

No. 846,357.

PATENTED MAR. 5, 1907.

H. F. SMITH.  
PRODUCER GAS APPARATUS.  
APPLICATION FILED APR. 17, 1906.

4 SHEETS—SHEET 1.

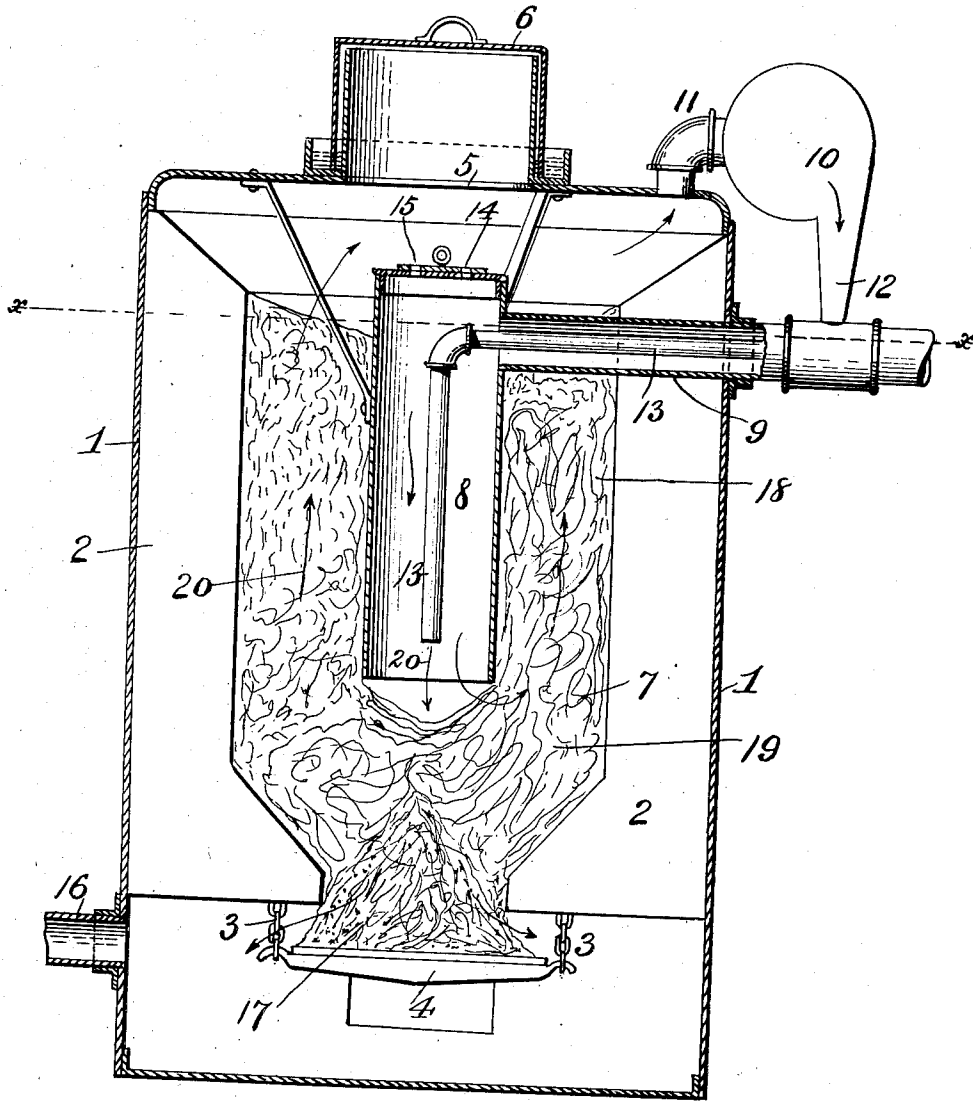


Fig. 1.

Witnesses:

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*J. M. Minter*

Inventor:  
*Harry F. Smith*

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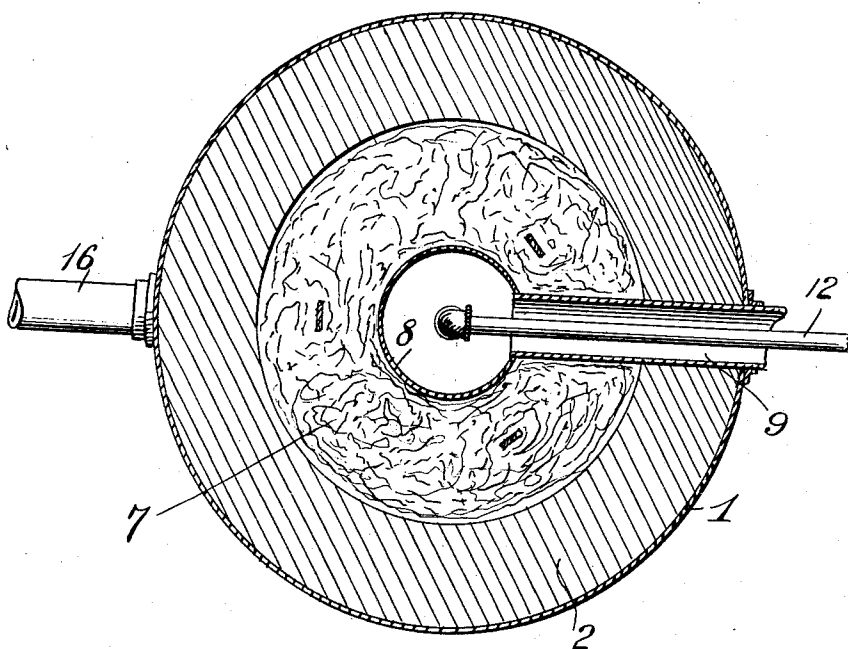


Fig. 2.

Witnesses:

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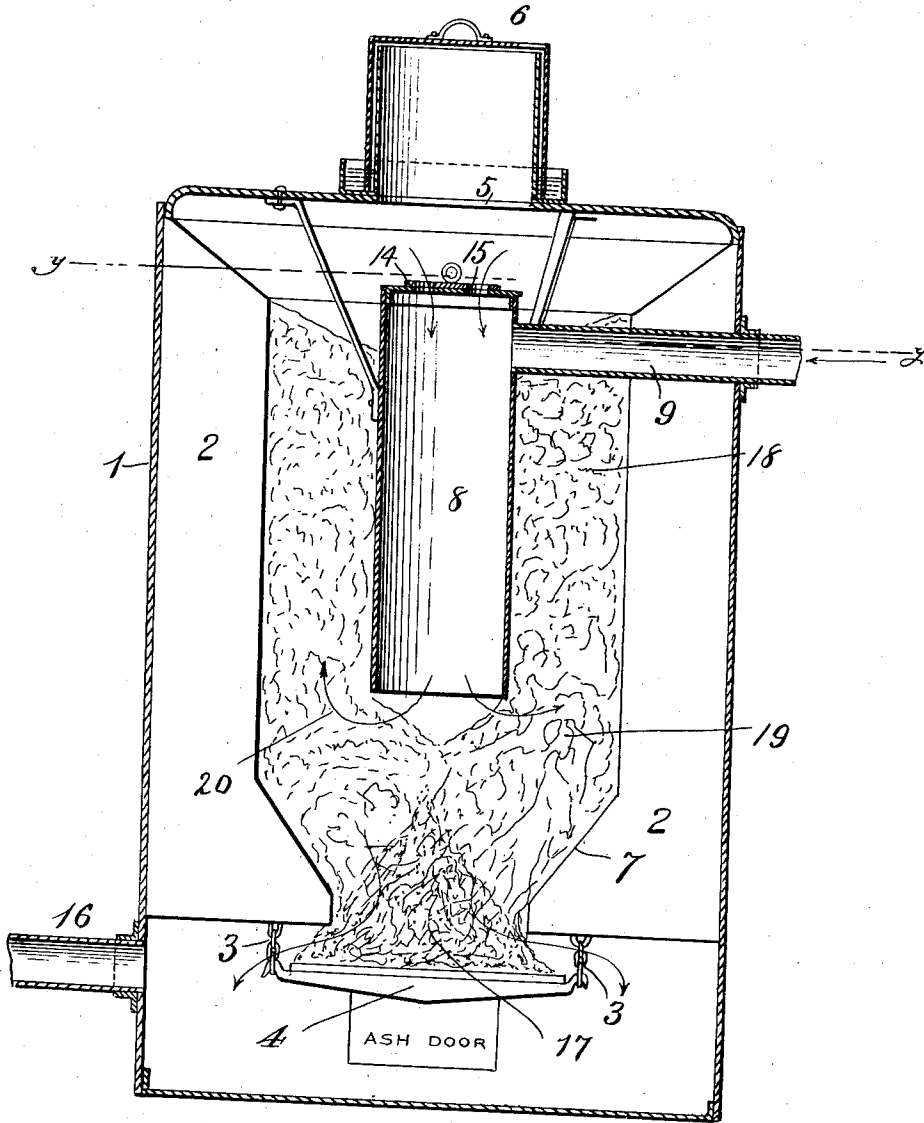


Fig. 3.

Witnesses:

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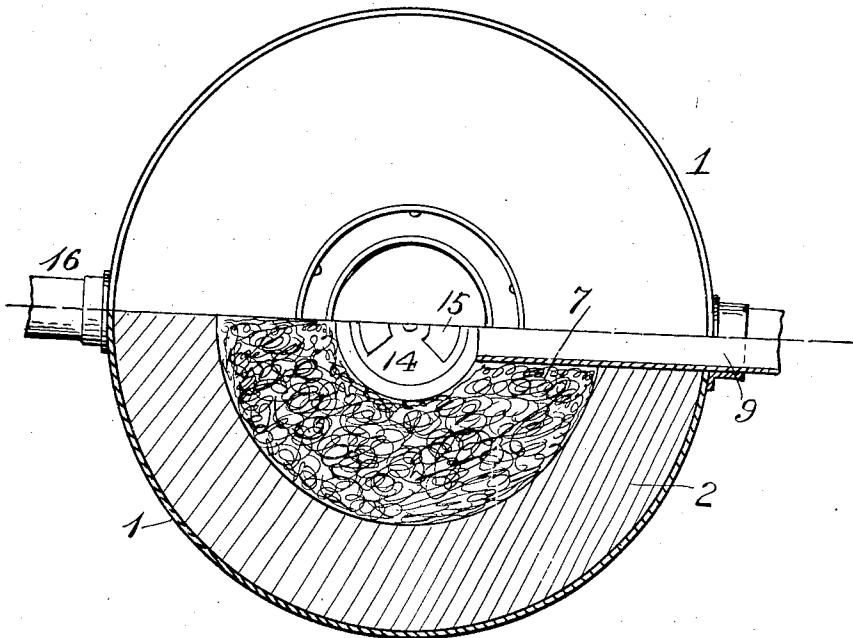


Fig. 4.

Witnesses:

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J. W. Minter.

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# UNITED STATES PATENT OFFICE.

HARRY F. SMITH, OF LEXINGTON, OHIO.

## PRODUCER-GAS APPARATUS.

No. 846,357.

Specification of Letters Patent.

Patented March 5, 1907.

Application filed April 17, 1906. Serial No. 312,231.

*To all whom it may concern:*

Be it known that I, HARRY F. SMITH, a citizen of the United States, residing at Lexington, in the county of Richland and State of Ohio, have invented certain new and useful Improvements in Producer-Gas Apparatus, of which the following is a specification.

My invention relates more particularly to what may be termed "gas-producers" for treating substances or fuels containing a considerable amount of volatile hydrocarbons associated with a certain amount of fixed carbon, of which lignite coals and bituminous coals are familiar examples. While reference shall particularly be had herein to the use of lignite or brown coals, it will be understood that any intention to confine myself to such use is hereby disclaimed. Its object is to provide for the aforesaid treatment of materials in a simple, economic, and effective manner in generating the required gas.

Said invention consists of certain features substantially as hereinafter fully disclosed, and particularly pointed out by the claims.

In the accompanying drawings, illustrating the preferred embodiment of my invention, Figure 1 is a sectional elevation thereof. Fig. 2 is a horizontal section produced upon the line  $x-x$  of Fig. 1. Fig. 3 is a sectional elevation of a modification of said invention; and Fig. 4 is a horizontal section thereof, taken on the line  $y-y$  of Fig. 3.

In carrying out my invention I provide a casing or shell 1, which has a suitable refractory lining 2, and suitably suspend or support in position by chains 3 or otherwise from the base of said lining or refractory material a grate 4 for the support of the fuel. Said casing has applied or fitted upon its upper end a charging-opening 5, which is closed by a cover 6.

Arranged within the casing 1, about centrally of the combustion or fuel chamber 7, is a vertical tube or cylinder 8, of metal or other suitable material, fixed in suspended position in any suitable way, preferably as shown, with its upper end extending somewhat above the combustion-chamber and its lower end terminating directly above the grate and at a suitable distance from it, which distance is determined by the character of the particular fuel used.

A pipe 9 has its inner delivery end secured to and communicating with the cylinder or tube 8 at its extreme upper end and extends therefrom out through the casing 1 for intro-

ducing air or a mixture of air and steam via said cylinder or tube into the producer or apparatus.

A rotary fan is arranged in a case 10, having a suction-pipe connection 11 with the interior or chamber of the casing or shell 1 at its upper end and a blast-delivery-pipe connection 12 with a pipe 13 arranged within the pipe 9 and having an arm extending down into the cylinder or tube 8 and delivering thereinto near its lower end, the purpose of which will be described later.

It is noted that a characteristic of the fuels of the class above mentioned is that when they are heated to a sufficiently-high temperature the volatile hydrocarbons are eliminated, leaving the fixed carbon behind or intact in the form of coke or charcoal. The thus-disposed-of hydrocarbons contain much tarry matter and also gases of high heating value which cause difficulties in producers of the ordinary type, thus preventing the use therein of this class of fuels for many kinds of works. It is therefore very desirable to handle fuels of this class in such a manner that the volatile hydrocarbons referred to shall be completely converted into fixed gases of relatively low heating value, so as to approximate in composition the gas generated by the action of the air and steam on the fixed carbons contained in these fuels.

The operation of this apparatus may be stated, briefly, as follows: It having been filled with fuel, suitable "kindling" is dropped through the cylinder or tube 8, so as to lie or rest upon the fuel just below said tube or cylinder, which kindling is then fired or ignited. The cover 14, previously removed from the upper end of the cylinder or tube 8, is replaced, and the register or damper 15 (an adjunctive part of said cover) is closed. A blast of air is now suitably generated in a well-known way for delivery into and through the pipe 9, which air-blast also passing through the cylinder or tube 8 and through the fuel after leaving the latter continues its passage out through the grate 4, being finally delivered through the pipe 16, constituting an outlet of the casing or shell 1 at a point about in alinement with the grate. The combustion thus created rapidly generates sufficient heat in the mass of fuel 17 below the discharge end of the cylinder or tube 8 to completely drive off or eliminate from this part of the fuel charge all the volatile hydrocarbons which it may contain. After these

hydrocarbons have been thus freed from the fuel in the bottom of the producer the cover 6 is removed, and the opening thus produced in the top of the producer results in inducing the passage or delivery of a part of the  
 5 said blast downward through the tube or cylinder 8 and thence upward through the fresh fuel 18. After this blast has continued for a short time the parts of the fuel 17 and  
 10 18 will have been thoroughly coked and the fuel intermediate of 17 and 18 will have become well fired or ignited, when the apparatus will be in condition to begin the operation of manufacturing the gas.

15 When the producer is operated by suction, the means for producing such suction (which may be either a gas-engine supplied from the producer or a gas-exhauster of suitable construction) is put in operation and air and steam  
 20 supplied in suitable proportions through the pipe 9, the damper or register 15 in the cover 14 being opened at this time. The air and steam entering the apparatus through the pipe 9 are impelled by the suction created  
 25 at 16 to pass into and down through the cylinder or tube 8, whence a part of said mingled steam and air will be drawn directly through the incandescent fuel or mass 17 19, converting the latter into gas in accordance  
 30 with the well-known laws governing such operations. It is obvious, however, from the construction of the apparatus that the pressures existing at either end of the passage or cylinder 8 must be the same or differ by a  
 35 very slight amount only. It is also evident that the combustion of the fuel between 18 and 19 will have a tendency to cause a part of the air flowing through cylinder or passage 8 to be diverted and pass upward  
 40 through the fuel 18 by natural draft, owing to the fact that the temperature in the burning fuel 18 will be higher than the temperature within said passage, the combustion taking place between 18 and 19 continually  
 45 generating heat, which passes upward into the fresh fuel 18, thereby eliminating the volatile hydrocarbons, or, in other words, coking the fuel. These volatile hydrocarbons pass upward into the top of the producer-chamber and thence again downward  
 50 through the opening in the cover 14, controlled by the damper 15, and accordingly enter the upper end of the cylinder or passage 8. Here they are mixed with the incoming fresh air and upon contact with the incandescent fuel opposite the lower end of the cylinder or passage 8 are completely burned or consumed, being associated with an excess of air. The products of this combustion consist of carbon dioxide and vapor of water, and these products of combustion in passing downward through the incandescent fuel 18 will be disassociated into carbon monoxide and hydrogen, producing in  
 60 this way a gas of exactly the same chemical

composition as that from the fixed carbon or solid constituent of the fuel. It is also here noted that the shallowest part of the fuel-bed is directly under the central passage or cylinder 8 and that the tendency of the coal is to  
 70 feed from the circumference of the fuel-chamber toward the center, the same sloping centrally at its bottom, and that as a consequence all ash will be delivered into this central portion of the fuel-bed and will there be  
 75 fused into a clinker or clinkers by the intense combustion occurring at this point. The temperature here is manifestly higher than at any other point in the fuel-bed, owing to the fact, as already indicated, of the greatest  
 80 shallowness of said bed at said point and the generation of the greatest or intensest draft here than elsewhere. In practice these clinkers are found to form in this part of the fuel-bed only and to lie a few inches beneath  
 85 the upper surface of the fire-bed at said point. When sufficient ash has accumulated to form a clinker of considerable size, said clinker is removed from above by engaging or grasping it by means of a suitably constructed grapple or tongs and withdrawing  
 90 it through the passage or cylinder 8 upward. From the foregoing it will be seen that a gas is produced which is not only perfectly free from tar and other undesirable ingredients,  
 95 but which is also uniform in chemical composition.

In case the fuel is very free burning and the tendency of the apparatus would be to permit too rapid combustion between the  
 100 fuel 19 and 18 the draft in this direction may be controlled or restricted by suitably manipulating the damper 14. In case the fuel is of very slow burning character and the natural draft caused by the difference in temperatures between the gases in the fuel 18 and the  
 105 cylinder or passage 8 is insufficiently rapid for carbonization or coking of the coal then a suction action is generated by bringing into service the contrivance 10, as previously described. The action of the blast thus produced has the effect to draw gases through the pipe 11 and deliver them, through the fan-casing 10 and the inner pipe 13, into the  
 110 passage or cylinder 8, whence they pass into and through the fuel, thus creating a continuous air-current along the lines indicated by the arrows 20, as will be readily appreciated.

In the modification as disclosed by Figs. 3  
 120 and 4 it will be noted that the same is in every essential particular the same as the preferred form of the disclosure of the invention, excepting the omission of the blast-generating device (designated generally as 10)  
 125 and its adjunctive parts—as, for instance, the pipes 11, 12, and 13.

I claim—

1. In a gas-producer generator operated by inverted combustion or downdraft, means  
 130

for introducing the elements promotive of combustion, as air and steam, comprising a passage arranged centrally within the fuel chamber or magazine and having its lower end delivering below the unignited fuel mass, into the ignited portion thereof and its upper end provided with a closure having suitably-controlled passages opening into the combustion-chamber, means for returning the gases from the combustion-chamber and delivering the same, together with indrafts or blasts of air, again into the incandescent fuel mass.

2. In a gas producer or generator operated by inverted combustion or downdraft, a steam and air passage arranged centrally within the fuel chamber or magazine, and having its lower end delivering below the unignited fuel and into the ignited portion thereof and its upper end provided with a closure having suitably-controlled passages opening into the combustion-chamber and means, including an outlet, for passing the air and steam through said ignited or incandescent fuel, and conducting away the gas thus generated or produced, below the fire-grate.

3. In a gas generator or producer operated by inverted combustion or downdraft, a centrally-located air and steam inlet passage having its upper end provided with a closure having suitably-controlled passages opening into the combustion-chamber and a fuel-magazine provided with an inlet for air and an outlet for products of combustion and volatile gases, a mixing-chamber or burner wherein the volatile gases from the fuel-magazine and the air passing into the centrally-arranged air-passage may be thoroughly mixed and burned, and means for passing the products of combustion, along with the commingled air, into the gas-generating portion of the fuel-bed.

4. An apparatus of the character described, comprising a central suspended air and steam passage, also removed from both the top of the producer-chamber and the fire-grate below, and delivering into the fuel-chamber, an air and steam inlet pipe delivering into the upper end of said steam and air passage, and a gas-outlet discharging at a

point below the grate, said suspended air and steam passage having a closure provided with suitably-controlled passages opening into the combustion-chamber.

5. An apparatus of the character described, comprising a central suspended air and steam passage delivering into the fuel-chamber, and having a closure provided with suitably-controlled passages opening into the combustion-chamber, said passage being also removed from both the top of the producer-chamber and the fire-grate below, an air and steam inlet pipe delivering into said passage, and means for generating a continuous air-current through the fuel-chamber via said air and steam passage.

6. An apparatus of the character described, comprising a central suspended air-passage delivering into the fuel-chamber and having its producer-chamber-contained end adapted to be closed during the suction action induced in said producer-chamber, said passage being also removed both from the top of the producer-chamber and the fire-grate below, a blast-generating device having a suction or inlet pipe connection with the producer-chamber at its upper end, and a blast-delivery pipe connected to said blast-generating device and discharging into said air and steam passage near its lower end.

7. An apparatus of the character described, comprising a fuel-chamber, a central air and steam passage delivering into said fuel-chamber and removed both from the top of the producer-chamber and the fire-grate below, an air and steam inlet pipe delivering into said passage, means for controlling the air-inlet end of said passage, a gas-outlet discharging at a point below the fire-grate, and a blast-generating device for inducing continuous air-suction current through the fuel-chamber via said air and steam passage.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HARRY F. SMITH.

Witnesses:

D. F. RITCHIE,  
WM. H. EARHART.