No. 851,756. PATENTED APR. 30, 1907.

A. E. JOHNSON.

GAS PRODUCING AND HEAT GENERATING PROCESS.

APPLICATION FILED JULY 1, 1905.

2 SHEETS—SHEET 1.

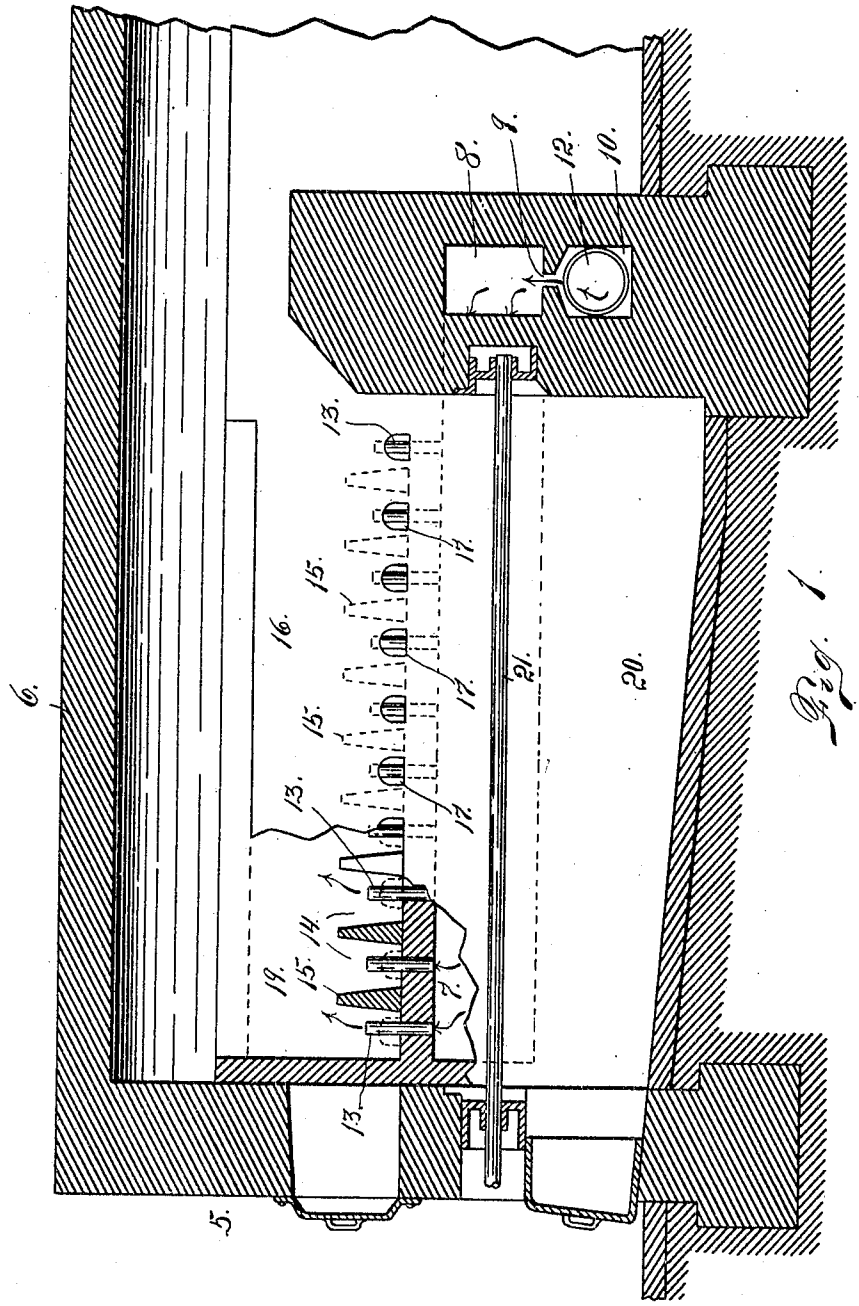

Fig. 1.

Witnesses
Otto E. Hoddick.
Dena Nelson.

Inventor
A. E. Johnson.
By A. J. & Brew
Attorney

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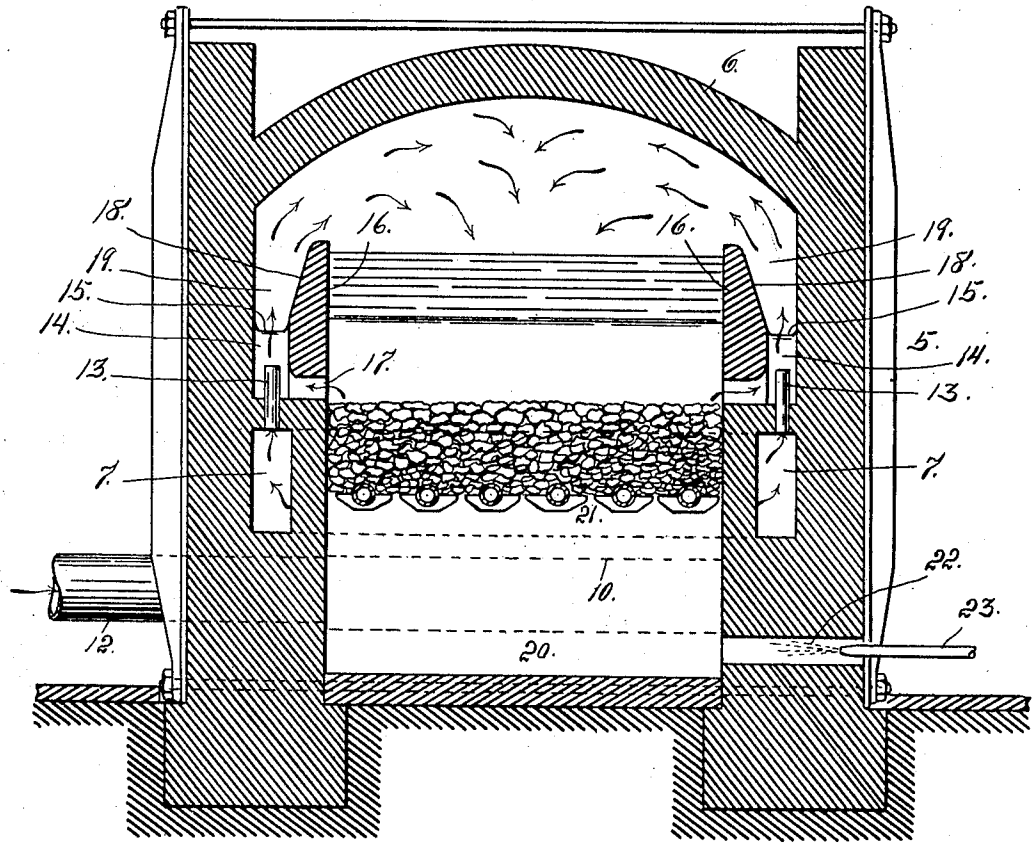

Fig. 2.

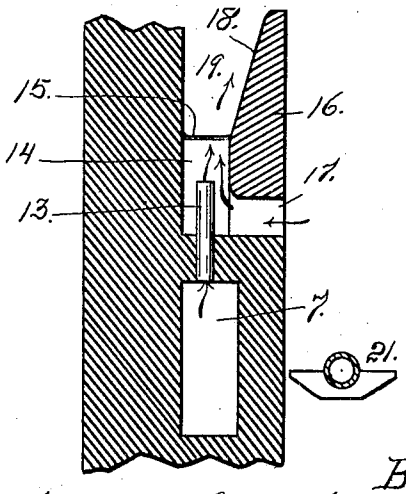

Fig. 3.

Witnesses
Otto E. Hoddick.
Dena Nelson.

A. E. Johnson.
Inventor
By
Attorney

UNITED STATES PATENT OFFICE.

ALFRED E. JOHNSON, OF DENVER, COLORADO, ASSIGNOR TO THE JOHNSON FURNACE AND ENGINEERING COMPANY, OF COLORADO SPRINGS, COLORADO.

GAS-PRODUCING AND HEAT-GENERATING PROCESS.

No. 851,756. Specification of Letters Patent. Patented April 30, 1907.

Application filed July 1, 1905. Serial No. 267,987.

To all whom it may concern:

Be it known that I, ALFRED E. JOHNSON, a citizen of the United States, residing at the city and county of Denver and State of Colorado, have invented a certain new and useful Gas-Producing and Heat-Generating Process; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to a gas-producing and heat-generating process, my object being to utilize to the best advantage the combustible elements contained in the fuel, and at the same time localize the combustion whereby the greatest heat may be generated where it is required. These requirements necessitate conditions whereby the fuel is only partially consumed in the fuel bed, the remainder of the fuel passing upwardly as gas or unconsumed fuel elements; and bringing air heated to the proper degree, into engagement with these unconsumed elements at the desired location where the heat is to be utilized for the purpose intended. In order to produce these conditions, I maintain a thick bed of fuel in the fire box, and pass air and steam under pressure up through this bed. In this event a comparatively small portion of the fuel is consumed in the bed, while the greater portion of it is formed into gas by the combined action of the air and steam, this gas rising upwardly above the fuel bed. I also introduce air under pressure into chambers formed in the furnace wall on opposite sides of the fire box and carry this air upwardly into chambers above and also on opposite sides of the fire box but extending above the fuel bed, the last named chambers communicating with the fire box at the top of the fuel bed. The velocity of the air when introduced into these upper chambers and across the fire box communicating openings, produces a partial vacuum in these upper chambers whereby a portion of the flame and heated gases is drawn into the upper chambers from the top of the fuel bed, whereby the air so introduced is suitably heated. Above this point where the flame and heated gases are made to mingle with the air, these upper chambers are separated from the fire box, thus preventing the heated air from coming in contact with the rising producer gas or unconsumed fuel elements, until these elements have reached a suitable elevation. As the air introduced into the side chambers of the furnace passes upwardly under pressure as aforesaid, the chambers are so constructed that the air is allowed to expand thus preventing any back pressure and maintaining an upward current until the arch on opposite sides is reached. In this manner two opposing currents of hot air are formed and as these currents meet at the top of the arch, they are given a downward impetus by virtue of their own resistance or opposing action, and though considerably heated, are still at a lower temperature than the rising gases from the fuel bed, and therefore have a natural downward tendency whereby they are caused to mingle with the unconsumed fuel elements, resulting in approximately perfect combustion in a zone suitably located between the arch of the furnace and the top of the fuel bed. This zone may be varied according to circumstances and according to the uses to which the furnace is to be applied. Below this zone of combustion is a zone of unconsumed fuel elements containing some incombustible products rising from the fuel bed and occupying a position immediately above the fuel bed, whereby the latter is protected from the direct contact of the air from above. The fuel of the bed is thus prevented from burning too rapidly. As the gases rise from the top of this protecting zone and unite with the air introduced above, other gases come up from the fuel bed, thus maintaining the gas protecting zone above the fuel bed. This is an essential feature in carrying out the process.

Having briefly outlined my improved process, I will proceed to describe a suitable mechanical construction for practicing or carrying the same into effect. This construction is illustrated in the accompanying drawing in which,

Figure 1 is a vertical longitudinal section of the furnace, the side wall on one side being partly broken away. Fig. 2 is a vertical cross section taken between the bridge wall and the front wall of the furnace. Fig. 3 is

an enlarged fragmentary detail view similar to Fig. 2.

The same reference characters indicate the same parts in all the views.

Let the numeral 5 designate the inclosing walls of the furnace equipped with buck-stays in the usual manner and also provided with an arch 6 which may be modified to suit the special requirements to which the furnace is to be applied. The side walls are provided with chambers 7 which communicate at their rear extremities with a transverse chamber 8 formed in the bridge wall and whose bottom wall is slotted as shown at 9 whereby the chamber 8 communicates with a chamber 10 below, into which air is introduced under pressure from a feed pipe 12. This air rising through the slot 9 enters the chamber 8 and passes forwardly through both side chambers 7. The top walls of these chambers 7 are provided with openings in which are inserted nozzles 13 of relatively small diameter and which protrude into relatively narrow compartments or short flues 14 commencing at the level of the top of the fuel bed and extending upwardly a short distance. These short flues 14 are formed by placing small partition walls 15 between the outer wall of the furnace and inner walls 16 preferably composed of fire clay or other suitable refractory material. At the bottom of these walls are formed openings 17 leading from the fire box just above the fuel bed, to the compartments or short flues 14. Above the top flues 14 or above the tops of the partitions 15, the surfaces of the adjacent walls 16 are beveled as shown at 18 whereby the chambers 19 between the walls 16 and the outer walls of the furnace are enlarged to permit the desired expansion of the air whose temperature has been considerably raised by reason of its union with the hot gases drawn from the top of the fuel bed by virtue of the suction induced by the introduction of the air under pressure through the nozzles 13 and across the inner extremities of the openings 17 in the fire wall 16.

The necessary air and steam or the necessary combination of combustion-supporting and combustion-retarding media is introduced to a closed chamber 20 below the grate 21 supporting the fuel bed. This chamber 20 should be sealed whereby there is no escape for the fluid introduced thereto except upwardly through the fuel bed. The air and steam enter the chamber 20 through a duct 22 into which protrudes a nozzle 23 through which the air and steam may be delivered to the duct.

The operation of this mechanism may be described as follows: The air under pressure is introduced to the bridge wall chamber 8 and passing thence into the chambers 7 upwardly through the nozzles 13 enters the short flues or compartments 14. The velocity of the air on entering these flues and passing across the openings 17 communicating with the fire box at the top of the fuel bed, is such that it produces suction or a partial vacuum, whereby a portion of the flame or heated gases is drawn through the openings 17 and uniting with the air so introduced, raises its temperature to a point at which it will readily combine with the combustible gases that arise from the fuel bed as heretofore explained. As this air passes upwardly through the chambers 19 located between the vertical inner walls and the outer walls of the furnace, the air is mixed thoroughly with the induced current of flame and heated gases, and since the chambers 19 increase in size as they extend upwardly by reason of the taper 18 of the walls 16, the air is allowed the necessary freedom for proper expansion, thus preventing any back pressure as heretofore explained, which back pressure would result in the absence of the enlargement of the chambers 19.

The air as it leaves the chambers 19 having an upward velocity due to its pressure, tends to follow the curve of the arch as indicated by the arrows, but as it spreads, its motion is checked on each side by the current from the opposite side, whereby it is caused to slowly settle downwardly where it meets the ascending imflammable gases or unconsumed fuel elements rising from the fuel bed, thus producing perfect or approximately perfect combustion and consequently intense heat in the upper part of the furnace or wherever the conditions stated are brought about. The zone of gases, however, is constantly maintained immediately above the fuel bed, whereby the latter is protected from the air above as heretofore explained. In this construction, provision is made for supporting a deep bed of fuel, upon a water-cooled grate. The slow burning of the fuel in the bed, together with the admission of a certain amount of steam with the air, tends to reduce the formation of clinkers while providing the necessary heat for the decomposition of the steam and the liberation of the volatile hydro-carbons.

Having thus described my invention, what I claim is:

1. The herein described process consisting first in passing air and steam up through a thick bed of fuel in various stages of combustion whereby gas is generated and caused to rise from the bed; second, maintaining a fuel bed protecting zone of gas immediately above the fuel bed; and third, causing a downwardly directed current of heated air to mingle with the upper stratum of the rising gases without disturbing the gas zone immediately in contact with the fuel bed.

2. The herein described gas generating and heat-producing process consisting in passing a gaseous fluid up through a thick bed of fuel in various stages of combustion resulting in

the production of fuel gas and causing the same to pass upwardly above the fuel bed; passing air upwardly under pressure on opposite sides of the fuel bed and causing a portion of the hot gases to mingle therewith in the p ane of the top of the fuel bed whereby the air so introduced is considerably heated and caused to enter the furnace considerably above the fuel bed and caused to mingle with the upper stratum of the rising gases; and maintaining a protecting zone of unconsumed fuel elements and incombustible gases immediately above the fuel bed.

3. The herein described process consisting in passing air and steam up through a thick bed of fuel in various stages of combustion whereby gas is generated and caused to rise upwardly from the bed; passing air upwardly under pressure at the side of the fuel bed whereby a partial vacuum is produced, and a portion of the flame and heated gases at the top of the fuel bed caused to mingle with the air, whereby the latter is heated to a considerable degree, and under conditions separating it from the body of the fuel gases rising from the bed, and allowing it to expand in volume as it moves upwardly; causing the air thus prepared to mingle with the gases rising from the fuel bed, and maintaining a protecting zone of gases immediately above the fuel bed.

4. The herein described process consisting in passing air and steam up through a thick bed of fuel in various stages of combustion whereby gas is generated and caused to rise from the fuel bed, introducing heated air to the furnace at a considerable distance above the top of the fuel bed and causing it to mingle with the upper stratum of the rising fuel gases, and maintaining a zone of unconsumed gases containing some incombustible elements immediately above the fuel bed.

5. The herein described process consisting in passing a combustion supporting medium and a combustion retarding medium up through a thick bed of fuel in various stages of combustion, whereby gas is generated and caused to rise from the fuel bed, and causing a downwardly directed current of heated air to mingle with the upper stratum of the said rising gases, and maintaining a lower stratum of gases immediately above the fuel bed in order to shield the latter from the descending air current.

6. The herein described process consisting in maintaining a protecting gas zone immediately above the top of a deep bed of fuel in various stages of combustion, passing a gaseous fluid up through the fuel bed, and introducing opposing currents of air above the produced zone of gases which rise from the top of the bed and protect the latter from direct contact with the air.

7. The herein described process consisting in introducing air above the top of a deep bed of fuel in various stages of combustion, maintaining a protecting gas zone between the top of the fuel bed and the air so introduced, and passing a gaseous fluid up through the fuel bed, the said fluid being of a nature to generate the gas which rises above the bed.

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

ALFRED E. JOHNSON.

Witnesses:
DENA NELSON,
A. J. O'BRIEN.