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METHOD OF AND APPARATUS FOR CARBONIZING COAL

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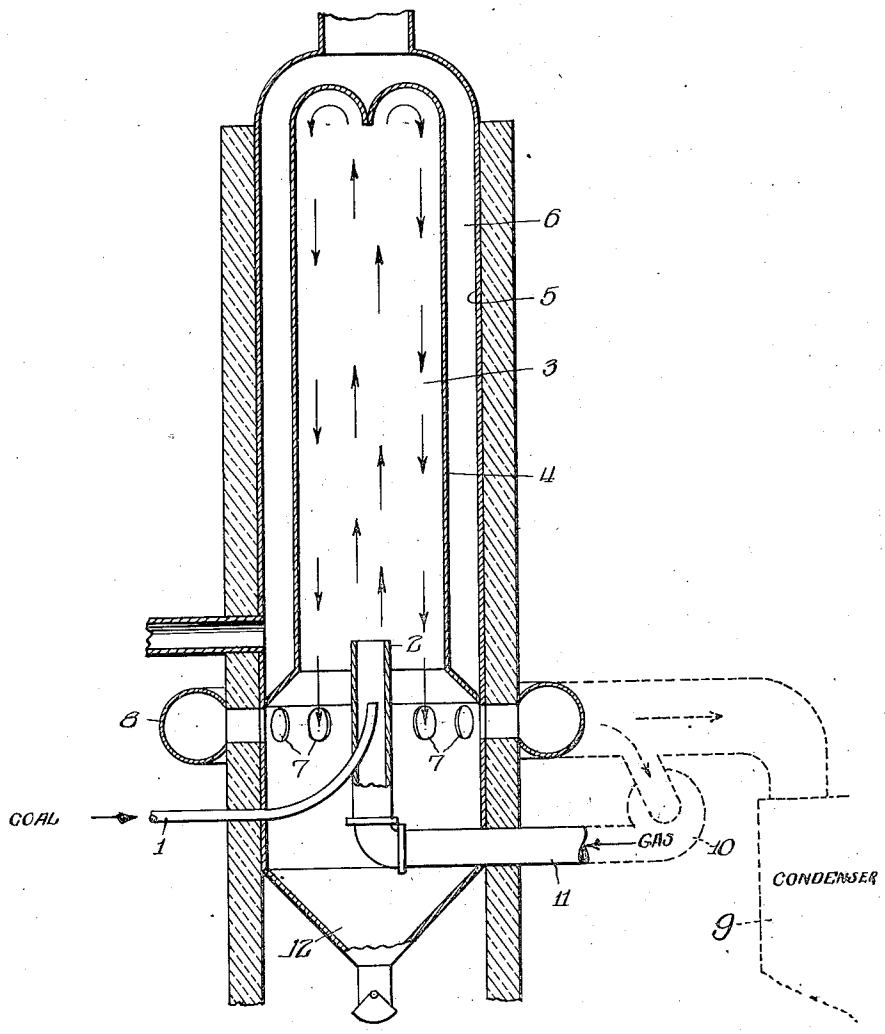

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UNITED STATES PATENT OFFICE

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METHOD OF AND APPARATUS FOR CARBONIZING COAL

Original application filed June 26, 1917, Serial No. 176,948. Divided and this application filed December 30, 1925. Serial No. 73,305.

This application is a division of our application Serial No. 176,948 filed June 26, 1917. The invention herein disclosed has particular reference to the carbonization of coal while in suspension in a heated gaseous medium.

The accompanying drawing is a vertical central sectional view of an apparatus embodying the features of our invention.

The apparatus herein shown is intended for the treatment of coal in a finely divided state. By finely divided coal we mean coal which has been crushed so that no particle will fail to pass through a forty, sixty or eighty- mesh screen for the maximum size; that is to say, a screen having forty, sixty or eighty meshes to the inch, while the minimum size may be infinitesimal, say, capable of passing through a two-hundred-mesh screen or smaller.

We have found that when relatively larger pieces of coal, even of the smaller sizes as prepared for the market, are heated, the oily matters on the outside of the pieces escape as soon as their boiling point is reached, leaving carbonized residue behind. The heat gradually penetrates into the interior of the piece, but the rate of such penetration is very slow, since the coal is not a good conductor of heat in the first place, and in the second place the carbonized residue formed on its exterior is a still poorer conductor. Accordingly such outside portion, from which the vapors have already escaped, becomes highly heated long before the interior of the piece has reached the temperature at which the oily constituents begin to boil off. When the boiling point of these is reached, and they vaporize, before they can escape they must pass through the outer layers of carbonized residue which, as previously stated, are highly heated, in fact are heated by this time above the point at which the vapors in question decompose. The distillation, accordingly, assumes a destructive aspect, such vapors depositing free carbon and yielding a large amount of gas with a corresponding decrease in the yield of valuable oils.

When, however, a finely divided particle of coal of the size prescribed above is heated, practically all parts of such particle are heated at the same time and to the same degree. In fact the degree of fineness is regulated by this consideration, viz., that the particles shall be so small that when exposed to a heating medium the temperature of the entire particle is practically simultaneously raised. Consequently when the boiling point of any oily matters which are contained in the particle is reached, such matters vaporize and go off practically the same as they would if they were in liquid condition at the start. The vapor, moreover, has a free escape from the particle, inasmuch as the latter is so small that it cannot impede such escape.

Accordingly, in dealing with particles of this size, it is possible, by disseminating the same in a heating medium, the temperature of which can be controlled, to keep the temperature of the particles, and thus of the vapors evolved therefrom, below the point at which any destructive distillation will occur; that is, because of the small size and uniformity of heating of the particle, by immersing the same in a completely surrounding and contacting heating medium, we are able to control the degree of heat to exactly that required for the maximum production of oily or other valuable distillation products. At the same time we avoid the premature condensation of these oily vapors, due to their encountering cooler material. The redistillation of such prematurely condensed ingredients results in products that are undesirable, just as does the encounter of the vapors with material that is too highly heated.

The apparatus for crushing the coal into the finely divided state required for use in our process, need not, of course, be described, there being various forms of crushers and grinding mills available for this purpose.

The apparatus shown in the accompanying drawing is adapted for practicing a method of heating finely divided particles of coal by immersing the same in a heated atmosphere, this atmosphere consisting of some suitable gas that will not combine in any way with the coal, namely, a neutral or reducing gas. For this purpose in practice it will be preferable to employ the gas which results from the

retorting of the coal itself, that is, part of the gas produced from the heating of one portion of the coal will be used to heat other coal.

The coal, in finely divided state, is introduced by means of a duct 1, into a current of hot gas that is discharged through a nozzle 2 into the interior of a carbonizing chamber 3, the wall 4 of which is maintained at a temperature somewhat above the boiling point of the vapors which it is desired to extract. Any preferred means may be employed to heat the chamber wall 4, as, for example, by surrounding said chamber by a wall 5 so as to provide between said walls an annular space 6, and supplying a suitable heating medium to said space. The chamber 3 is of sufficient height so that the particles of coal carried upward therein by the current of gas discharged from the nozzle 2 shall remain suspended long enough to be carbonized to the desired extent. The coal-laden stream of gas, after striking the upper end wall of the chamber 3, follows the side walls thereof downwardly, the gas and the vaporized constituents of the coal escaping through apertures 7 into a manifold 8. A portion of the gases and vapors are led to the condensing and distilling apparatus 9 while another portion is withdrawn by a fan 10 and returned through the pipe 11 and nozzle 2 to the chamber 3. The particles of carbonized residue collect in the hopper-like bottom 12 of the chamber 3, from which they may, from time to time, be withdrawn. If desired, a suitable filter, or electrostatic device, for precipitating the residual dust in the gases, may be employed, as need not be described in detail. It will be seen that a portion of the gaseous products travel in a closed circuit.

As hereinbefore stated, the coal is in such a state of subdivision that the particles are heated practically uniformly and instantaneously throughout, there being a free escape for the vapors formed, and the latter being at no time subjected to temperatures higher than their boiling points before escaping from the solid particles. In this way all of the objectionable results attendant upon previous methods of coal distillation are overcome, and a practically complete, or maximum, extraction of volatile constituents is obtained without material alteration in the character of these constituents. There will accordingly be a minimum amount of gas, and a preponderant quantity of liquid obtained by the distillation of the coal in the fashion described.

Other modes of applying the principle of our invention may be employed instead of the one explained, without departing from the scope of the invention as set forth in the appended claims.

We claim as our invention:

1. A process of carbonizing finely subdivided solid carbonizable fuel which comprises suspending the finely subdivided fuel in a gas substantially free from oxygen and at a temperature necessary for carbonization of the fuel, causing the fuel-laden gas and the fuel to travel in an upward direction and then in a counter-direction about the upward stream, then separating the carbonized fuel thus produced from the travelling gaseous products in finely subdivided state after the downward travel, and causing a portion of the said gaseous products to continue to travel in a closed circuit to receive fresh fuel, another portion of the condensible products of carbonization being removed from the apparatus.

2. The process of carbonizing finely divided solid carbonizable fuel which comprises expanding a current of heated gases which will not support combustion into a vertical chamber, causing said current to induce a feed of finely divided coal into said current, causing the fuel laden current to travel upwardly and centrally through said chamber and then downwardly and along the side walls of said chamber, heating the exterior of said chamber to heat the suspended coal particles to a temperature necessary for carbonization, and separating the carbonized fuel thus produced from the traveling gaseous products.

3. In an apparatus for producing carbonized coal in a finely divided state, in combination, a vertical retort closed at its upper end, a heating chamber surrounding said retort, a vertical gas nozzle in the lower end of said retort and opening upwardly, a coal feed duct opening upwardly in said nozzle, means in the upper end of said retort for deflecting an upward current of fuel laden gases, means for receiving carbonized fuel below said nozzle and communicating with said retort at the lower end thereof, and means for drawing off volatilized products from said retort.

4. In an apparatus for producing carbonized coal in a finely divided state, in combination, a vertical carbonizing chamber closed at its upper end, a heating chamber enveloping said carbonizing chamber, the lower end of said carbonizing chamber being formed with a collecting chamber for collecting the carbonized residue, a manifold about said collecting chamber and communicating through peripherally spaced openings with said collecting chamber, a nozzle extending vertically in said collecting chamber and into the lower end of said carbonizing chamber, said nozzle opening upwardly and being connected to said manifold, means for inducing a flow of gas from said manifold to said nozzle, and a fuel supply pipe opening upwardly in said nozzle.

5. In an apparatus for carbonizing coal in a finely divided state, in combination, a vertical carbonizing chamber closed at its upper end, a heating chamber enveloping said car-

bonizing chamber, the lower end of said carbonizing chamber being formed with a collecting chamber for collecting the carbonized residue, a manifold about said collecting chamber, said manifold communicating through peripherally spaced openings with said collecting chamber, means for withdrawing volatilized products from said manifold, a gas nozzle extending vertically in said collecting chamber and into the lower end of said carbonizing chamber, said gas nozzle opening upwardly, and a fuel supply pipe opening upwardly in said nozzle.

In testimony whereof we have hereunto affixed our signatures.

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