

No. 819,228.

PATENTED MAY 1, 1906.

A. E. JOHNSON.  
FURNACE.

APPLICATION FILED JULY 1, 1905.

3 SHEETS—SHEET 1.

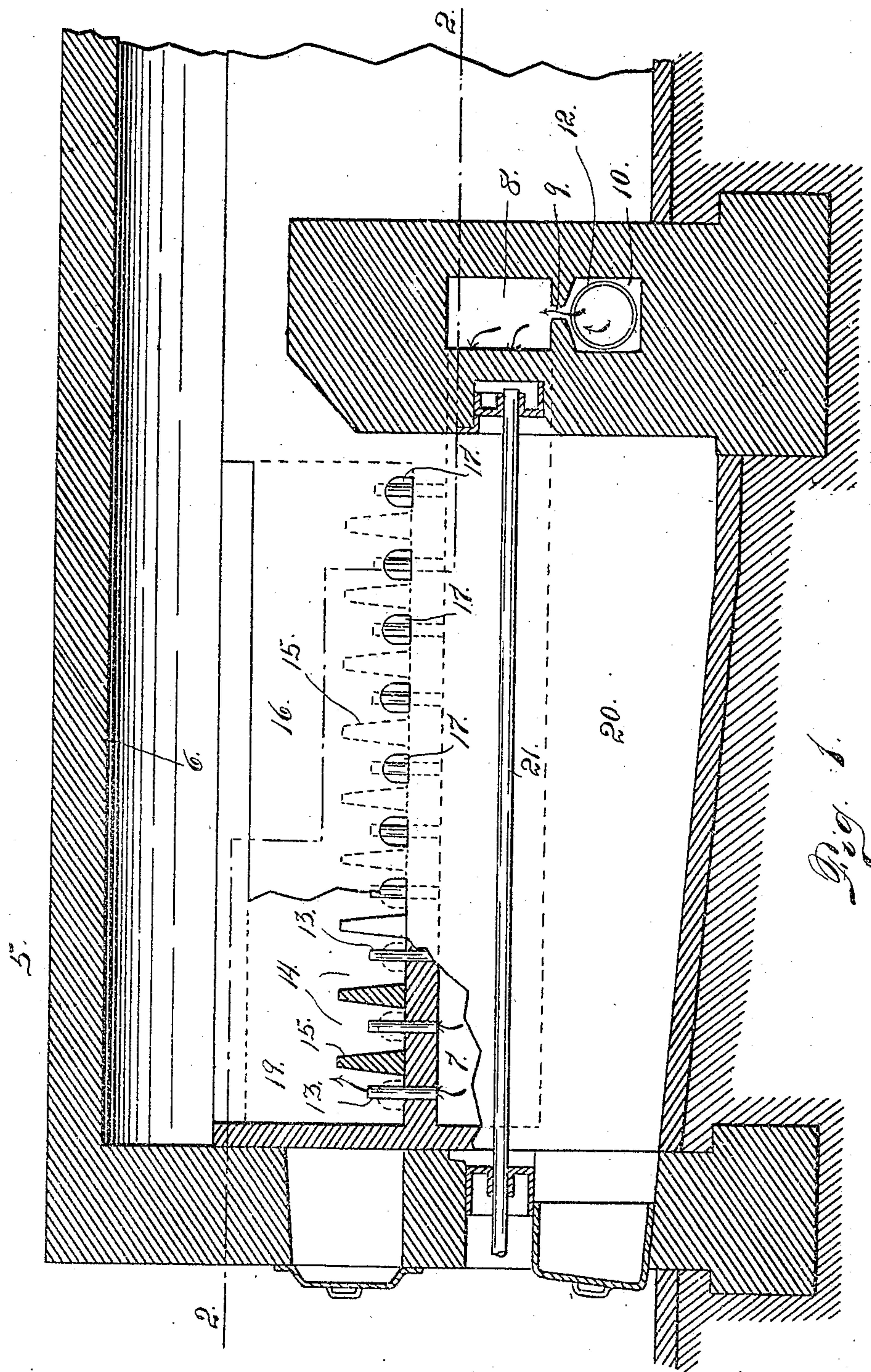


Fig. 1.

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Inventor  
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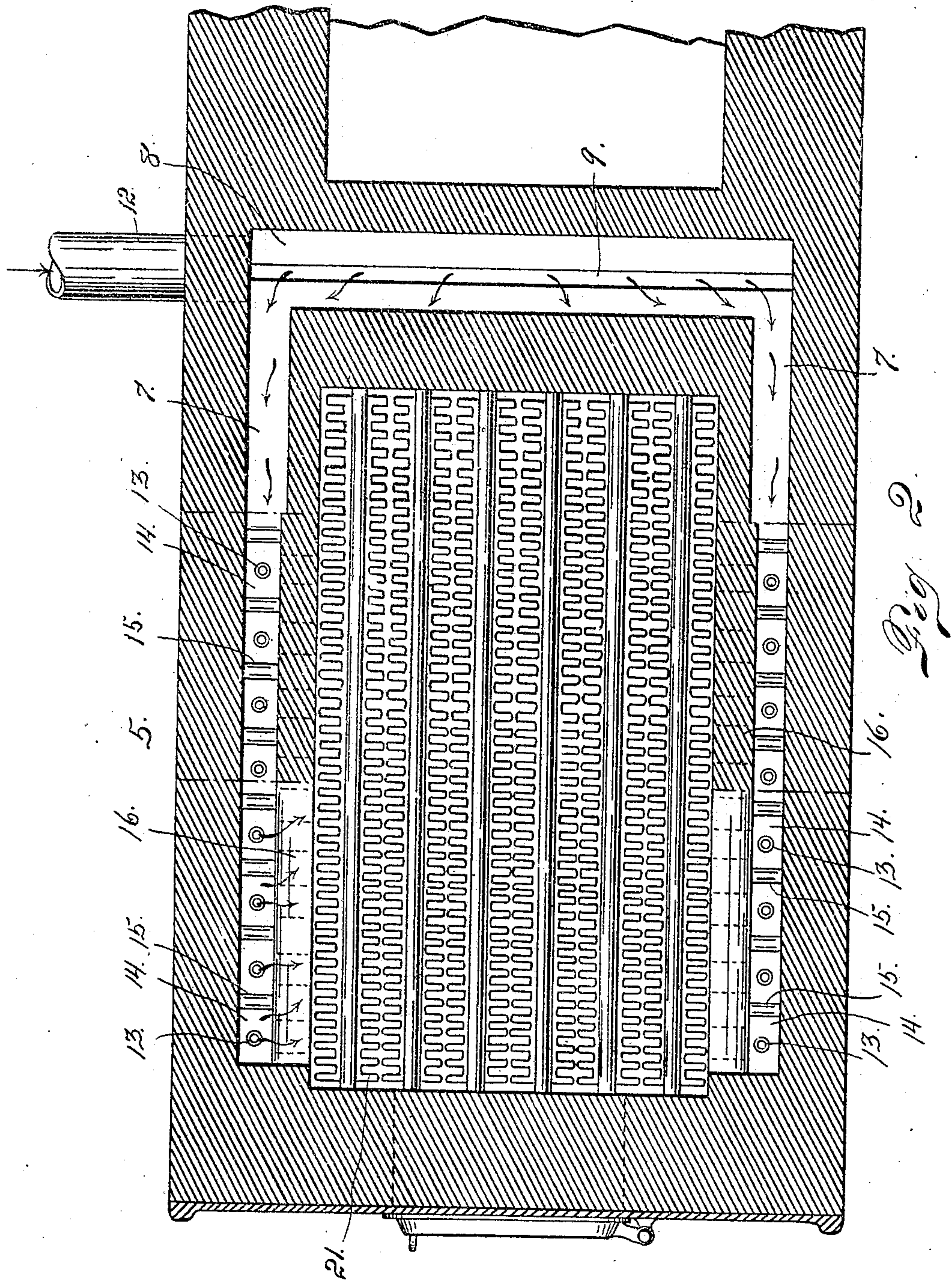
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3 SHEETS—SHEET 2.



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3 SHEETS—SHEET 3.

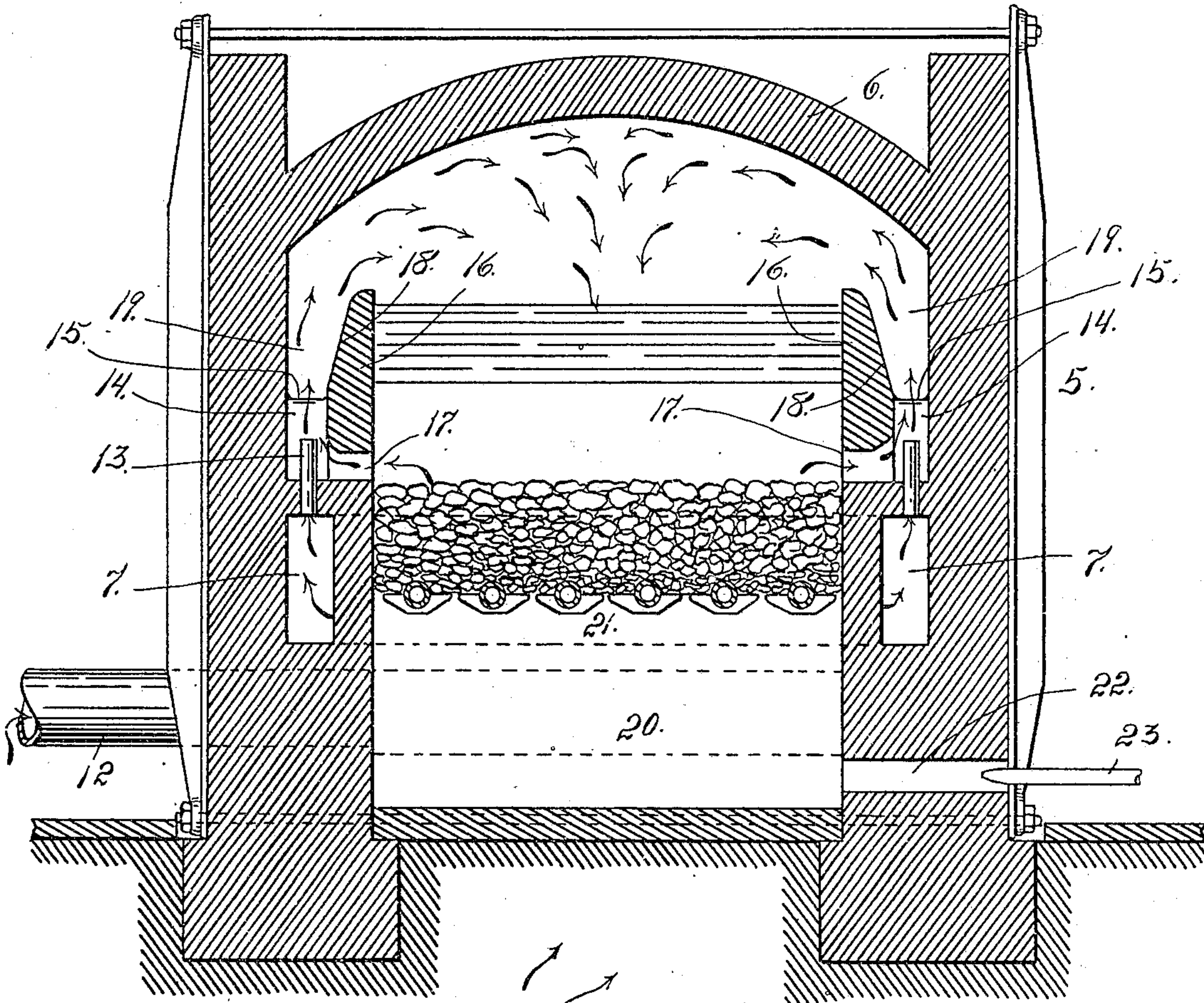
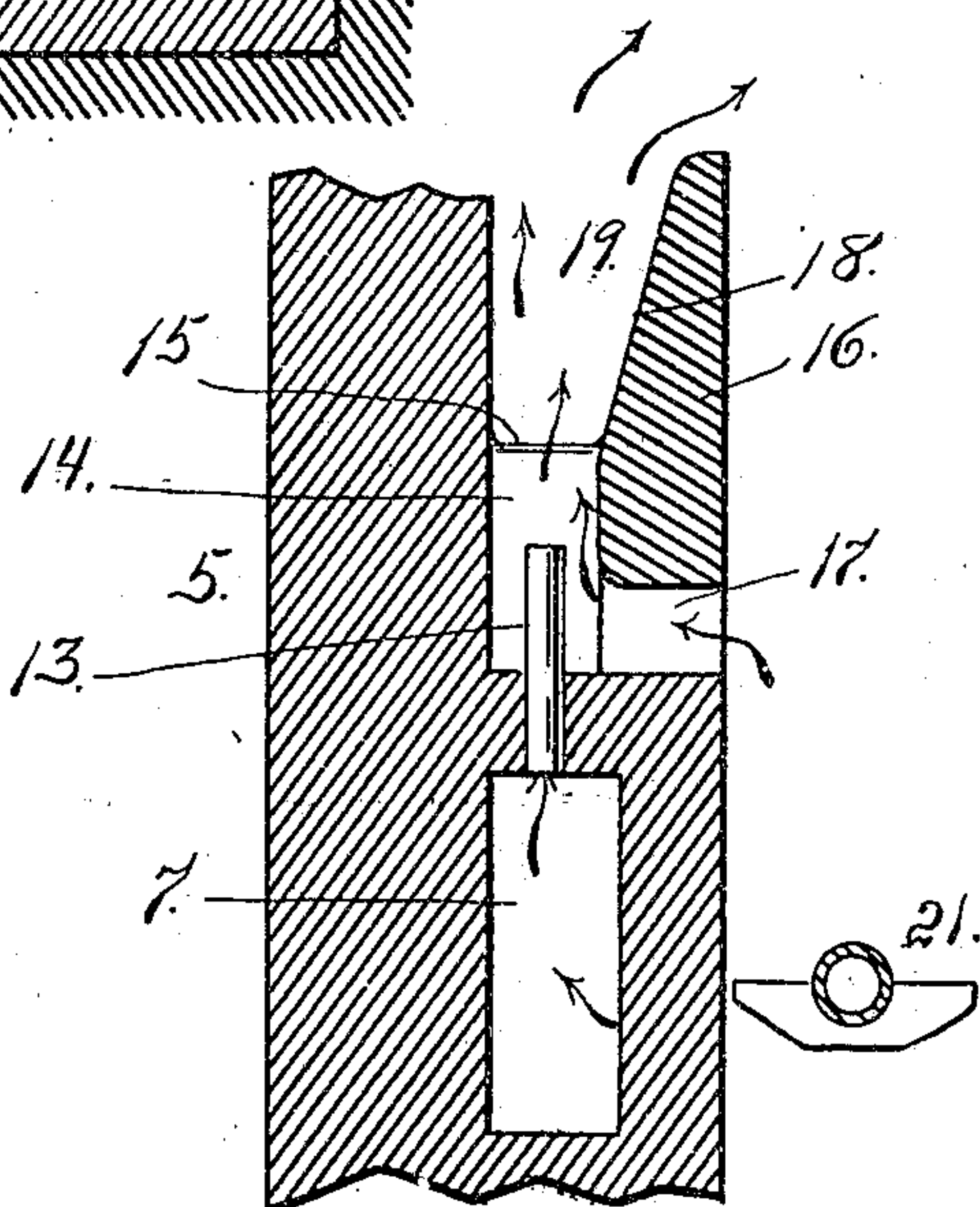


Fig. 3.



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Fig. 4. by A. E. Johnson  
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# UNITED STATES PATENT OFFICE.

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## FURNACE.

No. 819,228.

Specification of Letters Patent.

Patented May 1, 1906.

Application filed July 1, 1905. Serial No. 267,988.

*To all whom it may concern:*

Be it known that I, ALFRED E. JOHNSON, a citizen of the United States, residing in the city and county of Denver and State of Colorado, have invented certain new and useful Improvements in Furnaces; 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 figures of reference marked thereon, which form a part of this specification.

My invention relates to improvements in furnaces in which only partial combustion takes place in the fuel-bed, the latter being of considerable thickness. In a furnace of this class it is exceedingly important that the necessary air or oxygen for purposes of combustion shall be united with the unconsumed fuel-gases at the proper temperature and at the proper point or location where combustion is to take place. In order to attain the desired semigas-producing results, steam is introduced with the air into the chamber below the fuel-bed under suitable pressure to cause the air and steam to pass upwardly through the bed. The steam acts as a combustion-retarding medium, and by combining it with the air, whose oxygen is a combustion-supporting medium, the desired combination for my purpose is obtained—that is to say, I get a proper amount of combustion within the fuel-bed by reason of the union of the oxygen of the air with the combustible fuel elements, and at the same time by reason of the introduction of the steam with the air undue combustion is prevented, thus producing a gas and causing a large quantity of unconsumed fuel elements to pass upwardly above the fuel-bed, the draft of the furnace having a tendency to carry these elements rearwardly or to the location where the greatest heat is required. In order to bring about the desired or necessary union between these unconsumed fuel elements and the air at a proper temperature and at the proper location, I introduce air under pressure to a chamber formed in the furnace-walls around the fire-box and conduct said air through nozzles protruding through the top of this chamber and entering recesses or relatively narrow

compartments communicating with the fire-box at points preferably just above the top of the fuel-bed, the said compartments terminating above in a continuous chamber which increases in size as it extends upwardly, the said chamber being formed by placing walls on opposite sides of the fire-box, which walls are tapered on the side remote from the fire-box in order to enlarge the air-chambers outside of the fire-box and above the fuel-bed. This enlargement is necessary in order to allow the air an opportunity for proper expansion after it leaves the compartments below, thus obviating any back pressure of the air, which otherwise would result, thus preventing the object which I desire to attain—namely, the drawing of the heat from the fire-box by reason of the suction or partial vacuum produced in the compartments just above the fuel-bed, due to the introduction of air under pressure to said compartments and across the openings communicating with the fire-box, whereby the heat from the fire-box is mingled with the air, thus giving it the proper temperature. As this air is heated its tendency is to expand, and provision to permit this expansion is made by the enlargement of the chamber above, as heretofore explained. This heated air passes upwardly on both sides of the fire-box and strikes the arch of the furnace, resulting in two opposing currents, which may be said to meet at the center of the arch above the fire-box. This meeting of the two currents has a tendency to throw the air downwardly, and as this air, while considerably heated, is still cooler than the unconsumed fuel elements rising from the top of the fuel-bed, the air settles downwardly and unites with the rising unconsumed fuel elements, producing the necessary combustion in the upper part of the furnace. In this way I attain an ideal condition and approximate perfect combustion as nearly, I believe, as it is possible to attain this end.

Having briefly outlined my improved construction as well as the function I expect to attain thereby, I will proceed to describe the same in detail, reference being made to the accompanying drawings, in which is illustrated an embodiment thereof.

In the drawings, Figure 1 is a vertical longitudinal section taken centrally through the



furnace, the fire-wall, however, being partly broken away on one side to disclose the compartments into which the air-nozzles protrude. Fig. 2 is a horizontal section taken on the several planes indicated by the line 2 2, Fig. 1. Fig. 3 is a vertical cross-section taken through the furnace, cutting the fire-box at any point forward of the bridge-wall. Fig. 4 is a fragmentary sectional view similar to Fig. 3, but with the parts shown on a larger scale.

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 buckstays 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.

From the foregoing description the use and operation of my improved construction will be readily understood. The air under pressure is introduced to the bridge-wall chamber 8 and passing thence into the chambers 7 and 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 inflammable 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.

In my improved construction of furnace 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 hydrocarbons.

One important result obtained by the arrangement heretofore described for the introduction of air to the furnace around the fire-box is that by causing the air to flow upwardly against the sides and under the arch of the furnace these parts are protected from the injurious action of the intense heat produced under these conditions. It may be stated that while the temperature of the air is quite high by the time it has reached the in



terior of the furnace it is still relatively cool as compared with the intense heat due to the combustion of the furnace-gases.

Having thus described my invention, what I claim is—

1. A furnace having inner side walls extending above the fuel-bed and forming chambers between the furnace-walls proper and the fire-box, the inner walls being tapered whereby the said chambers increase in size as they extend upwardly, their upper extremities having free communication with the upper part of the furnace, the inner side walls having openings in their lower portions whereby the fire-box communicates with the chambers, and partitions located in the bottom of the chambers between the bottom openings in the side walls whereby a series of compartments or flues is formed, and means for introducing air from below and under pressure into the said compartments or flues for the purpose set forth.

2. A furnace having a chamber located outside of and above the tops of the fuel-bed, the said chamber increasing in volume as it extends upwardly, its top having free communication with the upper part of the furnace, the said chamber communicating at its bottom with the fire-box by a series of openings above the fuel-bed, partitions separating the bottom of the chamber into a series of compartments corresponding with the openings communicating with the fire-box, and upwardly-directed nozzles entering the bottom of the chamber and protruding into the respective compartments in the bottom thereof.

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

ALFRED E. JOHNSON.

Witnesses:

DENA NELSON,  
A. J. O'BRIEN.