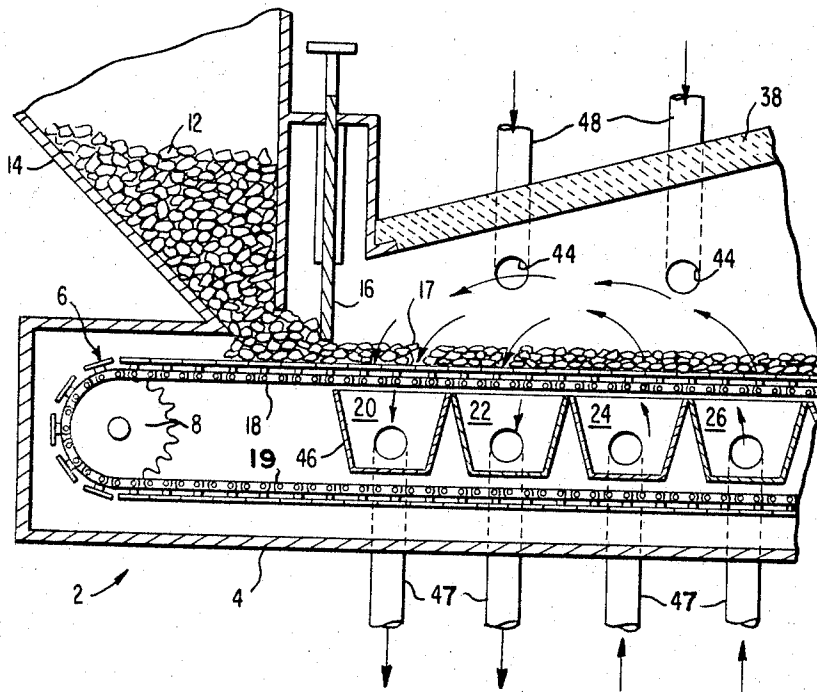
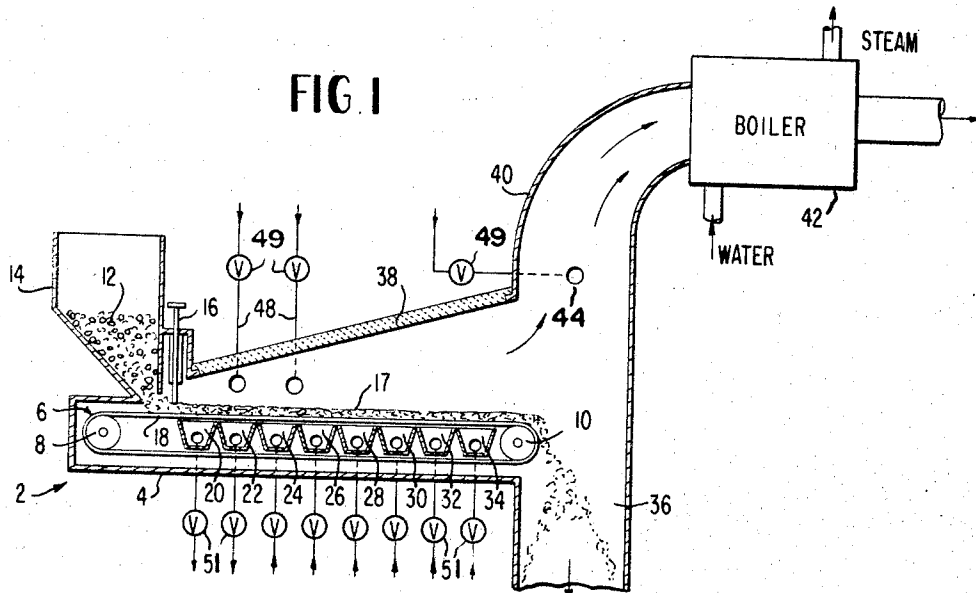


March 25, 1969

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METHOD FOR PRODUCING HIGH YIELD COKE BY
DOWNDRAFTING OF HOT GASES
Filed Aug. 5, 1966

3,434,933



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METHOD FOR PRODUCING HIGH YIELD COKE BY DOWNDRAFTING OF HOT GASES

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Filed Aug. 5, 1966, Ser. No. 570,466

Int. Cl. C10b 47/26

U.S. Cl. 201—32

4 Claims

ABSTRACT OF THE DISCLOSURE

A bed of green coal is fed horizontally through a hot coking furnace from the front end to the rear end thereof. Air is fed upwardly through the bed towards the rear end of the furnace and hot gases are downdrafted through the bed towards the front end of the furnace to create a vertical temperature gradient which gasifies tarry constituents in the upper portion of the bed and deposits them on the coal in the lower portion of the bed.

This invention relates to a method for producing coke and heat from coal on a chain grate furnace and, more particularly, to a method whereby tarry constituents are driven from some of the coal as it travels along a chain grate and redeposited on a coal layer adjacent the grate and near the input end of the furnace so that the redeposited tar will become carbonized as it proceeds through the furnace.

The subject method, save for the novel step herein-after disclosed, operates generally along the lines of those disclosed in my prior Patents Nos. 2,997,426; 3,013,951; 3,146,175 and 3,167,487 and the references cited therein. In particular, unpreheated coal at ambient temperatures below 100° F. is spread to form a bed on a chain grate and fed thereon through a hot carbonizing furnace and dropped into a retort at the output end of the furnace. As the coal enters the hot furnace, a portion of it at the upper surface of the bed ignites, and as the bed progresses through the furnace, it passes over successive zones of a zoned airbox, air is fed through the coal and the depth of ignition progresses downwardly until all or almost all of the entire thickness of the bed is incandescent, at about 1850° F. for hotter, by the time the coal drops off the output end of the chain grate. Overfire air may be introduced over the bed to produce certain desired effects, such as radiant heating of the coal.

In the prior art it has heretofore been the practice to downdraft some or all of the air box zones so as to draw off gaseous combustion byproducts, either for product recovery externally of the furnace or for recirculation through the coal in other regions of the furnace. Downdrafting through the bed as it passes over one or more initial airbox zones, i.e., those nearest the input end of the furnace, tends to increase the rate of ignition penetration, and it is in this region that the more volatile constituents, particularly the heavy tars, can be drawn off. In my prior Patent No. 3,167,487, initial air-box zones were downdrafted, the gases, consisting largely of tars in gaseous phase, were withdrawn and fed externally of the furnace through cool coal in a preheater so that the tars condensed upon the cool coal in the preheater and the temperature of the coal in the preheater was raised. However, the downdrafting was necessarily of sufficient volume so that the temperature of the gases withdrawn through the initial airbox zones was above their dew points.

In the present method, one or two initial airbox zones are downdrafted with sufficient volume of hot coal gas

passing through the coal to raise the temperature of the coal at and near the upper surface of the bed to gasify the heavy tarry constituents of the coal, but not enough to raise the temperature of the coal lying immediately above the grate, i.e., a layer about four inches thick, above the dew point of the tar. The coal occupying the bottom inch or so of the bed is heated by the grate to about 100° F. Assuming the bed to be about ten inches deep, the coal at and adjacent the upper surface of the bed, in the region overlying the first one or two airbox zones, will be at about 650° F. to 1000° F., this temperature decreasing in downward progression so that the bottom inch layer of coal is at about 100° F. The coal in the lower four inches or so adjacent the grate thus acts as a cool filter for the downdrafted gases so that the tarry constituents which have been driven in gaseous phase from the coal in the hot upper layers are condensed on the relatively cool coal on and adjacent the grate. If enough more hot coal gas is downdrafted so as to raise the temperature of the coal in about the bottom four inches of the bed above the dew point of the tars, then the tars will condense and solidify on the grate and clog it so that insufficient air is able to pass through it as the grate proceeds over subsequent airbox zones. If less than enough coal gas is downdrafted to raise the top six inches or so of coal to above about 320° F., then an inappreciable amount of tars will be gasified and driven from the coal.

These and other objects will be apparent from the following specification and drawings, in which:

FIG. 1 is a diagrammatic vertical cross-section through a carbonizing furnace in which the subject method is practiced; and,

FIG. 2 is an enlarged fragment of FIG. 1 showing the critical features of the method.

In the following example it will be assumed that the coal input to the furnace is West Kentucky No. 11 seam, sized from fines up to about 1½", and that it contains about 14% tar liquids. "Tar liquids," as herein used, means that volatile constituents of the coal which is solid at about 170° F. and below, is liquid at from about 180° F. to about 320° F., and which becomes gaseous at about 320° F. and above.

Referring first to FIG. 1, there is shown a chain grate furnace 2 having a lower enclosure 4 in which runs a chain grate 6 running over sprockets 8 and 10 which are driven by a suitable source of power. Coal 12 at ambient temperature is fed in through a hopper 14 and spread by a gate 16 so as to form a bed 17 of preferably about ten inches on the upper run 18 of the chain grate. Between upper grate run 18 and lower grate run 19 are airbox zones, for example, eight in number, and designated 20-34, inclusive. When bed 17 enters the hot pretreatment furnace, the coal spontaneously ignites along the upper surface of the bed and since grate 6 is hot, the bottom inch or so of coal in the bed is immediately heated to about 100° F. As the bed progresses through the furnace at the rate of about 50-70 feet per hour, ignition creeps downwardly so that all or nearly all of the entire thickness of the bed becomes incandescent, and the then carbonized coal, or coke, drops off the output end of the chain grate into a retort 36, in which it forms a slowly downward moving stack. Leading from the upper furnace enclosure 38 is a flue 40 which feeds hot gaseous byproducts through a boiler 42. Flue 40 may lead either from the rear end of the furnace as shown, or from the front part. Overfire air ports 44, supplied by conduits 48 controlled by valves 49, are provided both for starting up and for creating a fireball above the bed. Airbox zones 20-34 are defined by individual airboxes 46 (FIG. 2) to and from which lead airpipes 47 con-

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trolled by suitable valves 51. The pipes leading to the airbox zones which feed air upwardly through the bed are connected to a conventional plenum chamber not shown, and the pipes leading from the zones via which air is to be downdrafted through the bed are connected to a conventional vacuum or less-than-atmospheric pressure chamber, not shown. A total of about 1 lb. of air per 1 lb. of coal is fed upwardly through the bed via zones 24-34, inclusive.

Referring particularly to FIG. 2, it will be apparent that initial zones 20 and 22 are downdrafted, i.e., zones 20 and 22 are connected to a source of suction so that hot gases issuing upwardly from zones 24, 26 and, to lesser extent, subsequent zones 28-34, is drawn downwardly through bed 17. This, broadly, is not novel, but the novel and critical feature is the amount of hot coal gas downdrafted through the coal passing over these initial airbox zones. The quantity of gas withdrawn from zone 20 and/or zone 22 will vary primarily according to bed width and thickness and grate speed, but the essential criteria are as follows: there must be enough downdraft so that the coal temperature at the top surface of a ten inch thick bed is at least 1000° F., the temperature ranging downward to about 170° F. about one inch above the grate, and throughout the bottom inch layer of coal on the grate and temperature should not exceed about 170° F. and they preferably are between 100° F. and about 170° F. The essential action is that some of the hot gases, at about 1000° F. issuing upwardly from the coal as the latter passes over zone 24 and beyond are pulled downwardly through the coal passing over zones 22 and 24. Tars are driven from about the top six inches of the coal in the bed and condensed on the bottom four inches. The condensed tar, as it progresses on through the furnace, is carbonized and thus adds to the yield of coke.

I claim:

1. The method of treating carbonizable material containing appreciable volatile matter including tarry constituents which are solid at about 170° F. and below, liquid at from about 180° F. to about 320° F. and gaseous at about 320° F. and above, which comprises:

forming a bed of the carbonizable material at least several inches deep and horizontally passing the bed through a hot carbonizer furnace from an input end to an output end thereof so as to form a first bed portion contiguous to the input end of the furnace

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and an adjacent second bed portion which lies contiguous to the output end of the furnace;

feeding air upwardly through the second bed portion in limited quantities sufficient to react with the carbonizable material sufficient to produce in the furnace above the second bed portion hot coal gas at a temperature in excess of 1000° F. and downdrafting through the first bed portion from above the second bed portion part of said hot coal gas and creating with the downdrafted gas a heat gradient in the first bed portion ranging from about 650° F. to 1000° F. at the upper surface of said first bed portion to no more than from 100° F. to 170° F. at one inch above the bottom of the bed and below and thereby gasifying said tarry constituents in that part of the first bed portion which lies at and extends downwardly for part of the bed depth from the upper surface thereof and which is at about 320° F. and above, liquefying said tarry constituents in a vertically intermediate part of the first bed portion which is between about 320° F. and about 180° F., and drawing down and depositing the gasified and liquefied tarry constituents in the lower part of the first bed portion which is at no higher temperature than from about 170° F. to about 100° F.

2. The method recited in claim 1, wherein the quantity of air fed upwardly through the second bed portion is about one pound of air per pound of coal fed through the furnace.

3. The method recited in claim 1, the bed so formed being about ten inches deep.

4. The method recited in claim 1, wherein the coal is initially at ambient temperature and the bed is formed on a chain grate.

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U.S. Cl. X.R.

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