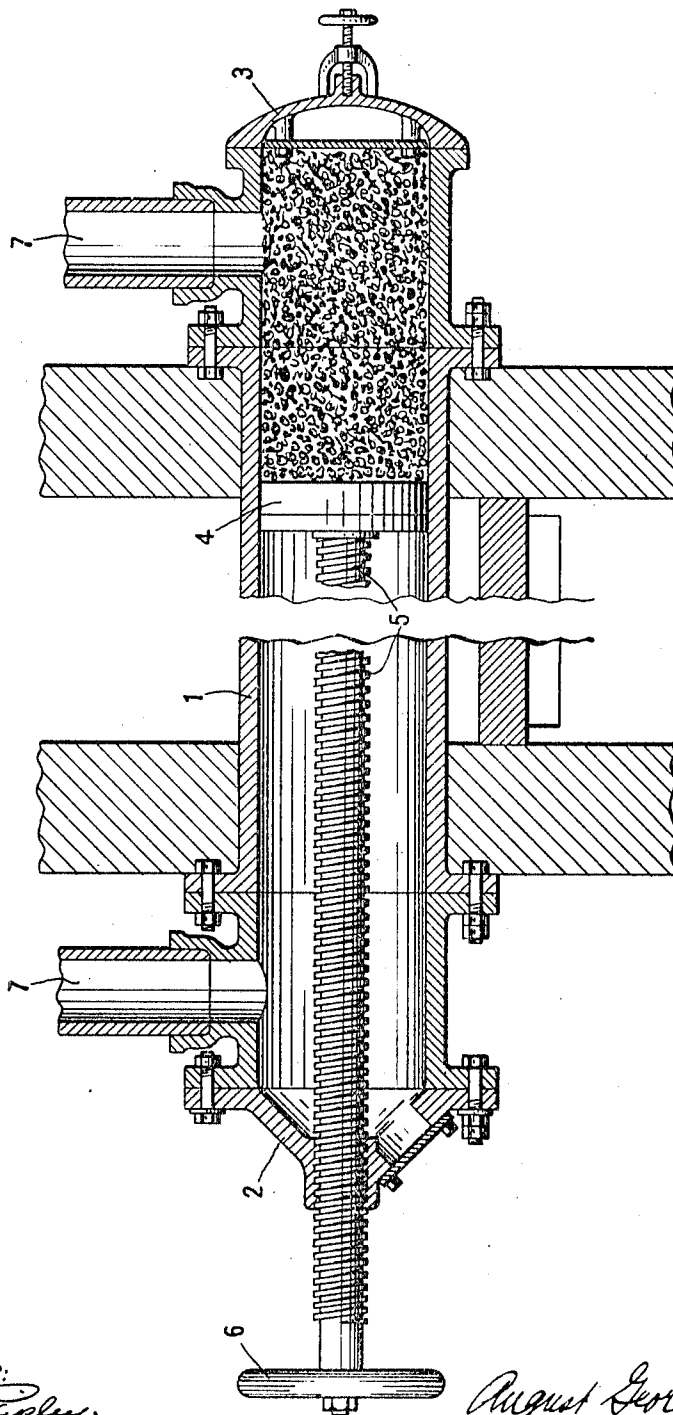


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PROCESS OF TREATING FUEL.
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Patented Feb. 15, 1910.



WITNESSES:

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UNITED STATES PATENT OFFICE.

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PROCESS OF TREATING FUEL.

949,326.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, AUGUST GEORGE MAUL, residing in New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Processes of Treating Fuel, of which the following is a specification.

This invention relates to the treatment of coal or other fuel material, and has for its object to provide a simple, efficient, and easily practiced art whereby the coal or other material is reduced to a densified or compressed coked condition, and freed from its fluid and volatile constituents.

The product of this process is a compact, practically non-porous article of uniform texture, which resembles in a great many ways "natural" coke or anthracite. It is therefore an artificial anthracite, as distinguished from the ordinary commercial or metallurgical coke.

It is one of the features of the present method that I perform the operation of compressing the fuel within the coking retort, at the proper time in the coking operation. Thus the coked fuel may be compressed at the time when it is most favorable to such treatment, there is no danger of ignition or partial cooling and consequent non-uniform product, and the fullest effects of both coking and compression may be had on the material.

How this art may be practiced will now be explained, reference being had to the accompanying drawing, in which is exemplified a form of apparatus in connection with which the process may be performed.

Referring to the drawing, which is a central vertical section through a retort adapted for my process, 1 indicates a coking retort proper, which may well be of cylindrical shape, as shown, and supported in a suitable structure of masonry. At each end the retort is provided with a cap-plate 2, 3. Within the cylinder is a piston or plunger 4, rigidly secured to a rod 5, which extends through the cap-plate 2 of the cylinder. Rod 5 is threaded and engages a correspondingly threaded central boss on cap-plate 2, so that upon and in accordance with the direction of rotation of said rod the plunger 4 may be reciprocated within

the cylinder. Means, as a hand wheel 6, upon the outer end of rod 5, are provided for the rotation of the rod. Gas exits from the cylinder are provided by pipes 7 let into the cylinder, preferably at the top thereof.

In the practice of my process I first provide a suitable quantity of coal, which may be given a preliminary cleaning or other treatment, as desired. A suitable quantity of coal is now introduced into the cylinder, which is then tightly closed. The cylinder may be heated to effect the coking of the contained coal in any well known manner, as by the combustion of gas or other fuel thereunder. As the coking of the coal takes place, the released gases and volatile or fluid constituents escape through the pipes 7, whence they may be conducted to suitable conserving, recovering, and treating devices, not shown.

For a clear understanding of the invention I will now describe an operation which includes the steps of my process, though it is to be understood that the said operation is merely illustrative, and the details thereof are not to be considered as limitative of the invention, except as required by the claims.

Supposing that the mass of coal under treatment is a six hour charge, that is, a charge which will take six hours to coke or distil, it will be found that after a few minutes a small quantity of gas will be given off, which gradually increases. Accordingly, at about the end of the first hour of coking, when the coal is becoming soft, the first actuation of rod 5 is begun, by turning the hand-wheel 6 to advance the plunger 4. The advance of the plunger is in consonance with the withdrawal of the volatile constituents of the fuel, that is the plunger is simply moved to take up the room left by the escape of volatile matter. At the end of this advance movement the plunger is stopped, and the heating of the mass within the cylinder continued. The reason for thus stopping the advance of the plunger is plain. Obviously the pressure should not be exerted steadily, since the gas would not have an opportunity to escape freely, and its quality would be not so good. Also, a continuing pressure would cause carbon deposit in the

ascension pipes, causing them to become clogged, and in the retort, thus taking some of the richest illuminant from the gas, as well as making operation dangerous and impractical. The flow of gas during the first three hours is much greater than that of the last three hours; in fact at the end of five hours the gas will practically have ceased passing off. Therefore, a second advance of the plunger will be made a few minutes after the first advance already referred to (the time depending on the quantity of coal to be distilled), because more gas has escaped and there is consequently more room left to be taken up. After this second advance the plunger is again stopped and coking continued. The third advance will be made after a somewhat shorter interval than that between the first and second advances, because the flow of gas is now more rapid; and the extent of the advance will be greater than that of the second advance, for the same reason. This operation is continued, the time between advances growing gradually shorter and the extent of advances gradually increasing, in consonance with the distillation processes. But at a certain point in the distillation, after about the third hour for a six hour charge, the flow of gas etc. begins to diminish. As a consequence the time intervals between advances of the plunger gradually grow longer, and the extent of advance of the plunger gradually diminishes, all in keeping with the slower and diminishing output of gas.

It should be understood that in order to make the product as nearly like anthracite as possible it is found that the mass must be kept constantly agglomerated, and yet real compression must be avoided for reasons stated. Also, at about five and one-half hours, in a six hour charge, the coked material, which is in a soft, doughy, black mass, undergoes a change, and becomes incandescent and brittle, and it is essential that when this period is reached that the material be compact, densified and practically as non-porous as possible, in order to make a product as near the "natural coke," or anthracite coal, as possible. Compression after the change from doughy to incandescent and brittle, or while the change is going on, would result in a fine, almost powdered coke, which would be undesirable, and greatly decrease its value as a fuel. Therefore, I have devised the art described, consisting of steps as set forth, by virtue of which the fuel is subjected to a series of advance movements of the plunger, separated by intervals during which there is no advance, thus securing the desirable effects of agglomeration, without the ill effects of persisting pressure. And the gaging of these advances of the plunger, and of the time intervals between advances, is a simple matter, because they are merely

to be kept in consonance with the withdrawal of volatile matter, easily determinable since the turning of the screw to the point where it resists further advance shows that all the volatile matter for the time being has passed off, and that the mass should be left to distil for a period.

About the end of the fifth hour, in a six hour charge, the flow of volatile matter practically ceases. At this period the fuel is in a soft doughy mass, but homogeneous by reason of the follow-up movements of the plunger to which it has been subjected and with the number of pores at a minimum, and very small. Real pressure is now applied frequently and at short intervals, and in each step the fuel is compressed until it will yield no more; the application of heat continued for a few minutes, then pressure applied again to the limit of compressibility, until the coke begins to harden, at which point the pressure ceases. The application of heat is continued for about ten minutes and the mass is then discharged and quenched in the usual manner, the produce being a substance which approximates more nearly the "natural coke," anthracite coal, than anything heretofore known, being as nearly non-porous as is physically practicable, considering that it is made in connection with the manufacture of gas in the ordinary way, all as a result of the steps of plunger advance in consonance with the withdrawal of the volatile matter. Obviously the carrying out of this process could be left to the operation of automatic mechanism without great difficulty.

It will be apparent that by my process, as the mass and volume of the coal are reduced under distillation, the cubical content of the retort is reduced accordingly, but without exerting any such pressure upon the charge as will change its volume relatively to its mass. Then, when the mass has reached substantially its minimum under distillation, and before the charge becomes incandescent and brittle, its relative volume is changed by actual compression.

It is to be understood that when the operation is complete, the end of the cylinder controlled by cap-plate 3 is opened, when upon further advance of a plunger 4 the coke compressed material may be forced out of the cylinder, and then removed to a suitable place.

As the art above described could be carried on by the use of radically different apparatus, and as many variations from the details of the process set forth could be incorporated without deviation from the broad principles of my invention, I desire that all matter herein set forth and shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense. Having thus described my invention what

I claim as new and desire to secure by Letters Patent is:

1. The process of producing compressed coke, which consists in providing a body of fuel within a closed retort in which provision is made for the escape of the volatile constituents of the fuel, and which is provided with a movable wall; applying heat to the retort to cause escape of volatile matter, advancing the wall against the body of fuel to an extent equal to the escape of volatile matter, holding the wall stationary while continuing the application of heat to the retort, and then advancing the wall to compress the mass.

2. The process of treating fuel, which consists in reducing its mass by distillation while maintaining practically constant its relative volume as compared with its mass, and then, when the mass of the fuel has reached its minimum under distillation, changing its relative volume.

3. The process of producing compressed coke, which consists in providing a body of fuel within a closed retort in which provision is made for the escape of the volatile constituents of the fuel, and which is provided with a movable wall; applying heat to the retort to cause the escape of the volatile constituents of the body of fuel; advancing the movable wall against said body of fuel to reduce its volume to an extent equal to the volume of volatile matter discharged from the retort; repeating the above step until the volatile matter present in said body of fuel has been discharged from the retort; and then advancing the wall to densify the same.

4. The process of producing densified coke, which consists in providing a body of fuel within a closed retort in which provision is made for the escape of the volatile constituents of the fuel, and which is provided with a movable wall; applying heat to the retort to cause escape of the volatile matter of said body of fuel; advancing the wall against said body of fuel to an extent proportional to the reduction of the mass thereof by distillation, until the volatile matter of said body of fuel has been discharged therefrom; and then compressing the fuel to densify it.

5. The process of producing densified coke, which consists in providing a body of fuel within a closed retort in which provision is made for the escape of the volatile constituents of the fuel, and which is provided with a movable wall; applying heat to the retort to cause the escape of volatile matter; advancing the movable wall against the body of fuel so that its volume is mechanically reduced, while heating the same so that its mass is reduced by distillation, and then, when the mass of the fuel has been reduced to a minimum through distillation

further moving the wall against the fuel to reduce its volume and give it greater density.

6. The process of producing densified coke, which consists in providing a body of fuel within a closed retort in which provision is made for the escape of the volatile constituents of the fuel, and which is provided with a movable wall; applying heat to the retort to cause escape of volatile matter from said body of fuel; advancing the movable wall against the body of fuel in successive steps to an extent proportional to the reduction of the mass thereof by distillation, until the volatile matter of said body of fuel has been discharged therefrom, and then compressing the fuel to densify it.

7. The process of producing densified coke, which consists in providing a body of fuel within a closed retort in which provision is made for the escape of the volatile constituents of the fuel, and which is provided with a movable wall; applying heat to the retort to cause the escape of volatile matter of the body of fuel; advancing the movable wall against the body of fuel in successive steps, while heating the latter, so that its volume is mechanically reduced while its mass is reduced by distillation, and then, when the mass of the fuel has been reduced to a minimum through distillation, further moving the wall against the fuel to reduce its volume and give it greater density.

8. The process which consists in subjecting coal to distillation within a retort, to drive off volatile matter, and then, when the volatile matter is all driven off, but before the charge becomes incandescent and brittle, subjecting it to compression within the retort in order to densify it.

9. The process which consists in subjecting coal to distillation within a retort, to drive off volatile matter, and then, when the volatile matter is all driven off, subjecting it to compression within the retort in order to densify it.

10. The process which consists in subjecting coal to distillation within a retort to drive off volatile matter, while maintaining practically constant its relative volume, as compared with its mass and then, when the volatile matter is all driven off, but before the charge becomes incandescent and brittle, subjecting it to compression within the retort in order to densify it.

11. The process which consists in providing a body of fuel within a retort; applying heat to the retort to cause escape of the volatile constituents of the fuel; reducing the cubical content of the retort proportionately to the escape of volatile matter, and then applying pressure to the fuel within the retort to densify it.

12. The process which consists in providing a body of fuel within a retort; applying heat to the retort to cause escape of

the volatile constituents of the fuel; reducing the cubical content of the retort proportionately to the escape of volatile matter, and then, when the volatile matter is all driven off, but before the charge becomes incandescent and brittle, applying pressure thereto within the retort to densify it.

In testimony whereof I affix my signature in the presence of two witnesses.

AUGUST GEORGE MAUL.

Witnesses:

FRANK J. KENT,
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