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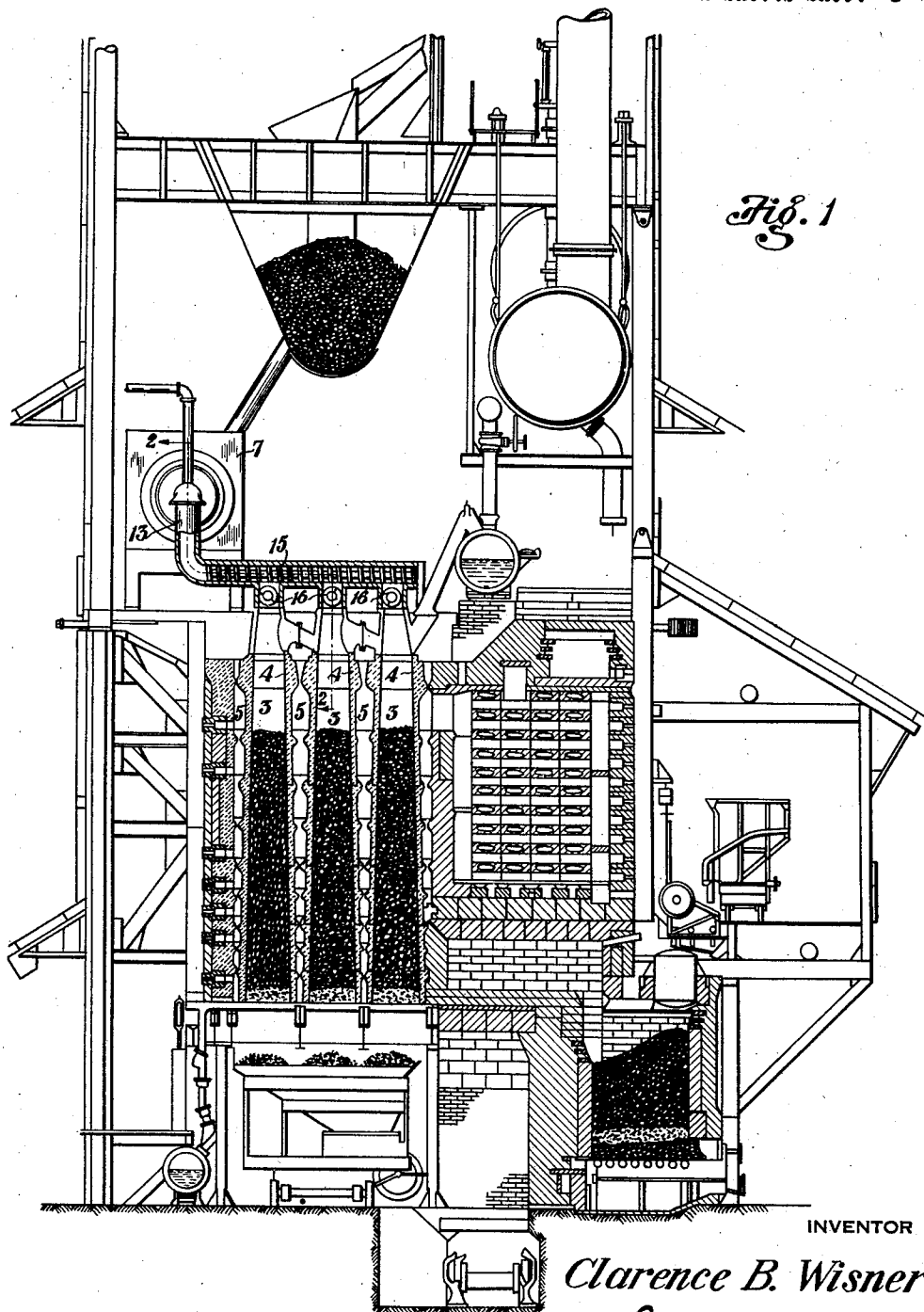
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CARBONIZING AND COKING PROCESS

Filed July 13, 1928

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

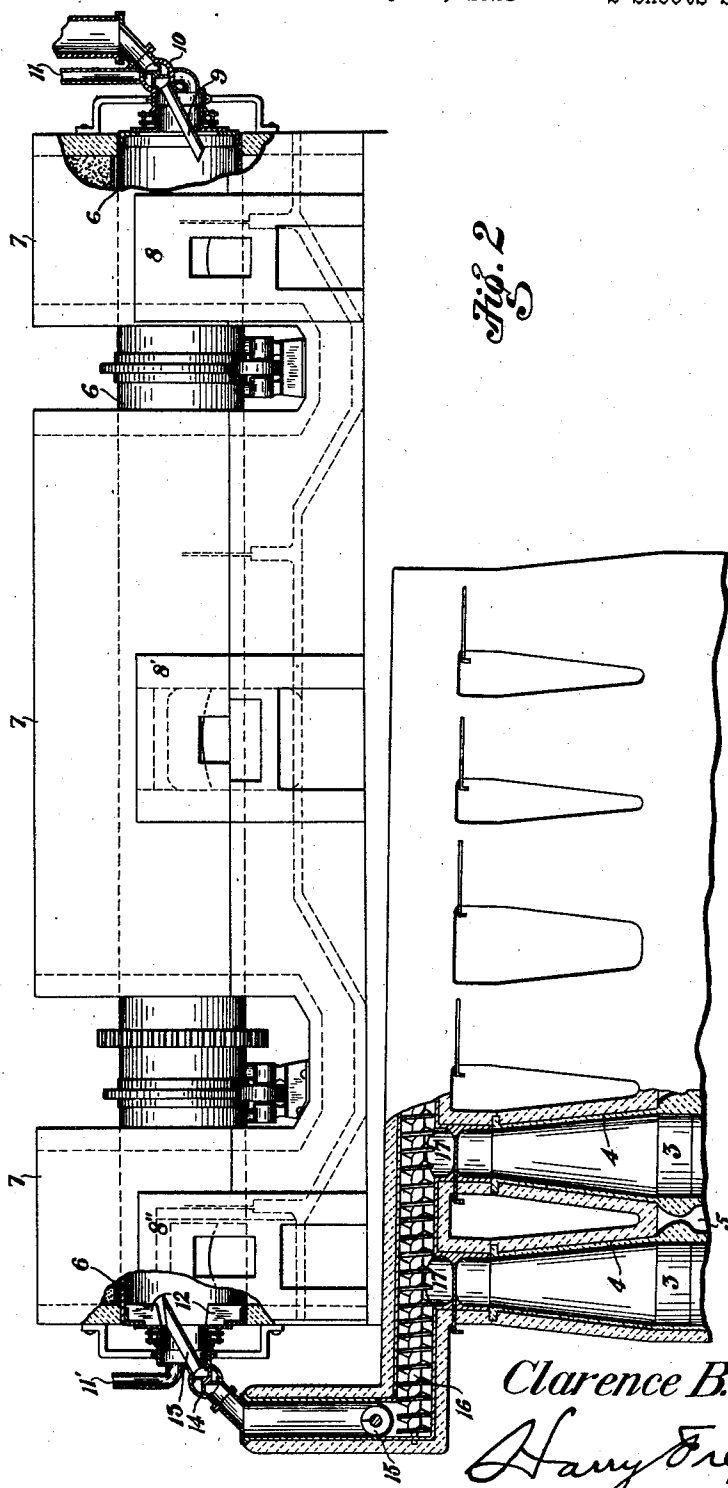


Fig. 2

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CARBONIZING AND COKING PROCESS

Application filed July 13, 1928. Serial No. 292,485.

This application is a continuation of the common subject matter in my pending application, filed April 27, 1923, Serial No. 635,024, for By-product coking processes.

5 The invention may apply to the coking of high volatile coal in a by-product retort wherein the necessary temperature for the coking process has heretofore required the walls of the retort to be maintained at a tem-
10 perature of some 2000° F., for a period of from eleven to thirty hours; and one object of the improvement is to reduce the temperature required in the walls of the retort, and another, the time required to complete the
15 coking process.

It is customary in the manufacture of by-product coke to carry the heat of the walls of the retort at about 2000° F., and at the completion of the process, the heat in the center
20 of the charge approaches 1750° F. It is well known that a good coke can be made at a heat within the charge of less than 1500° F.; and it has been found that if the charge is preheated so that advantage can be taken of the
25 heat of formation resulting from the chemical reactions during the intumescent stage of carbonization, a good metallurgic coke can be made at a temperature much less than is usually employed.

30 That is to say, by preheating the charge to a temperature somewhat below the critical point at which hydrocarbon vapors begin to form, holding such a temperature for a substantial time to temper the charge, and then
35 conveying the charge through a heat retaining conveyer to a retort having its walls heated at a sufficient temperature to quicken the eduction of volatile hydrocarbon products, and taking advantage of the heat of the reacting
40 chemicals, usually known as the heat of formation, the walls of the retort need not be carried at such a high heat, and the period required for coking the coal is materially reduced, because when the charge is intro-
45 duced into the retort it has been uniformly heated to a point near below the critical temperature, and less heat and less time are required for completing the coking process.

And again, as the coking proceeds from the
50 periphery to the center of the retort by the

older methods, the hydrocarbons produced by the peripheral coal passes to the center and are condensed upon the cooler coal there located, and must necessarily be revaporized
55 several times before reaching the top of the furnace; which difficulty is avoided by the present improvement, because the preheating of the incoming charge prevents any considerable condensation of the hydrocarbon vapors arising from the coking of the coal in
60 the retort, thereby avoiding the revaporizing of the hydrocarbons during the coking process; because the preheating has been carried so near to the dew point of the educed vapors as to render negligible any condensa-
65 tion which may result from high boiling hydrocarbons.

It is evident that the benefits of preheating solid fuel are not limited to the coking
70 of coal or to the carbonization of the same at high temperatures, because when any solid volatile fuel is prepared for thermal chemical decomposition, by preheating and tempering it as herein described, and then transferring
75 it to an oven or retort for the process of coking or carbonization, the preheating and tempering of the coal not only shortens the coking cycle, but lessens the swelling and produces a heavier and denser coke, reduces
80 the amount of over-done coke lying against the walls and makes a more uniform product; and renders it possible to coke certain types of coals which will not make a satisfactory coke without being modified by such a pre-
85 heating and tempering process.

In my Patent No. 1,490,357, I describe a preheating step in which the heating is done in an oxidizing atmosphere, air being drawn
90 countercurrent to the coal through and over it. That method of treating many coals is beneficial to subsequent carbonization in which chemical characteristics of the coal may be and probably are changed slightly by chemical actions started by oxidation, but
95 not given time to react.

There are other coals, when coked alone or blended for coking, in which such an oxidation is not beneficial, but in which it is desired to quicken carbonization by heating it
100 in a closed container up to near the softening

point of the coal and holding it at such temperature for a time before charging it into ovens or retorts, which may be referred to as a tempering of the coal, and may be done without affecting the chemical characteristics of the by-products.

I have found that by rapidly and uniformly heating coal to and then holding it from ten minutes to approximately forty-five minutes at a substantially constant temperature preferably of not less than 350° or more than 450° F., depending upon the character of the particular coal, it is brought to and maintained in a nascent condition in which the coal is susceptible of a thermal tempering; and without undertaking to explain just how such tempering occurs, it may be and probably is because of the presence of contained oxygen in the coal, which may supply enough oxygen for tempering the coal in a neutral atmosphere, if sufficient time is given therefor; it being understood that time as well as temperature are important for accomplishing the tempering modification to which I have given the name of thermodizing.

The improved process may be carried out by the apparatus illustrated in the accompanying drawings, forming a part hereof, in which—

Figure 1 is an elevation section of a well known apparatus for a by-product coking process showing an end view of the thermodizing apparatus; and

Fig. 2, a section on line 2—2, Fig. 1, showing a side elevation of the thermodizing apparatus.

Similar numerals refer to similar parts throughout the drawings.

A well known form of apparatus for the by-product coking of coal includes a plurality of tubular vertical retorts 3, tapered from a smaller upper end to a larger lower end, and having refractory walls 4 around and among which flues 5 are provided for conducting heating gases so as to heat the walls of the retorts to some 2000° F., which temperature has heretofore been found necessary or desirable for properly coking the coal fed into the retorts.

Coal is preferably crushed to a size for passing through a quarter inch screen, and is then fed into the upper end of the retorts, the lower ends of which may be intermittently closed and opened, so that when the contents thereof have been properly coked the same may be discharged downward and additional coal or another charge may be fed into the top of the retort.

For the purpose of the present improvements, a preheating container may be located at one side of and above the coking retorts or ovens, and may comprise a rotatable steel-plate tube 6 mounted in a masonry housing 7 provided with combustion cham-

bers 8, 8' and 8'' so as to uniformly heat the container throughout its length.

Coal may be fed into one end of the container by means of a chute 9 controlled by a gas tight valve 10, and an outlet pipe 11 may lead into the open for discharging water vapors formed in this tube.

The tubular container is slightly inclined downward from its inlet to its outlet end wherein may be provided a series of flights 12 forming pockets for carrying the coal upward and dropping it upon the inner end of an outlet chute 13 for discharging the coal through a gas tight valve 14 into a screw conveyer 15 extending across one end of the series of retorts, and the discharge end of the container may be provided with an outlet pipe 11' for discharging water vapors formed in the tube.

The coal is advanced in the tubular container by the rotation thereof and during this operation it is also agitated by a tumbling action as it rises with the wall of the container and falls inward therefrom; so as to rapidly and uniformly heat and temper the coal by the extraneous heat received through the wall of the container, in which it is maintained at the desired temperature during the desired period of time.

Underneath the conveyer 15 may be located a series of charging conveyers 16, one extending along the upper ends of each row of retorts, each retort being provided with a valve inlet opening 17 so that coal delivered by the heating apparatus may be charged at will into any one of the retorts; the conveyers and the receiving ends of the retorts being preferably surrounded with suitable heat resisting material, so as to maintain the temperature of the coal as it is delivered from the thermodizing container.

It is preferred to hold the heat in the coal, during a period of from ten to approximately forty-five minutes at a substantially constant temperature between 350° F. to 450° F., depending upon the character of the particular coal under treatment, the same being near to but substantially below the critical temperature, so as to preheat the coal without volatilizing any of the hydrocarbons contained therein; and the container is preferably closed to exclude the air, so as to prevent such an oxidation of the coal as will destroy or unduly reduce its coking qualities.

The improved method of coking may be used for preparing high volatile coals for low temperature carbonization as well as for by-product coking; and it consists essentially in a thermal conditioning or tempering of the coal before it is charged into the carbonizing retort or coking oven.

The beneficial results of the improved processing, which I have termed thermodizing, include a shorter coking cycle; the produc-

tion of a heavier and denser coke from certain types of coal by reason of the reduced swelling of the coal while in the pasty stage; a more rapid heating and a shorter time in the by-product oven, which reduces the overdone coke lying against the hot walls and makes a more uniform product; and brings into the class of coking coal some types of fuel which are not included in that class because of the present unnecessarily long by-product coking cycle.

It is well known to coal chemists that when finely divided high volatile coals are uniformly heated up to 350° F., there occurs an exothermic reaction in which a very small amount of CO is driven off.

I have discovered that from this point up to 450° F., the coking condition of the coal may be improved by holding it at such temperature from ten minutes to forty-five minutes, for which purpose some types of coal require a strong oxidizing atmospheric condition within the thermodizing retort, while other types of coal, which have a high oxygen content, are improved by a neutral atmospheric condition within the retort.

At 450° F. the thermal treatment may be completed, and the improved coal may be ready for the carbonizing or coking retort; but it has been found beneficial to drive as much heat as possible into the coal before charging it to the retorts, so that the temperature in the coal is preferably allowed to rise close to, but not to, the critical temperature at which hydrocarbon vapors may be detected by a strong tar odor or the driving off of white smoke, but the coal must not be carried to a point at which its coking quality will be damaged.

What the critical temperature is will vary considerably with each type of coal, and for many types of coal it is assumed to be about 300° C., or 572° F. For the purpose of illustration, two types of coal may be cited.

Indiana coal No. 5, when heated to 580° F., will begin to give off hydrocarbon vapor, and the end point of the tar vapors, that is, the temperature at which the liquid tar stops, will be about 850° F. This coal is classed as a non-coking coal and when coked by usual methods, it swells like popcorn and the residual coke weighs about twenty pounds to the cubic foot; but dense strong coal balls weighing twenty-seven pounds to the cubic foot may be made of this coal by thermodizing it in a neutral atmosphere, according to the method set forth in my application filed August 7, 1926, Serial No. 127,942; and a similar increase in density and weight results when this coal is thermodized and coked in a by-product oven, in which case the coking time is reduced some thirty percent and the capacity of the oven increased correspondingly.

Pittsburgh No. 8 coal, which is a standard

coking coal, has a higher temperature at which the vapors begin, the same being about 660° F., while the tar end point approximates 900° F., and for this reason, it is usual to mix other coals with it for coking, because of its excessive binder, and because in the plastic stage of low temperature carbonization it sticks to the retort and is unmanageable. Thermodizing in a neutral atmosphere corrects this fault and improves the coke product made from such coal.

Rapid and uniform heating up to from 350° F. to 450° F. and holding the fuel at a substantially constant temperature within that range during a predetermined time of from ten minutes to approximately forty-five minutes; together with an accurate control of temperature at which the fuel is maintained, are important conditions for a successful thermodizing of the coal before carbonizing or coking the same; and for this reason, the improved process consists of two parts: First—thermodizing in a rotating container, and second—carbonizing or coking in another container, in which the charge may be tumbled or remain quiescent.

In my said Patent No. 1,490,357 is described a dual process in which the thermodizing is done in a current of air, while in this application is described more definitely the temperatures at which and between which, and the time during which thermodizing of some types of coal may be accomplished, in a neutral atmosphere.

The drawings and description herein illustrate thermodizing as applied to by-product vertical gas retorts. Its application to other types of carbonization retorts and coke ovens is identical except as to means for conveying the thermodized coal from the thermodizing retort to the second container in which the process is completed, which will vary to meet the individual conditions.

I claim:

1. The method of carbonizing coal which includes tumbling crushed pieces of coal in a closed container while rapidly and uniformly heating the coal therein to a substantially constant temperature between 350° F. and substantially below the point at which substantial formation of volatile hydrocarbons by heat decomposition of said coal begins, holding the coal at said substantially constant temperature substantially out of contact with air for approximately forty-five minutes to modify its coking quality to a substantial extent, and then carbonizing the modified coal.

2. The method of preparing coal for carbonization which includes the step of tumbling crushed pieces of coal in a closed container while rapidly and uniformly heating the coal therein to a substantially constant temperature between 350° F. and substantially below the point at which substantial

formation of volatile hydrocarbons by heat decomposition of said coal begins, and holding the coal at said substantially constant temperature substantially out of contact with
5 air for approximately forty-five minutes to modify its coking quality to a substantial extent.

3. The method of carbonizing coal which includes tumbling crushed pieces of coal in
10 a closed container while rapidly and uniformly heating the coal therein to a substantially constant temperature between 350° F. and substantially below the point at which
15 substantial formation of volatile hydrocarbons by heat decomposition of said coal begins, holding the coal at said substantially constant temperature substantially out of contact with air for approximately forty-five minutes to modify its coking quality to
20 a substantial extent, and then carbonizing the modified coal while it is maintained in a quiescent condition.

4. The method of preparing coal for carbonization which includes the step of tumbling the finely crushed coal through a closed
25 container while rapidly and uniformly heating the coal to a substantially constant temperature between 350° F. and 450° F., and holding it at said substantially constant temperature for approximately forty-five minutes, to modify and improve the coal for
30 carbonization.

5. The method of carbonizing high volatile coals which includes the step of tumbling
35 the finely crushed coal through a closed container while rapidly and uniformly heating the coal to a substantially constant temperature between 350° F. and 450° F., and holding it at said substantially constant temperature for approximately forty-five minutes, to
40 modify and improve the coal for carbonization, and then carbonizing the modified coal.

6. The method of coking coal which includes the step of tumbling finely crushed
45 coal through a closed container while rapidly and uniformly heating the coal to a substantially constant temperature between 350° F. and 450° F., and holding it at said substantially constant temperature for approximately
50 forty-five minutes, to modify and improve the coal for coking, and then coking the modified coal in a quiescent condition.

In testimony that I claim the above, I
have hereunto subscribed my name.

55 CLARENCE B. WISNER.