said retort, means for withdrawing distilled residue from the other end of said retort, and means for externally heating said retort to distill gases and vapors from said carbonaceous material, the combination comprising a steam inlet for admitting steam into said retort, a substantially horizontally extending cracking tube within the retort having an inlet adapted for the withdrawal of gases, vapors, and steam within the retort from a point intermediate the ends of the retort and substantially spaced therefrom and substantially spaced from said steam inlet; said cracking tube being otherwise substantially imperforate except for an outlet remote from said inlet to said cracking tube, and means for withdrawing said gases, vapors and steam from said retort through said cracking tube.

6. In apparatus for distilling solid carbonaceous material having an externally heated substantially horizontally extending longitudinally rotatable tubular retort, means for charging material to be distilled at one end of said retort, means for passing said material through said retort, means for withdrawing distilled residue from the other end of said retort, and means for heating said retort externally to distill gases and vapors from said carbonaceous material within the retort and for heating the portion of the retort adjacent the discharge end of said retort to a higher temperature than the portion of the retort adjacent the charging end thereof, the combination comprising a steam inlet for admitting steam into said retort adjacent the discharging end of said retort, a substantially horizontally extending longitudinally rotatable cracking tube within said retort extending from a point intermediate the ends of said retort tube through said portion of said retort adjacent the discharge end thereof and adapted to withdraw gases, vapors, and steam within the retort only from a point substantially removed from the ends of said retort and from said steam inlet, and means for withdrawing the gases, vapors, and steam from said retort through said cracking tube, said cracking tube within said retort being adapted to be heated by said external heating means for said retort to a temperature affording cracking of said volatiles in said cracking tube.

7. In apparatus for distilling solid carbonaceous material having an externally heated substantially horizontally extending longitudinally rotatable tubular retort, means for charging material to be distilled at one end of said retort, means for withdrawing distilled residue from the other end of said retort, and means for heating said retort to distill gases and vapors from carbonaceous material within the retort, the combination comprising an inlet for inert gases at one end of said retort, pipe connections extending from the external heating means to the inlet for inert gases, an inlet for steam at the opposite end of said retort, and a longitudinally rotatable substantially horizontally extending cracking tube within the retort adapted for the withdrawal of gases, vapors, and steam from said retort only at a point intermediate said inert gas inlet and said steam inlet and substantially spaced therefrom, and means for withdrawing said gases, vapors, and steam from said retort through said cracking tube.

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