

No. 715,311.

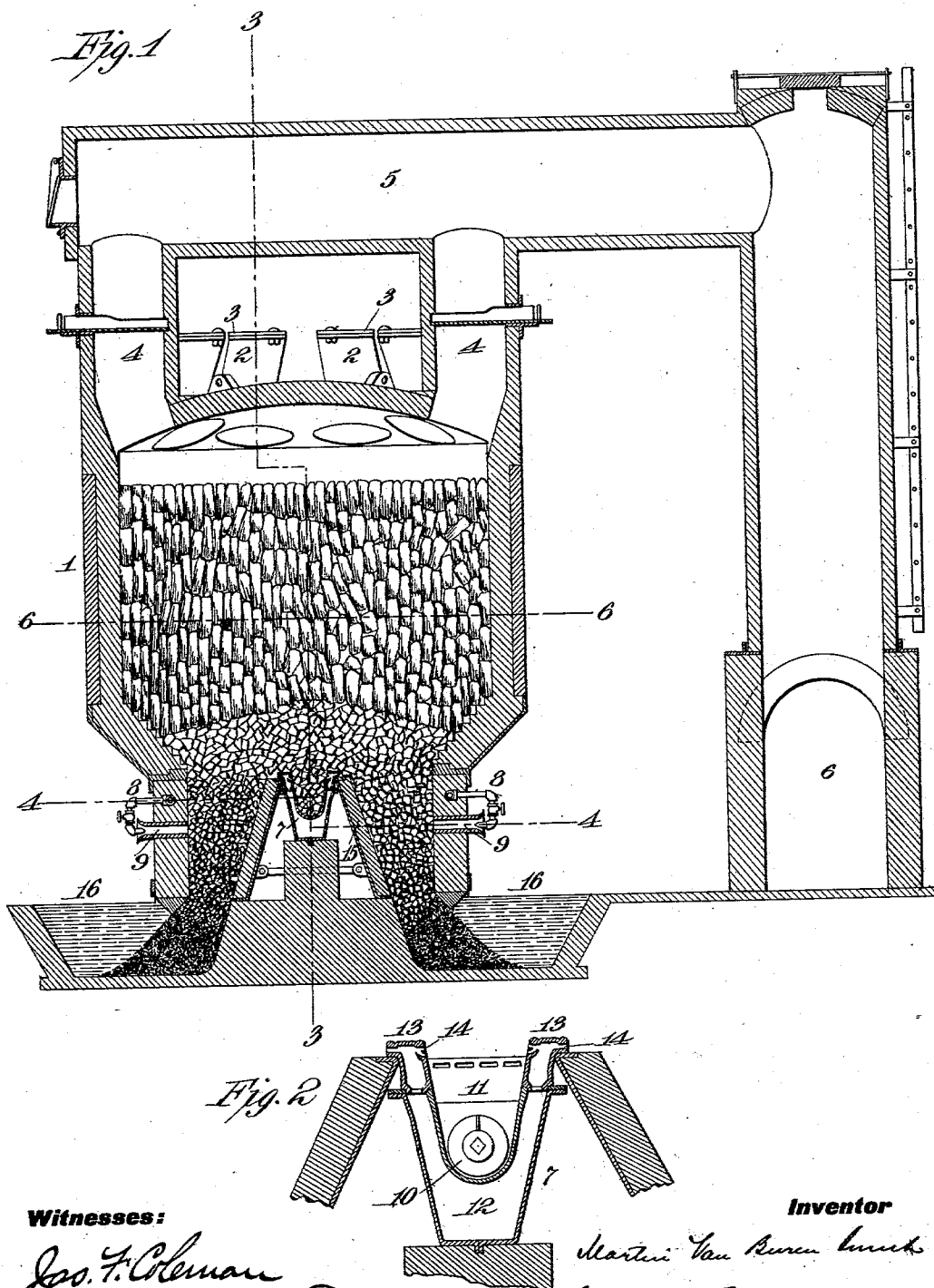
Patented Dec. 9, 1902.

M. VAN B. SMITH.
PROCESS OF GENERATING PRODUCER GAS.

(Application filed Nov. 18, 1901.)

(No Model.)

4 Sheets—Sheet 1.



Witnesses:

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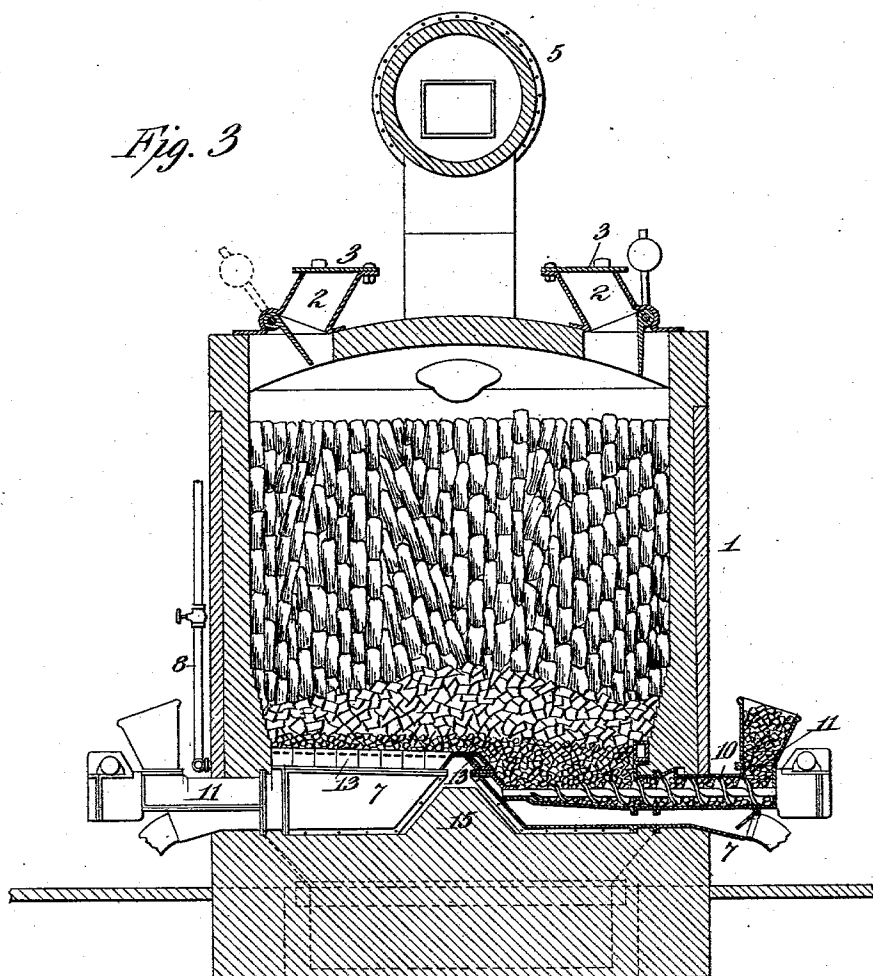
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4 Sheets—Sheet 2.



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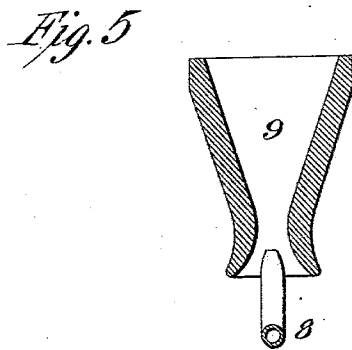
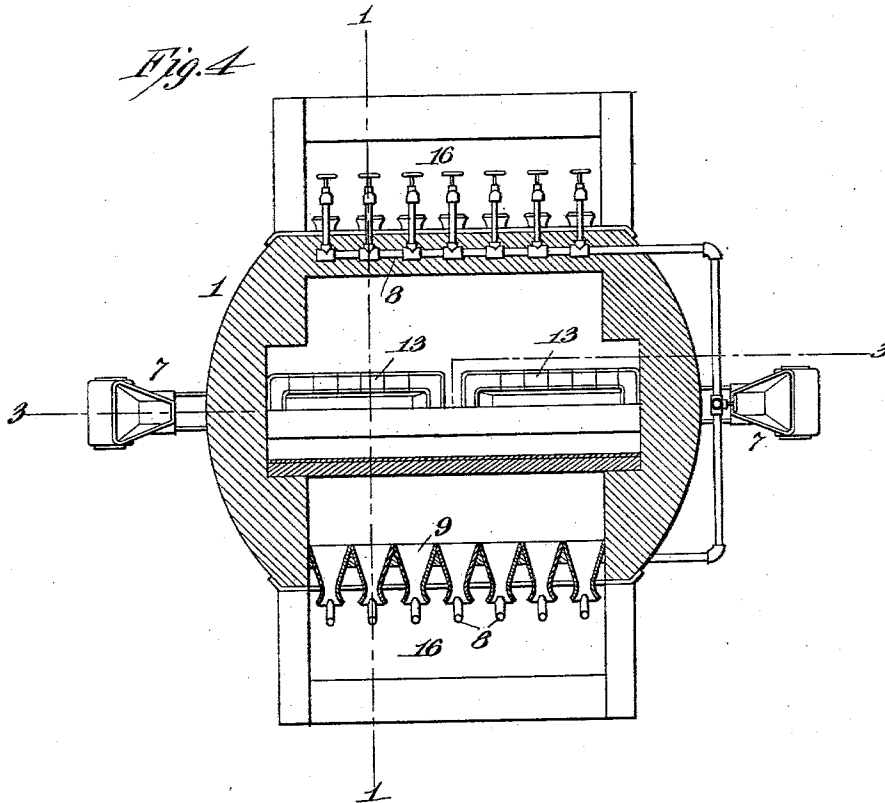
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4 Sheets—Sheet 3.



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4 Sheets—Sheet 4.

Fig. 7

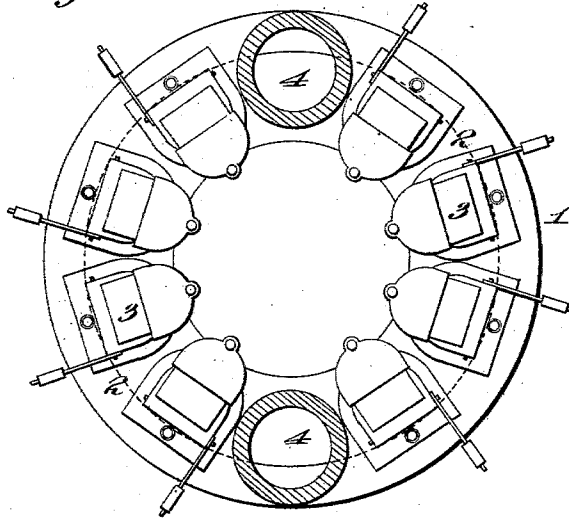
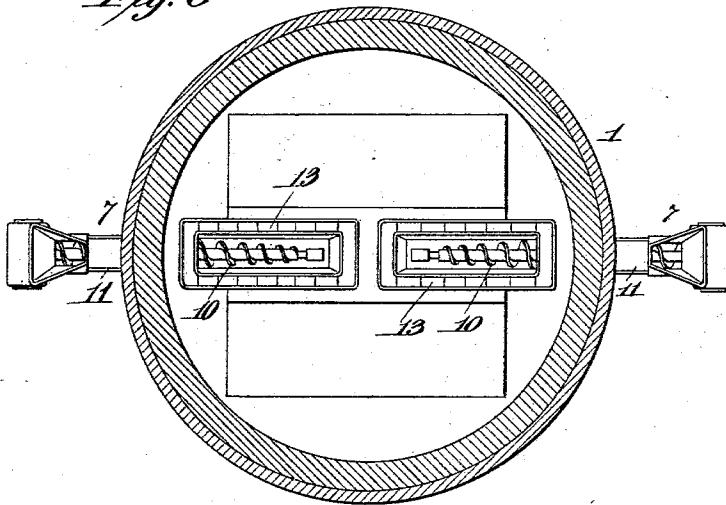


Fig. 6



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UNITED STATES PATENT OFFICE.

MARTIN VAN BUREN SMITH, OF NEW YORK, N. Y., ASSIGNOR TO THE
AMERICAN STOKER COMPANY, OF NEW YORK, N. Y., A CORPORATION
OF NEW YORK.

PROCESS OF GENERATING PRODUCER-GAS.

SPECIFICATION forming part of Letters Patent No. 715,311, dated December 9, 1902.

Application filed November 18, 1901. Serial No. 82,665. (No specimens.)

To all whom it may concern:

Be it known that I, MARTIN VAN BUREN SMITH, a citizen of the United States, residing in the borough of Manhattan, in the city,
5 county, and State of New York, have invented a certain new and useful Process of Generating Producer-Gas, of which the following is a description.

In an application for Letters Patent filed
10 November 23, 1898, Serial No. 697,235, I describe an apparatus for generating producer-gas, wherein green fuel is introduced into a body of incandescent coke from below in the presence of a limited air-supply, insufficient
15 to produce combustion of the gas, the resulting ash being continuously withdrawn from the apparatus through water-sealed ash-pits below the body of incandescent fuel. My present application is designed to cover the
20 process involved in the operation of apparatus of this type, either of the specific form described and claimed in said application or equivalent apparatus designed to perform substantially the same operations.

25 My object is to provide a simple and efficient process for the generation of producer-gas and by which a practically stable gas will be generated in the first instance and which will not be contaminated with unstable constituents which require to be removed by
30 subsequent purifying processes.

In the accompanying drawings I illustrate an apparatus of the type described by me in my said application and which is entirely
35 suitable for the carrying on of my present method.

In the drawings, Figure 1 is a cross-section through the generator, taken on the line 1 1 of Fig. 4; Fig. 2, a cross-section through the
40 underfeed-stoker, showing the same in enlarged view and in detail; Fig. 3, a longitudinal section on the line 3 3 of Figs. 1 and 4; Fig. 4, a cross-section on the line 4 4 of Fig. 1; Fig. 5, an enlarged detail of one of the
45 nozzles shown in Fig. 4 and through which air and steam are introduced into the generating-chamber; Fig. 6, a section through the generator on the line 6 6 of Fig. 1, and Fig. 7 a top view of the generator.

In all of the above views corresponding 50 parts are represented by the same numerals of reference.

Up to the present time it has been the common practice in the operation of generators of producer-gas to apply the fresh or green 55 fuel on top of the incandescent coke, and as a consequence the gases generated are charged with water expelled from the green coal and frequently also with vaporized liquid hydrocarbons, such as tar. These additional con- 60 stituents make the producer-gas unstable, and it is therefore the practice at the present time to remove them by subsequent purifying processes when a stable gas is desired. One of the principal features of my present inven- 65 tion consists in reversing this practice by the introduction of the green fuel below the incandescent body of coke instead of above it. The result of this change is marked. In the first place the water expelled from the green fuel in 70 passing up through the incandescent body of coke is converted into hydrogen and carbonic-oxid gases, which are stable. In the second place the liquid hydrocarbons are oxidized and also converted into hydrogen and carbonic-oxid gases. In the third place, since 75 the distillation of the hydrocarbons takes place in a zone in which free oxygen is present, they are decomposed and converted into carbonic-acid gas, which in its passage through 80 the incandescent coke on its way to the exit-flue is converted into carbonic-oxid gas in precisely the same way that the carbonic-acid gas resulting from the combustion of the coke is on its way to the flue converted into 85 carbonic-oxid gas. As a result, the gas produced is more nearly pure carbonic-oxid and hydrogen gases, free from moisture and volatilized liquid hydrocarbons, and therefore a stable gas generated as such and not made 90 stable by any subsequent process, such as washing or scrubbing or draining off of the non-stable and deposited constituents. Various difficulties arising from the instability of producer-gas as now made are therefore 95 avoided, and a gas which is suitable for general heating purposes is produced. In the manufacture of such gas I prefer to intro-

duce steam, as it is the common practice to do in the manufacture of producer-gas, to supplement the combustible gases produced.

The following is a description of the structure shown in the accompanying drawings:

1 1 are the walls of the furnace, which are contracted near the bottom, as shown.

2 2 are suitable hoppers arranged on top of the furnace, through which the initial charge of fuel is introduced. These hoppers are provided with weighted doors 3.

4 4 are the uptakes leading to the gas-main 5.

6 is a conduit leading to a regenerative furnace or other device for utilizing the gas produced in the generator.

7 7 are devices for introducing the fuel under the bed of incandescent coke contained in the generator-chamber. These devices are shown as an underfeed-stoker, in which the coal is fed from the hopper by means of an Archimedes screw and is by said screw elevated into the gas-generating chamber.

8 8 are steam-pipes, and 9 9 are air-openings, the parts being assembled and arranged so that the issuing steam forces into the lower part of the generating-chamber commingled air and steam.

The underfeed-stoker is shown in detail in Fig. 2, in which 10 is the Archimedes screw; 11, the coal-reservoir; 12, an air-chamber provided with a forced draft. 13 13 are twyer-blocks, and 14 14 are openings from which air is ejected. These stokers, as shown in Fig. 3, may be arranged end to end and placed at or near the pinnacle of a central abutment 15, located so as to discharge the green fuel above the point where the air and steam enter through the nozzles 8 9. 16 16 are water-sealed ash-pits, into which the incombustible ash or residue descends.

The operation of the device shown in the drawings may thus be described: Through the hoppers 2 2 on starting the generator kindlings are first introduced, and on top of them coke is introduced to the desired depth. The fire being lighted and the coke brought to the required condition of incandescence, the stokers are started, and green coal is continuously fed into the generator under the incandescent coke. This fuel as it is fed upward is converted into coke by the distillation of its hydrocarbon constituents, (solid and liquid,) which in the presence of the air issuing through the twyer-openings are decomposed, forming carbonic-acid gas (which passing upward through the incandescent body of coke above it is converted into carbonic-oxid gas before it leaves the generator) and hydrogen. The water contained in the coal is, like the steam introduced through the nozzle 8, decomposed, producing hydrogen gas. The fresh coke overflows from the stoker and passes down at the sides of the abutment on which it is located, where it meets the incoming air and steam introduced through the nozzles 8 9. In the presence of

the free oxygen (and perhaps aided by the oxygen of the steam) combustion of the coke ensues and carbonic-acid gas is produced, which passing upward through the incandescent body of coke above it is converted into carbonic-oxid gas. The hydrogen which results from the decomposition of the steam passes up through the incandescent coke unchanged. As a result a new industrial gas is formed, which differs from ordinary producer-gas in that it is practically free from water, tar, and other unstable constituents and in which a portion at least of the hydrocarbon has been converted into carbonic-oxid gas by combustion and subsequent carbonization, it being understood that carbonic acid in its passage through the incandescent body of coke takes up carbon and is converted into carbonic-oxid gas.

It will of course be understood that in the practice of my process any means whereby the green fuel is introduced under the incandescent body of coke may be employed and that, furthermore, my invention in its broader aspects is not limited to the use of a stoker of the construction shown or of any particular construction, the advantage of this feature of the apparatus described being that a continuous and uniform feed of fuel is assured with the minimum labor. Although I now prefer to use separate nozzles 8 9 for the introduction of air and steam to effect the combustion of the coke, the passages through the twyers of the stoker may be relied upon for the introduction of all the atmospheric air required in the operation, and, in addition, steam may be introduced by way of these openings. In any event the introduction of steam may be omitted altogether, although it is universally recognized as good practice to introduce so much steam as can be decomposed without reducing the temperature within the generator below the required point.

When I speak of the incandescent body of coke being above the freshly-introduced fuel, it will be understood that the same result would be attained if the coal were introduced above the coke and the exit-pipe were below it. In other words, the incandescent coke is to intervene between the freshly-introduced fuel and the exit-pipe from the generator.

Instead of distilling the hydrocarbons in the presence of free oxygen or commingling them with free oxygen before they leave the generator or retort, thus causing combustion, the coal might be introduced above the zone of free oxygen where combustion would not take place. In the apparatus shown in the drawings, this might, for example, be done by omitting the air-openings 14 14 in the twyer-blocks. The resulting gas in this case would contain a larger proportion of hydrocarbon gas; but the water in the coal would still be converted into hydrogen gas during its passage through the incandescent coke.

Having now described my invention, what

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

1. The method of generating producer-gas from coal, which consists in maintaining a
5 volume of incandescent fuel from which free air is excluded, in injecting into the incandescent fuel two columns of air insufficient in volume to support complete combustion, and in feeding below the volume of fuel and
10 between the injected air a continuous supply of green or fresh fuel, as and for the purposes set forth.

2. The method of generating producer-gas from coal, which consists in maintaining a
15 volume of incandescent fuel from which free air is excluded, in injecting into the incandescent fuel two columns of air insufficient in volume to support complete combustion, in feeding below the volume of fuel and be-
20 tween the injected air a continuous supply of green or fresh fuel, and in continuously withdrawing the resulting ash formed by the combustion, as and for the purposes set forth.

3. The method of generating producer-gas
25 from coal, which consists in maintaining a

volume of incandescent fuel from which free air is excluded, in feeding below the volume of fuel a continuous supply of green or fresh fuel with an insufficient supply of air to support complete combustion, and in introduc- 30
ing below the combustion-zone of the burning fuel an additional supply of air, as and for the purposes set forth.

4. The method of generating producer-gas from coal, which consists in maintaining a
35 volume of incandescent fuel from which free air is excluded, in feeding below the volume of fuel a continuous supply of green or fresh fuel with an insufficient supply of air to support complete combustion, and in introduc- 40
ing below the combustion zone of the burning fuel an additional supply of air and steam, as and for the purposes set forth.

This specification signed and witnessed this
30th day of October, 1901.

MARTIN VAN BUREN SMITH.

Witnesses:

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JNO. ROBT. TAYLOR.