June 16, 1931. C. HAYES 1,810,828

METHOD OF CARBONIZING COAL

Filed May 16, 1927 2 Sheets-Sheet 1

Fig. 1.

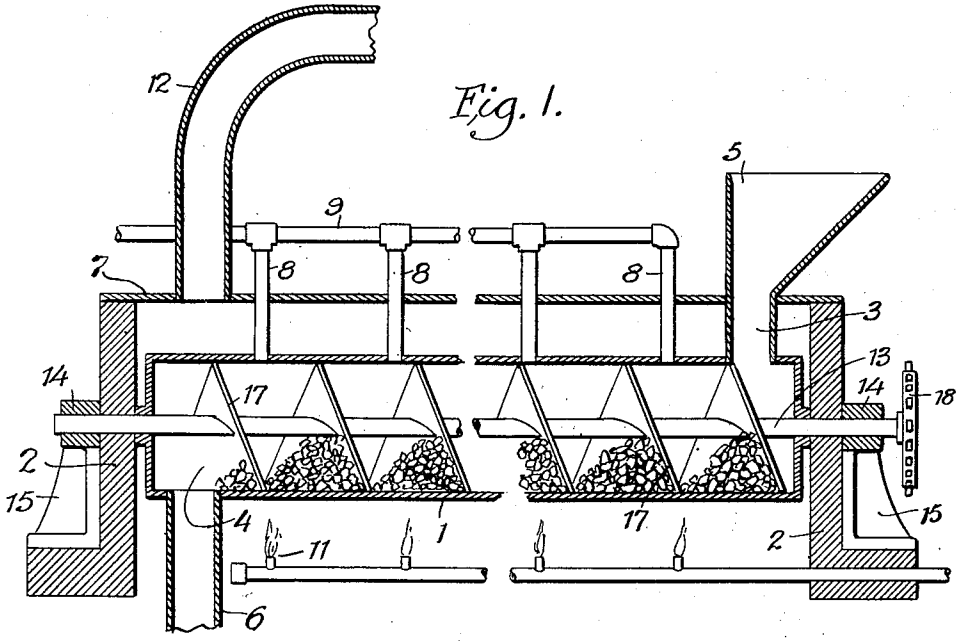


Fig. 2.

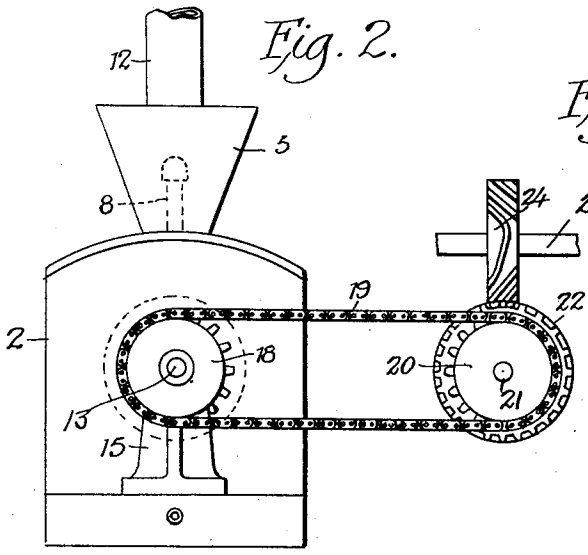
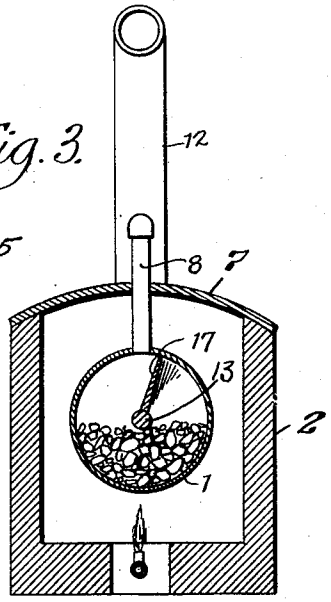


Fig. 3.



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June 16, 1931. C. HAYES 1,810,828

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Filed May 16, 1927 2 Sheets-Sheet 2

Fig. 4.

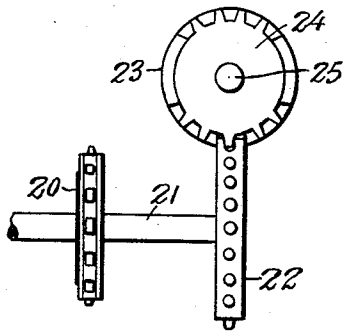


Fig. 5.

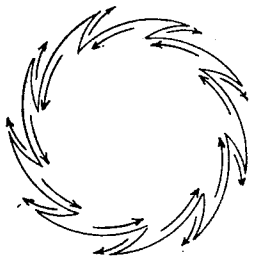


Fig. 6.

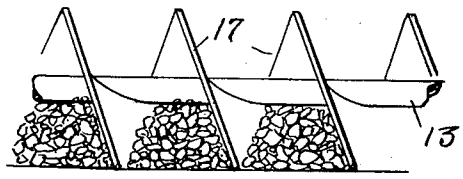
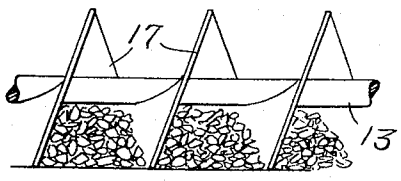


Fig. 7.



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UNITED STATES PATENT OFFICE

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METHOD OF CARBONIZING COAL

Application filed May 16, 1927. Serial No. 191,877.

My invention relates to low temperature carbonization of coal, that is, the treatment of bituminous coal or other coal or carbonaceous material rich in volatiles to drive off the volatiles at a temperature not sufficiently above the boiling points of the volatiles to cause these volatiles to be converted into permanent gas, and to leave the carbon of the coal free or nearly free from volatiles, the aim of the lower temperature carbonization process being the elimination of volatiles as condensable vapors and the production of char resembling coke and capable of use as a fuel either as it comes from the retort or compressed into briquettes.

While the lighter volatiles may be readily driven off more or less completely at a low temperature the higher temperature necessary to drive off the volatiles of higher boiling point tends to break up the lighter volatiles into fixed gas. And as the coal is softened by continued heat its particles tend to stick together in a mass and to hold onto the volatiles of higher boiling points making it necessary to either use higher heat or to leave such volatiles in the char.

I have discovered that by agitating the coal, opening it up to provide free escape for volatiles and drawing off the volatiles as formed I am able to extract the volatiles, including those of relatively high boiling points to a nearly complete extent without the use of heat high enough to cause the lighter volatiles to be converted into gas.

With this object in view my invention consists in the method hereinafter described and claimed.

Referring to the drawings which are illustrative only of apparatus adapted to carry out my method and are not intended to restrict the invention to the use of the apparatus shown and described or to any particular apparatus.

Figure 1 is a central, vertical, longitudinal, sectional view of apparatus adapted for carrying out my invention;

Figure 2 is an end view of the apparatus shown in Figure 1;

Figure 3 is a vertical cross sectional view of Figure 1;

Figure 4 is a detail view of the reversing gear;

Figure 5 is a diagrammatic view indicating the movement imparted to the screw conveyor;

Figure 6 is a fragmentary, longitudinal, sectional view of the retort showing the effect upon the body of coal the advancing movement of the screw conveyor, and

Figure 7 is a similar view showing the effect of the reverse movement of the screw conveyor.

In the drawings 1 indicates a retort suitably supported at its ends in brickwork 2 and having inlet opening 3 for the coal to be carbonized at one end and outlet opening 4 at the other end for discharging the residue remaining after the volatiles, commonly known as char, have been driven off. A hopper 5 is connected with the inlet opening 3 and a pipe 6 leads downward from outlet 4 to a suitable receptacle (not shown). Above the retort is a top plate 7, which with the brick-work 2 forms an enclosing chamber for the retort, this top plate being, if preferred, of brick continuous with the sides and ends of the chamber which while conveniently formed of brick may be of any heat resisting material.

The retort may be conveniently formed of iron or steel pipe one foot in diameter and about twenty feet long but need not be of any particular diameter or length provided only that its length is sufficiently greater than its diameter to provide for a considerable travel of the coal being treated. From the upper part of the retort pipes 8 lead to a manifold 9 for drawing off the volatiles driven off from the coal by the heat of the retort. 10 indicates the means for heating the retort, here shown as a pipe leading from a suitable supply of fuel or gas and provided with suitable burners 11. A pipe 12 leads from the combustion chamber for escape of products of combustion to a stack (not shown) or to the atmosphere.

Centrally through the retort extends a shaft 13 supported at its ends in bearings 14 carried by suitable supports 15. On this shaft within the retort is carried a screw con-

veyor 16 having a diameter nearly that of the interior of the retort and so arranged that when rotated in one direction its vanes 17 will push the coal towards the discharge opening 4 and rotated in the other direction will push it backward toward the inlet opening 3.

On one end of the shaft 13 is a sprocket wheel 18 which, through sprocket chain 19, is driven by sprocket wheel 20 carried on shaft 21 which also carries gear 22, the teeth of which are engaged by fins 23 on reversing gear 24 mounted on shaft 25 driven by any suitable source of power. These fins 23 of this reversing gear are so arranged as to impart to the gear 22 and through it to sprocket wheel 20, sprocket wheel 18 and shaft 13 of the screw conveyor movement of rotation first in one direction through a predetermined arc, preferably less than a complete rotation, and then in the other direction through an arc of considerably less than the arc of the first movement.

In carrying out the method of my invention, the retort being heated to a temperature preferably from 350 C. to 450 C., that is, within the temperature commonly used in low temperature carbonization, the coal is introduced from hopper 5 through inlet 3 and, the shaft 13 being rotated, is moved by the vanes 17 of the screw conveyor towards the discharge opening 4. The coal is introduced in quantity only sufficient to fill the retort to materially less than full capacity, preferably only to fill it to about the level of the shaft 13, so as to leave ample space above the body of coal for the volatiles driven off to pass off freely and to be drawn off by the pipes 8 and manifold 9. As the screw conveyor is rotated in a direction to advance the coal towards the outlet opening 4 it will cause the coal to pile up forward of the vanes 17 as indicated in Figure 6 and when rotated in the other direction, will cause the coal to be drawn back from the piles and to be piled up in rear of the vanes as indicated in Figure 7. The screw conveyor being rotated through a greater arc in the direction calculated to move the coal towards the discharge opening than in the reverse direction, the body of coal will be eventually moved to the discharge opening. The rotation of the screw conveyor in alternate direction tends to agitate the body of coal and to turn or tumble the particles of coal over one another, to open up the body of coal so as to permit free escape of volatiles, and to bring all particles of the coal into contact with the heated walls of the retort. This alternate movement also prevents any of the coal softened by the heat of the retort from sticking to the walls of the retort or other surfaces.

A further and important result of the alternate forward movement and rearward movement is that the actual movement of the body of coal within the retort and subjected to its heat being the sum of its forward and rearward movement may thus be several times the distance between the inlet and discharge openings, thus making it possible to secure in a retort of limited length the effective heat treatment which with continuous forward movement would require a retort of such great length that it would be difficult to heat evenly through its length and difficult to keep in line.

The retort being only about half filled with coal ample space is left above the coal for the volatiles to collect and be drawn off by pipes 8 and manifold 9 as rapidly as they are set free from the coal.

The coal introduced from hopper 5 is preferably finely divided. As it is advanced within the heated retort and the lighter volatiles are driven off by the heat of the retort the coal is softened and is reluctant to part with the volatiles of higher boiling point and unless the body of softened coal is agitated and opened up it is difficult to extract these volatiles without the use of excessive heat. By the movement above described this reluctance is overcome and the volatiles of higher boiling points may be extracted to any extent desired, provided, of course, that the temperature of the retort is as high as or slightly higher than the boiling points of the volatiles to be eliminated.

Having thus described my invention, what I claim is:

1. The process of carbonizing coal which comprises forming a body of coal in a stationary horizontal retort on the bottom thereof, in quantity insufficient to fill said retort so that there is a free space in said retort above said body of coal, carbonizing said body of coal in said retort while transferring said body of coal along said retort on said bottom by alternately advancing said body of coal along said retort a distance that is materially shorter than half the length of said retort and retracting said body of coal a distance that is less than the first said distance, heat being applied to said coal from the bottom of the retort during the carbonization.

2. The process of carbonizing coal which comprises forming a body of coal in a stationary horizontal retort on the bottom thereof, in quantity insufficient to fill said retort so that there is a free space in said retort above said body of coal, carbonizing said body of coal in said retort while transferring said body of coal along said retort on said bottom by alternately advancing said body of coal along said retort a distance that is materially shorter than half the length of said retort and retracting said body of coal a distance that is less than the first said distance so as to agitate the body of coal and open it up to facilitate the escape of vola-

tiles into the space above it and to prevent the coal softened by the heat from adhering to the walls of the retort, heat being applied to said coal from the bottom of the retort during the carbonization.

3. The process of carbonizing coal which comprises forming a body of coal in a stationary horizontal retort on the bottom thereof, in quantity insufficient to fill said retort so that there is a free space in said retort above said body of coal, carbonizing said body of coal in said retort while transferring said body of coal along said retort on said bottom by alternately advancing said body of coal along said retort a distance that is materially shorter than half the length of said retort and retracting said body of coal a distance that is less than the first said distance so that the aggregate distance travelled by any particular portion of the body of coal along the bottom of the retort exceeds the length of the retort.

In testimony whereof, I hereunto affix my signature.

CHARLES HAYES.