3 Sheets--Sheet 1.

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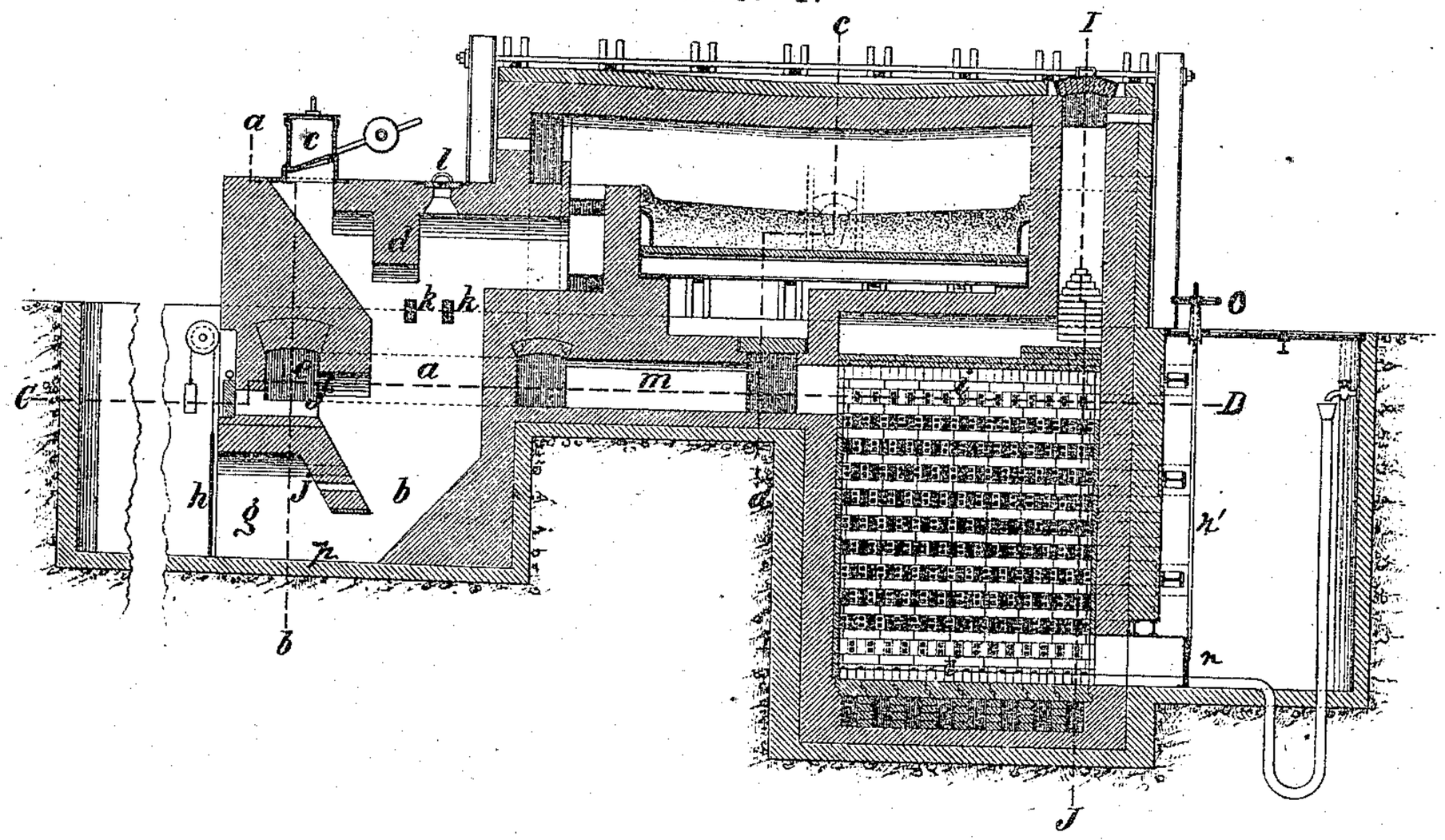
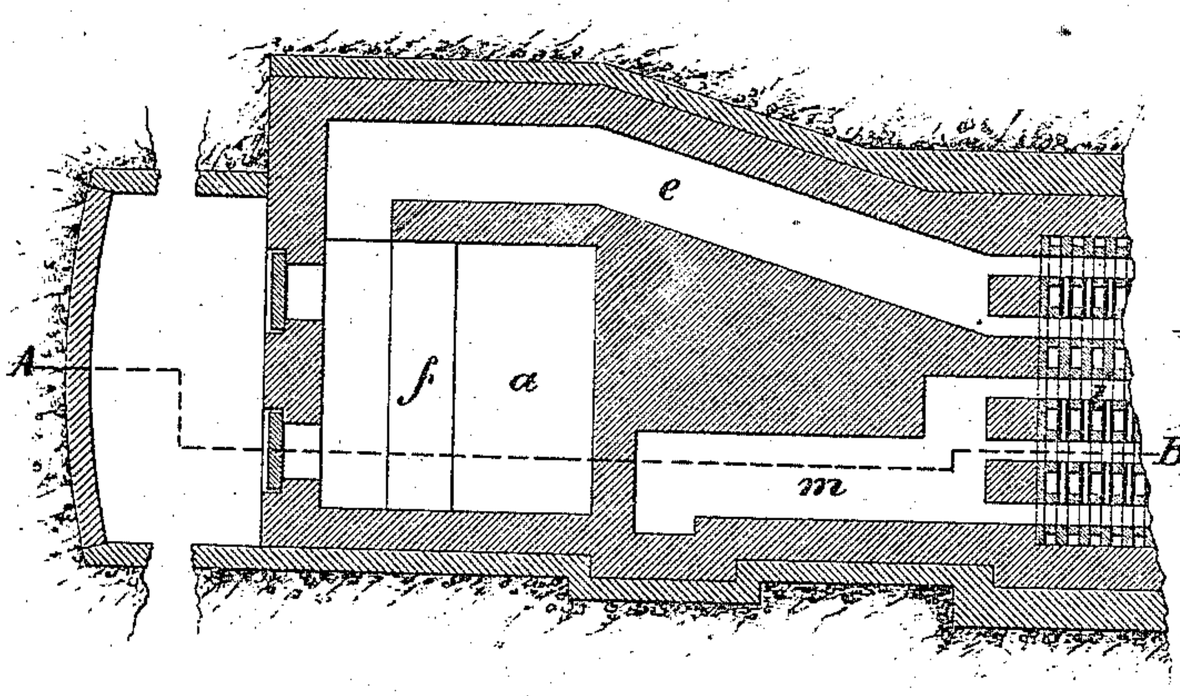
Process and Apparatus for Generating Gaseous-Fuel.

No. 163,247. Patented May 11, 1875.

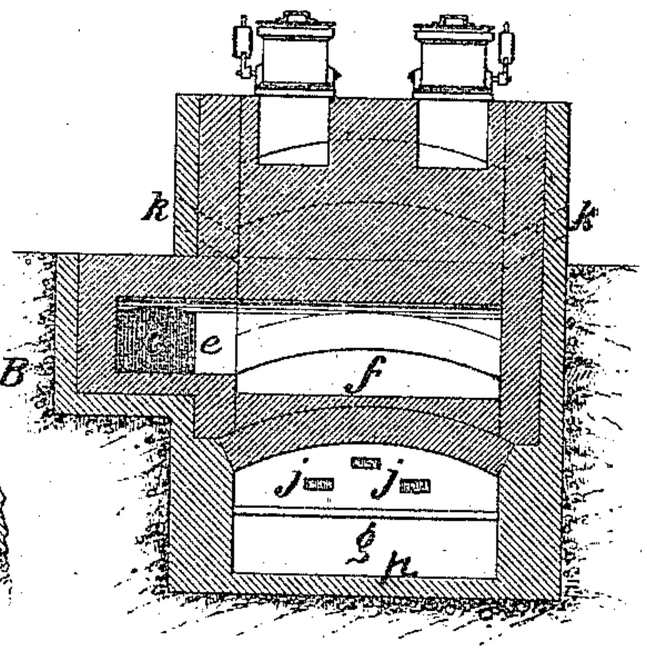
— FIG. 1. —



— FIG. 2. —



— FIG. 3. —



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by his Atty
Henry Baldwin Jr.

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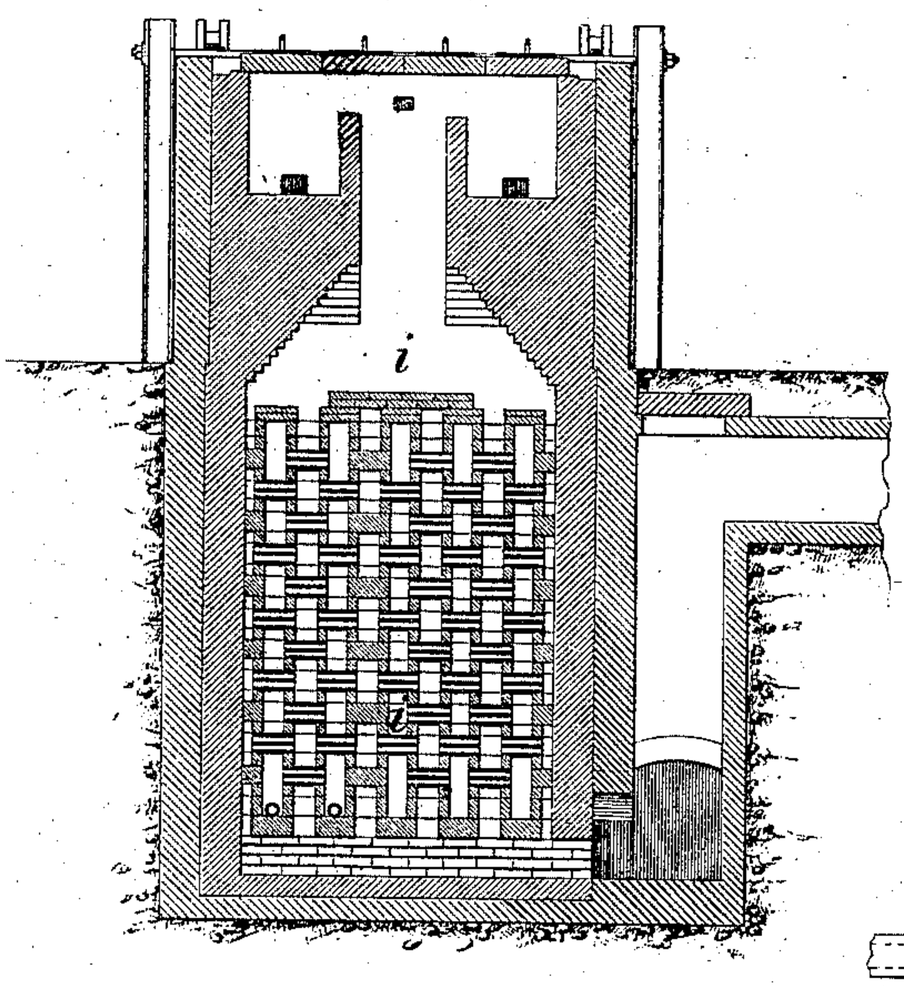
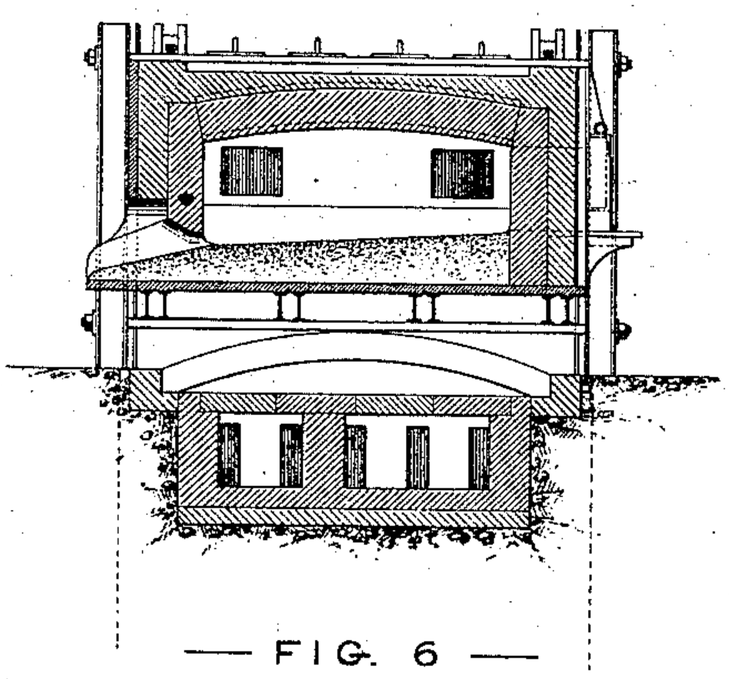
Process and Apparatus for Generating Gaseous-Fuel.

No. 163,247. Patented May 11, 1875.

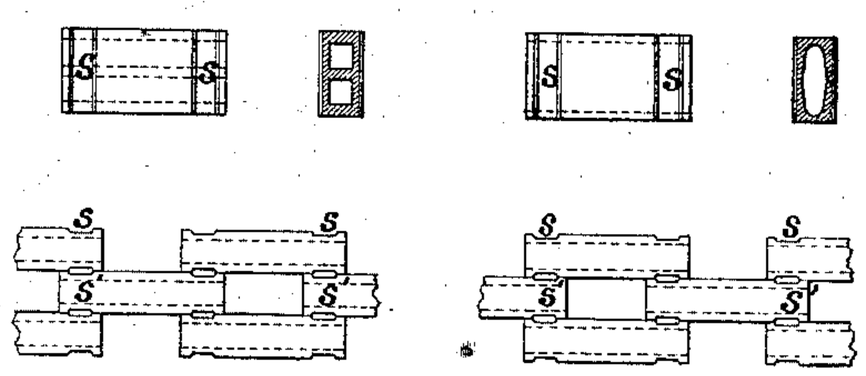
— FIG. 4. —



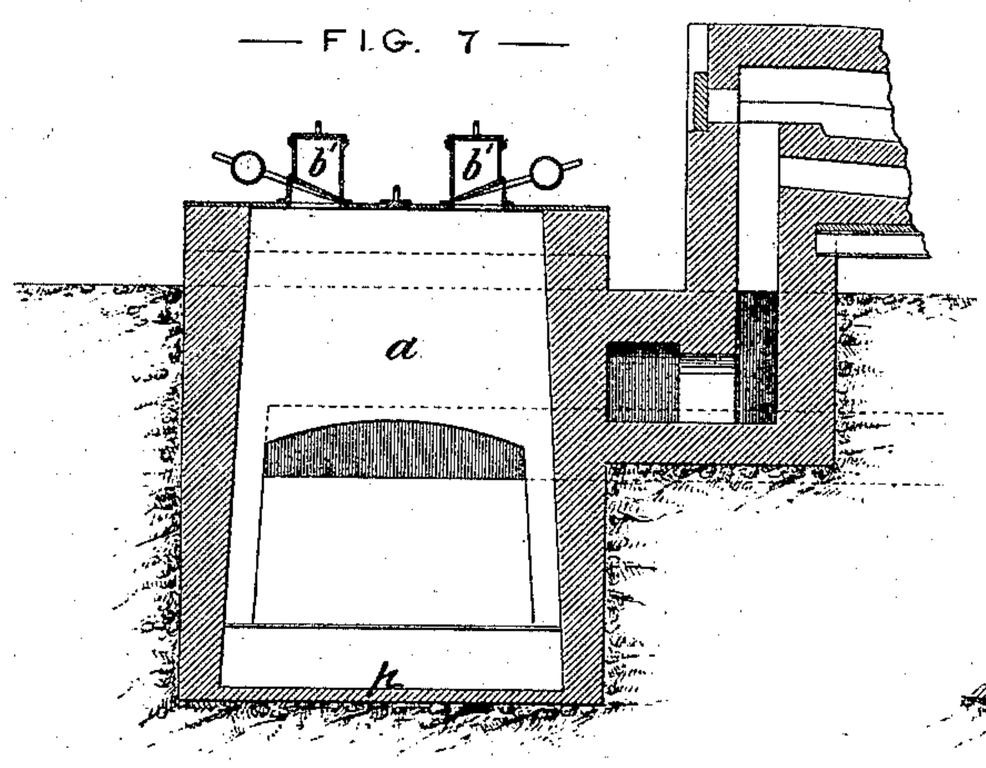
— FIG. 5. —



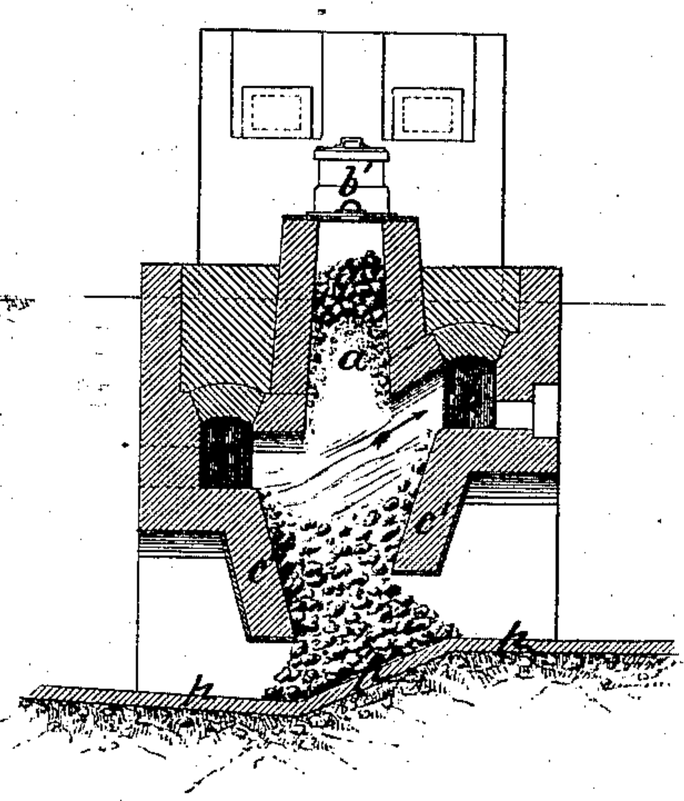
— FIG. 6 —



— FIG. 7 —



— FIG. 8. —



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Process and Apparatus for Generating Gaseous-Fuel.

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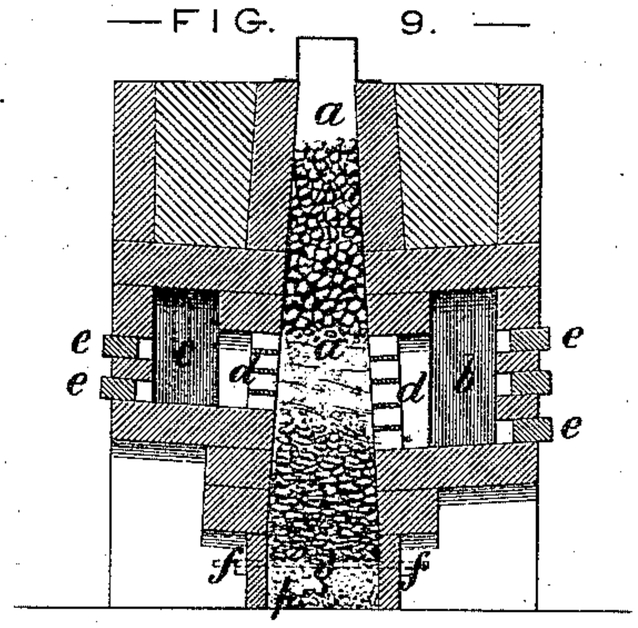
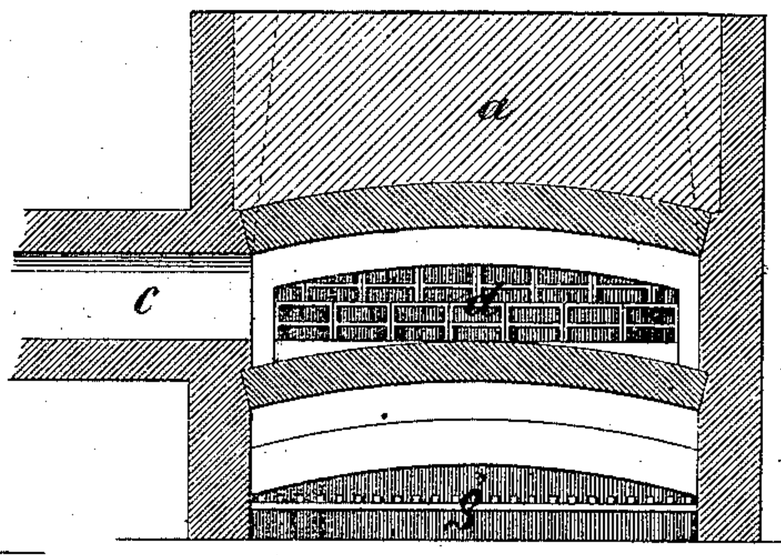
— FIG. 9. —

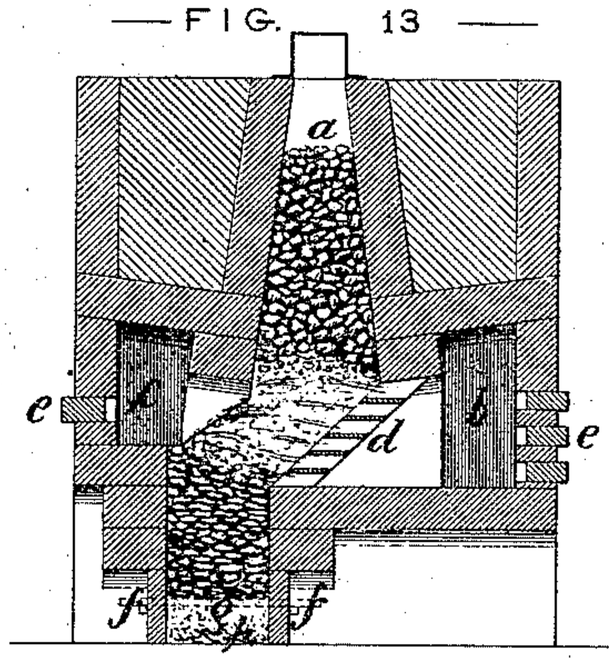


— FIG. 10 —

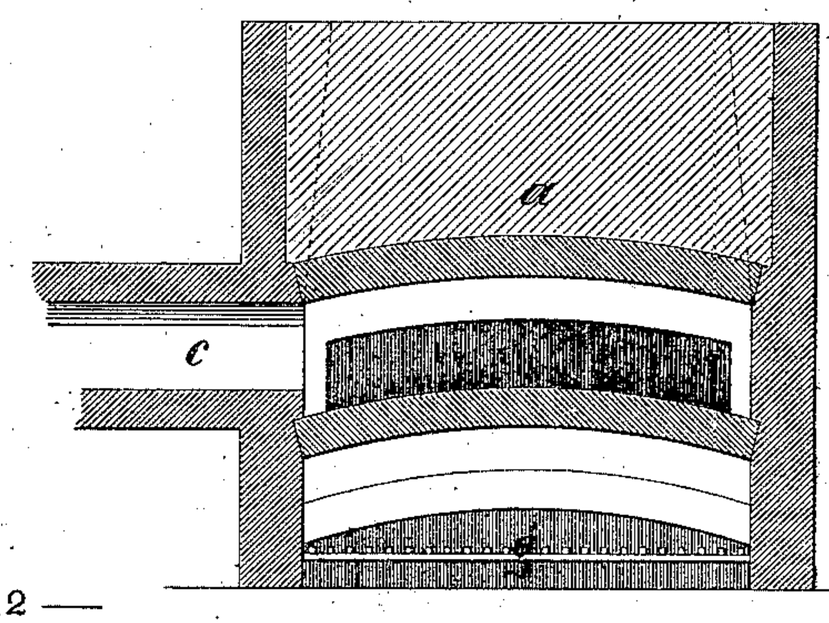


— FIG. 11 —

— FIG. 13 —

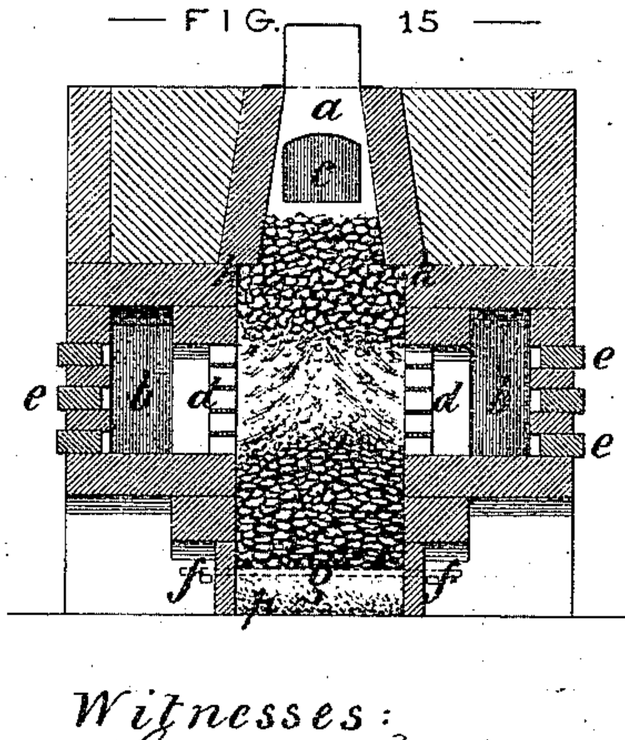


— FIG. 14 —

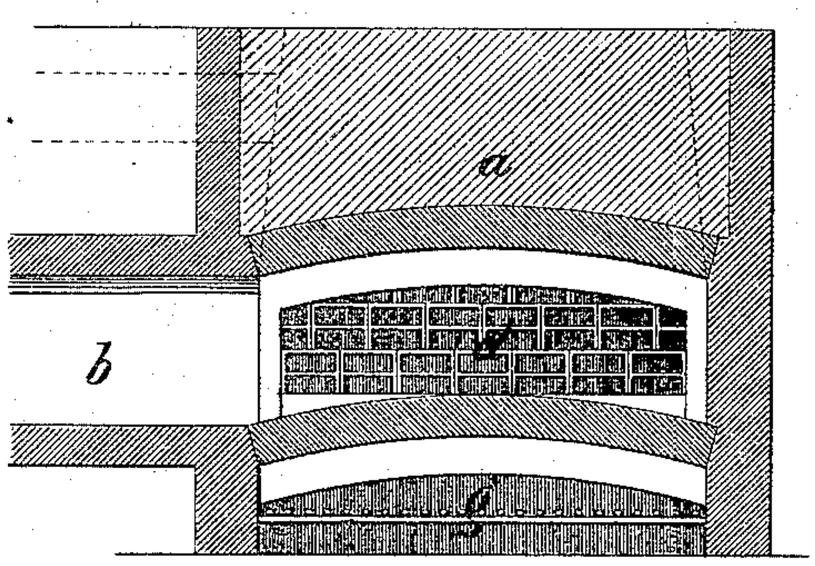


— FIG. 12 —

— FIG. 15 —



— FIG. 16 —



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UNITED STATES PATENT OFFICE.

AUGUSTE PONSARD, OF PARIS, FRANCE, ASSIGNOR TO WILLIAM SELLERS, OF PHILADELPHIA, PENNSYLVANIA.

IMPROVEMENT IN PROCESSES AND APPARATUS FOR GENERATING GASEOUS FUEL.

Specification forming part of Letters Patent No. **163,247**, dated May 11, 1875; application filed August 7, 1874.

To all whom it may concern:

Be it known that I, AUGUSTE PONSARD, of the city of Paris, in the Republic of France, have invented certain new and useful Improvements in the Art of Generating Gaseous Fuel, of which improvements the following is a specification:

It is the object of my invention to increase the production of carbonic oxide from a given quantity of fuel; to produce this gas at the highest possible temperature, so as (without passing it through any recuperator or regenerator) to introduce it at the highest possible temperature to the furnace in which it is to be consumed; to support the combustion of this gas by the introduction to the furnace of air previously heated by the waste products of combustion, and to simplify the apparatus required for the production and consumption of gaseous fuel, while attaining a higher heat than has been heretofore obtained therefrom.

Previous to my invention, when the highest heats from gaseous fuel have been required it has been necessary that the temperature of the gas should be raised before its introduction to the furnace for combustion, not only because it could not be produced at a sufficiently high temperature, but because much of its original heat had been lost in its passage from the producer to the furnace, in most instances widely separated. In that system the expense of the apparatus is increased, not only by the cost of the separate structures, but by the means required to connect them; and as the more volatile particles of the gas are deposited in passing from the producer toward the furnace, and in restoring the heat by the recuperator the gas deposits another portion upon the recuperator, this operation is attended with a constant waste of fuel.

My invention consists, first, in supporting the combustion of the gas producing fuel by supplying it with a continuous current of highly-heated air, and so regulating this supply as to control the activity of the combustion; second, in defining the traverse of this air, and the gas produced thereby, so that the gas shall pass off at the highe t temperature; and, third, in effecting an intense combustion by the introduction to this gas, as it passes to the furnace, of air previously heated by the waste products of combustion.

At the ordinary temperature of the atmosphere, the air and the fuel for the production of carbonic-oxide gas will not combine with sufficient rapidity to produce sensible heat. The rapidity of their combination and the intensity of the resultant heat are probably in proportion to the temperature of the two, respectively, previous to their combination.

In gas-producers, as heretofore constructed, the gas-producing fuel performs two functions—first, to heat the air and the fuel to a sufficient temperature to continue an active combustion, producing carbonic-acid gas, and, second, to heat the remaining fuel to such a degree that a slower combustion without flame will take place, in which the carbonic acid should take up another charge of carbon and become carbonic oxide; but in all such producers a portion of the carbonic acid will pass through without taking up another charge of carbon.

Now, if the air which is to support the primary combustion should be so heated that none of the heat from the fuel would be required for the primary conditions, the carbonic acid would be produced at a much higher temperature, and its liability to pass through the remaining fuel without taking up another charge of carbon would be diminished, so that the product of carbonic oxide from a given quantity of fuel would be greater than has heretofore been obtained. Moreover, the air coming to the fuel heated, instead of to be heated, not only promotes the combustion of the fuel and the production of carbonic oxide, but it also intensifies the temperature of this gas by the direct contribution of heat instead of abstracting it, as heretofore.

It must be borne in mind that the consumption of fuel at any temperature, however high, will be proportioned to the quantity of air admitted to combine with it, so that, while the quantity of air admitted is kept within the limits which must be observed to prevent a too active combustion, the result obtained will be an increased quantity of carbonic oxide at a higher temperature than has heretofore been possible.

In the accompanying drawings I have shown an improved apparatus, in which the operation of my invention is exemplified.

Figure 1 represents a vertical longitudinal

section of my improved apparatus applied to a heating-furnace, line of section A B, Fig. 2. Fig. 2 is a horizontal section thereof, following the line C D, Fig. 1. Fig. 3 is a vertical transverse section on the line *a b*, Fig. 1. Fig. 4 is a vertical transverse section on the line I J, Fig. 1. Fig. 5 is a vertical transverse section on the line *c d*, Fig. 1. Fig. 6 represents in detail, and upon an enlarged scale, the hollow bricks which I use, and the manner in which they are put together in the recuperator. The principal feature in their construction is the recessed ends *s*, which, when in position, as at *s' s'*, form chambers in which fire-clay can be packed, so as to form a key to hold the structure together, as well as an interruption to the passage of gas and air at the joint. This general arrangement of the recuperator is the same as described in Letters Patent of the United States No. 130,313, granted to me August 6, 1872.

The gas-producer consists of a rectangular chamber, *a*, the lower part *b* of which is greatly contracted, in order that the residuum of the fuel (cinders and slag) in the contracted space *b* may be easily removed with stoking-irons.

The fuel is charged through the hopper and clap-valve *c*, and the arch *d* serves to limit its height in chamber *a*. The fuel is supported by the hearth *p*, upon which the cinders and slag will accumulate, and from which they may be removed, as hereinafter described. The hot air is brought from the recuperator *i* to the front of the producer through the conduit *e*, and reaches the fuel through the opening *f*, which takes up nearly the whole width of the chamber *a*.

The ash-pit *g* can be closed by means of vertically-sliding doors of sheet-iron, *h*, which are raised by means of counter-weights; or it may remain open if the pressure of the hot air entering the producer is not great enough to force back the gas through this part of the apparatus. To prevent the loss of gas which might result from its driving back under pressure, the sliding doors may, after each clearing of the pit, be luted with ashes, earth, or sand.

In the front wall of the contracted portion *b* of the producer, above the arch of the ash-pit, openings *j* are provided, through which stoking-irons may be introduced to lift and stir the fuel; and to remove the ashes and slag to the lower part of the apparatus through the openings *j*, bars may be inserted to sustain the fuel above the hearth, and within the producer, while the ashes, cinders, or slag are being removed from the hearth *p* beneath the bars. In the side walls of the producer are also provided openings *k*, which, together with the sight-holes *l*, arranged in the arch, allow the introduction of stoking-irons to compact the fuel, and to break up any arches that may be formed by the agglomeration of coal, especially if a rich kind of coal is used. The recuperator *i* is divided into two parts, one of which serves to heat the air required to support combustion in the producer, and the other to heat the air for the combustion of the gas as it enters the furnace by means of the passage *m*. This division of the recuperator into two distinct parts may be made complete or partial only; in other words, they may be entirely separated by a solid wall, or the transverse air-passages only may be filled up (divided) by solid bricks, leaving the passages for products of combustion in communication. This latter disposition is represented in the drawing.

Whatever arrangement may be adopted, independent valves must be placed before each group of orifices for the admission of air into the divided recuperator, to regulate the quantity of air admitted to the producer, as well as to the furnace. In the drawings, the position of these valves is represented at *n*, Fig. 1, in the rear of the recuperator, and they are operated by screwed rods *n'* and hand-wheels *o*.

With a view to obtain the maximum advantages of my improved system hereinbefore described, I contemplate varying, under varying circumstances, the construction of the producer, with the view, in all cases, to admit the air above the hearth, to define its traverse through the fuel, and to carry off the carbonic oxide from that section of the producer where this gas is the hottest.

In the disposition represented in Figs. 7 and 8, the gas-producer consists of a vertical chamber, *a*, (which is charged with fuel by means of two ordinary valve-boxes, *b'*,) the lower portion of which presents openings upon opposite sides, by means of which the cinder and ashes may be removed. To this end the lower portion of the space *a* terminates in two inclined planes, *c*, extending down to a certain distance above the ground, in such manner that raking-bars may be easily inserted into the openings thus provided, to loosen and remove the ashes and cinders accumulating in this portion of the producer. In this disposition the conduit *b* for the outgoing gas is placed lower than shown in the drawings, Figs. 1 to 5, and is elevated above the plane of the conduit *c*, for the admission of air, so that the air will traverse the fuel in a slightly-ascending plane.

Figs. 9 and 10 represent a gas-producer, *a*, which from the top to its base presents the form of a frustum of a pyramid. This is varied in width according to the nature of the combustible employed. In this disposition the conduit *b* of the outgoing gas is placed at the same height with, or even a little lower than, the conduit *c*, supplying the hot air, and the two orifices of these conduits are fitted with a grating, *d*, forming a part of the inclosure of the space *a*. This grating is constructed of refractory pieces, (as bricks,) the shape of which may vary, while they are so disposed as to leave sufficient sectional area for the air and gas. These bricks are simply built up without the interposition of any mortar, so that they may be easily replaced (when

deteriorated) through the openings *e*, provided in the two parallel long sides of the producer. The lower part of the apparatus is closed by loose walls *f*, which are withdrawn to remove the ashes produced by combustion, the coal remaining supported during this time by the grate *g*, the removal of a few bars of which will allow the cinders accumulated in this part of the producer to fall.

Figs. 11 and 12 represent diverse arrangements of the gratings *d*, designed to prevent the coal from falling out laterally into the passages *b* and *c*, for the outlet of gas and inlet of air. In Fig. 11 the grating is formed by thin bricks *h*, laid flat upon bearers *i*, leaving passages between these shallow enough to prevent the coal from sliding outward. In Fig. 12 the grating is formed of hollow bricks *j*, arranged in quincunx, or simply superposed, so as to leave numerous passages for the gas and air, while they prevent the coal from obstructing the passages *b* and *c*.

It is evident that the forms and dispositions of these pieces of refractory clay may be greatly varied without inconvenience, provided they are arranged to be easily withdrawn and replaced through the openings *e* when they become injured from use.

Figs. 13 and 14 represent a producer in which only the orifice *b* for the outlet of gas is closed by a grating, *d*, disposed in steps. The other side where the air is admitted is inclined, and if a similar inclination is given to the grating, the layer of coal traversed by the air is about equal at all points.

Figs. 15 and 16 represent a producer, in which the hot air enters the fuel from above, and the gas may go out through one side or both sides of the apparatus. The drawing represents two outlets, *b*, and I have also increased the width of this part of the chamber, so that the layer of fuel traversed by the air may be as uniform as possible. It will also be observed that I have provided in the masonry offsets *k*, into which the fuel may slide, and which will tend to prevent the hot air entering by the passage *c* from following the inclosure of space *a*, and compel it to traverse the fuel before reaching the outlets *b* for the gas.

The air which supports combustion in the gas-producer acquires the force necessary to enter the producer from the heat which it receives in passing through the recuperator; but it may also be injected either by means of a blower, or by a jet of steam, or by a blast-engine of any kind. Of these methods I prefer to employ the jet of steam, because the steam in passing through the fuel is decomposed, and produces a gas rich in carbon. I obtain this result, when the air is not forced, by admitting into the lower part of the recuperator a small quantity of water by means of an iron tube, which is inserted into the air-inlet, as shown in Fig. 1. This water is vaporized in the iron tube, and escapes as steam into the recuperator.

I am aware that a gas-producer has been described, in the operation of which previously-heated air was introduced to support the combustion of the gas-producing fuel. Two regenerators and conduits alternately carried a current of air to, and a current of gas from, the producer, and these currents were reversed for the purpose of heating the air, but with the effect of cooling the gas. Each conduit and regenerator, therefore, was alternately filled with gas or with air, so that with each reversal of the currents the gas contained in the one was returned through the fuel, while the air contained in the other was delivered into the flue leading to the furnace, where it would mix with and deteriorate the quality of the gas. In this case the length of the flue to the furnace permitted an admixture; but with a delivery directly into the furnace, such as I contemplate and set forth, the flame would be extinguished, and its place supplied by a blast of heated air alone at each alternation, which would not only diminish the heat, but oxidize the contents of the furnace.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. As an improvement in the art of generating gaseous fuel, the method, substantially as hereinbefore set forth, of increasing the production and intensifying the heat of the carbonic oxide, by supporting the solid fuel upon the hearth of the producer, and supplying to it above the hearth a regulated continuous current of highly-heated air.

2. The method, substantially as hereinbefore set forth, of supplying to the producer a regulated continuous current of highly-heated air above the hearth, and confining the traverse of the air supplied and the gas produced to the hottest section of the producer, substantially as described.

3. The combination, substantially as hereinbefore set forth, of a gas-producer, a furnace, a recuperator, through which the air is supplied which supports the combustion in the gas-producer, and a recuperator, through which the air is supplied which supports the combustion in the furnace.

4. The combination, with the gas-producer, the furnace, and the recuperator, of the regulating-valves, substantially as set forth.

5. The divided recuperator, substantially as described.

6. The bricks provided with recesses, substantially as and for the purposes set forth.

A. PONSARD.

Witnesses:

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HENRI VARLIN.