

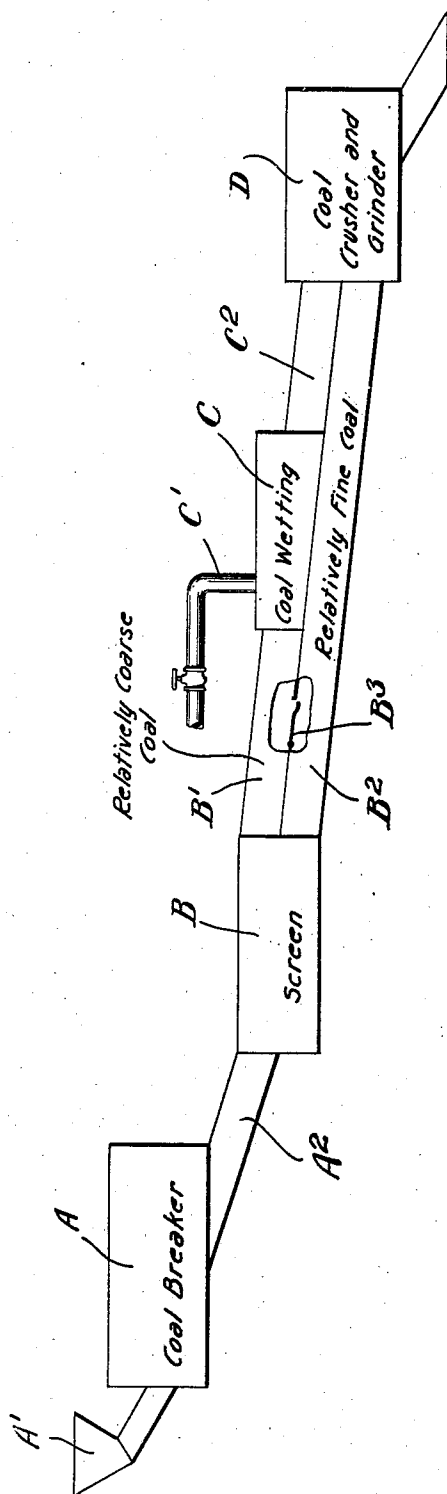
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PREPARING COAL FOR CONVERSION INTO METALLURGICAL COKE

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PREPARING COAL FOR CONVERSION INTO
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The present invention comprises improvements in the preparation of coal for conversion into metallurgical coke. At the present time substantially all metallurgical coke produced in this country is formed by coking dry, unwashed, comminuted coal, in coking chambers or retorts into which the coal is charged while in its dry condition, in which it has a moisture content of less than three per cent, and ordinarily after it has been subjected to a crushing or breaking operation of such character that seventy to eighty per cent of the coal will pass through a screen having openings three millimeters square, and not more than about thirty to forty per cent of the coal will pass through a screen having openings two millimeters square. One object of the present invention is to provide a simple and effective method of giving a substantial moisture content to comminuted coal to be coked, said method being useful in preparing high volatile coal and low volatile coal for coking. Another and important object of the invention is to provide an improved method of preparing low volatile expanding coal for retort coking.

I have discovered that in producing metallurgical coke from low volatile coals known as expanding coals, it is advantageous to depart from the usual practice in preparing such coals for coking by increasing the fineness of the coal and by suitably wetting the coal. When prepared for coking in accordance with the present invention, a low volatile, expanding coal cokes with little or none of the swelling which is characteristic of the coking of such a coal when prepared for coking in the ordinary manner. In consequence of the wetness of the finely divided coal, the distillation gases formed in the coking operation do not carry objectionably large amounts of coal dust out of the coking chamber and into the associated gas collecting apparatus, as they would do if dry, unwashed coal were similarly sub-divided, but not wetted, before being charged into the coking chamber.

In my preferred method of preparing unwashed, expanding coal for conversion into metallurgical coke, I subject the coal to a crushing or breaking action effective to reduce the coal to such fineness that about seventy per cent of the coal will pass through a screen having apertures two millimeters square, and wet the coal by thoroughly mixing with the coal enough water to give the coal a moisture content of not less than about six per cent. The moisture content of the coal may be made considerably greater than the minimum of about six per cent needed

to prevent the distillation gases from sweeping an objectionable amount of coal dust out of the coking chamber, without giving rise to seriously objectionable consequences. However, the addition of water to the coal in amounts sufficient to give the coal a moisture content in excess of about eleven per cent will increase the carbonization heat per pound of coal required, and will create some risk of injurious contact with the hot coking chamber walls of water oozing out of the coal charged into the coking chamber.

A mass of finely sub-divided coal will hold a greater volume of water than a mass of coal less finely divided, and in practice it is difficult to uniformly wet coal as finely divided as is the expanding coal prepared for oven charging in accordance with the present invention by directly adding to it the amount of water needed to give it a moisture content of from six to eleven per cent. In the preferred form of the present invention, I wet and subdivide the coal by the following procedure; namely, I screen the dry coal, after it has been subjected to a crushing or breaking operation effective to reduce the coal to such fineness that something like half of the coal will pass through a screen having apertures two millimeters square, to separate the particles of coal too coarse to pass through said screen from the finer coal particles, and then add to all or a portion of the coarser particles of coal the amount of water needed to increase the moisture content of the total mass of coal to its desired value of not less than about six per cent and usually not greater than about eleven per cent. After the coarser coal particles are thus wetted, I mix them with the finer coal particles separated from the coarser particles in the screening operation, and further sub-divide the coal in the mixture by a grinding and crushing action which reduces the coal to the desired final degree of fineness and which distributes the water carried into the mixture by the coarser coal particles with suitable uniformity throughout the sub-divided coal mass.

In adding the water to the coarser coal particles and then increasing the fineness of the coal and distributing the added water throughout the coal mass by a crushing and grinding operation, I take advantage of the fact that it is comparatively easy to effect a suitably uniform distribution of the water through the final, finely sub-divided mass of coal, by transferring moisture from the coarser, wetted particles to the dry, finer particles in the course of said crushing and grinding operation, whereas it is difficult to

directly add a small amount of water to, and distribute it with the desired uniformity throughout a mass of finely divided coal particles.

I have also discovered that in preparing dry, unwashed, high volatile, non-expanding coal for conversion into metallurgical coke, it is practically desirable to add water to the coal in amounts sufficient to increase its moisture content to from about six to nine per cent, as this permits the time required for coking coal charged into a coking chamber to be reduced without giving rise to the formation of graphite deposits on the coking chamber walls.

As those skilled in the art understand, a reduction in the time taken in coking coal of any particular composition and condition requires an increase in the temperature of the coking chamber heating walls, and in coking high volatile, dry coal prepared for coking in the usual manner, any increase in the heating wall temperature above its customary value tends to the deposit on the coking chamber walls of carbon in the form of graphite cracked out of the distillation products evolved from the coal. The removal of such graphite deposits is troublesome, and they not only interfere with the discharge of the finished coke, but decrease the effective heat conductivity of the coking chamber heating walls and thereby increase the carbonization heat per pound of coal required and prevent the reduction in the time required for coking a charge from being as great as it otherwise would be. The addition of water to the dry, high volatile coal has the effect of reducing the maximum distillation gas temperatures and of increasing the amount of steam in the distillation gases and minimizes the said tendency of an increase in coking chamber wall temperatures to result in graphite deposits on the furnace chamber walls. Furthermore, an increase in the moisture content of the coal up to or slightly above nine per cent will not significantly increase the carbonization heat required per pound of coal, since such an amount of water will be vaporized by heat which is abstracted from the distillation gases, and which, but for such vaporizing action and the resultant cooling effect on the distillation gases, would be carried out of the coking chamber as sensible heat in the gases.

In preparing high volatile, non-expanding coal for coking in accordance with the present invention, it is not necessary to sub-divide the coal more finely than has heretofore been customary and in some cases it is practically possible to add the water needed to bring the moisture content of such coal up to nine per cent or so without following the preferred procedure hereinbefore described of preparing low volatile, expanding coal for coking by adding water directly to coarser coal particles and then mixing said particles with finer coal particles and crushing and grinding the mixture. Such preferred procedure may advantageously be employed in many cases, however, in preparing high volatile, non-expanding coals for coking in accordance with the present invention.

The use of the present invention has important practical advantages. For one thing, it permits of a substantial reduction in the time required to coke a high volatile, non-expanding coal charge. For example, in coking such a coal charge in a coking chamber having an average width of seventeen and three-quarter inches, the minimum coking time heretofore customary in this country is about sixteen hours. In using the same oven in coking the same coal, when the latter is prepared for coking in accordance with the present inven-

tion, the coking time may well be not more than about thirteen hours. The use of the present invention in preparing low volatile, expanding coals for coking not only eliminates difficulties otherwise experienced in discharging coke from the oven chambers in which it is formed, but also materially reduces the maximum stresses to which coking chamber walls are subjected by the charge during the coking and coke removing operations, when the charge is formed of low volatile, expanding coal prepared for coking in the usual manner.

In the one figure of the accompanying drawing, I have diagrammatically illustrated, by way of example, one form of apparatus adapted for use in the practice of the present invention, though those skilled in the art will understand that the invention may be carried out by the use of apparatus of very different form.

In the drawing, A represents an initial coal breaker or grinding machine which may be of any usual form adapted to sub-divide run-of-the-mine coal into particles about half of which will, and about half of which will not, pass through a screen having openings two or three millimeters square. The coal breaker A receives run-of-the-mine coal through an inlet chute A' and discharges broken coal through an outlet A². The latter leads to the inlet of a coal screening device B having an outlet B' for the coarser coal particles which will not pass a screen having apertures two or three millimeters square, and having a separate outlet B² for coal fine enough to pass said screen. The coal discharged through the outlet B' passes into a coal wetting device C having an inlet C' through which water is passed into admixture with the entering coal at a suitably regulated rate and having an outlet C² leading to a coal crushing and grinding device D, which also receives the finer coal discharged from the screen device through the outlet B².

The crushing and grinding device D suitably increases the fineness of the coal and effects a suitably uniform mixture of the wetted coal received from the outlet C² of the coal moistener with the finer coal received through the outlet B² of the coal moistener device B. The device D may well be a hammer mill of usual form, or it may be any other usual or suitable coal disintegrator, adapted to effect the desired sub-division of the coal and distribution throughout the sub-divided coal of the water on the coal particles received from the coal wetting device C. To insure that the amount of coal passing through the coal moistener will not be too large to be properly wetted in the moistener C, an adjustable diverter switch B³ may be provided to pass more or less of the coal received by the outlet B' away from the device C and into the outlet B².

As is well known to those skilled in the art, metallurgical coke needs to have a relatively strong structure such as can be obtained by so-called high temperature carbonization in which the coke formed attains a temperature of the order of 1800° F. or above. Such structural strength is not obtained by so-called low-temperature carbonization of coal in which the maximum temperature of the coke or "char" produced is of the order of 900-1000° F. In preparing high volatile, non-expanding coal in accordance with the present invention for conversion into metallurgical coke I may in some cases advantageously increase the structural strength of the coke formed by adding to the coal one per cent or so of a suitable, inorganic, binder material, such as

clay which may be mixed with the water added to the coal to give the latter the desired moisture content.

While in accordance with the provisions of the statutes, I have illustrated and described the best form of embodiment of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit of my invention, as set forth in the appended claims and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. The method of preparing dry, crushed coal for conversion into metallurgical coke by high temperature carbonization, which consists in separating the coal into two portions, one of which contains relatively coarse particles and is sufficiently large to hold the amount of water needed to increase the average moisture content of said coal portions to not less than about six per cent and not more than about eleven percent, and the second of which portions contains relatively fine particles, adding said amount of water to

the said portion of the coal containing relatively coarse particles, and mixing the two coal portions and increasing the fineness of the mixture by a crushing and grinding action.

2. The method specified in claim 1 in which the coal mixture subjected to the said crushing and grinding action is thereby reduced to such fineness that not less than about seventy per cent of the coal will pass through a screen having apertures two millimeters square.

3. The method of preparing dry, crushed, low volatile, expanding coal for conversion into metallurgical coke by high temperature carbonization, which consists in separating the coal into two portions, one of which contains relatively coarse particles and is sufficiently large to hold the amount of water needed to increase the average moisture content of said coal portions to not less than about six per cent and not more than about eleven percent, and the second of which portions contains relatively fine particles, adding said amount of water to said one portion of the coal, and mixing the two coal portions by a crushing and grinding action and thereby so increasing the fineness of the mixture, that about seventy per cent of the coal will pass through a screen having two millimeters square.

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