(No Model.) 2 Sheets—Sheet 1.

F. L. BARTLETT.

AUTOMATIC SMOKELESS METALLURGICAL FURNACE.

No. 539,021. Patented May 14, 1895.

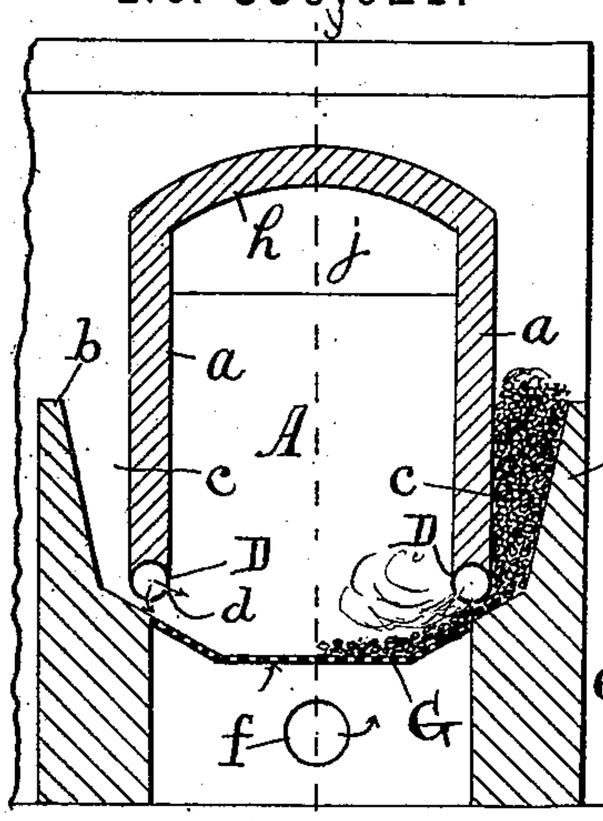

Fig. 1.

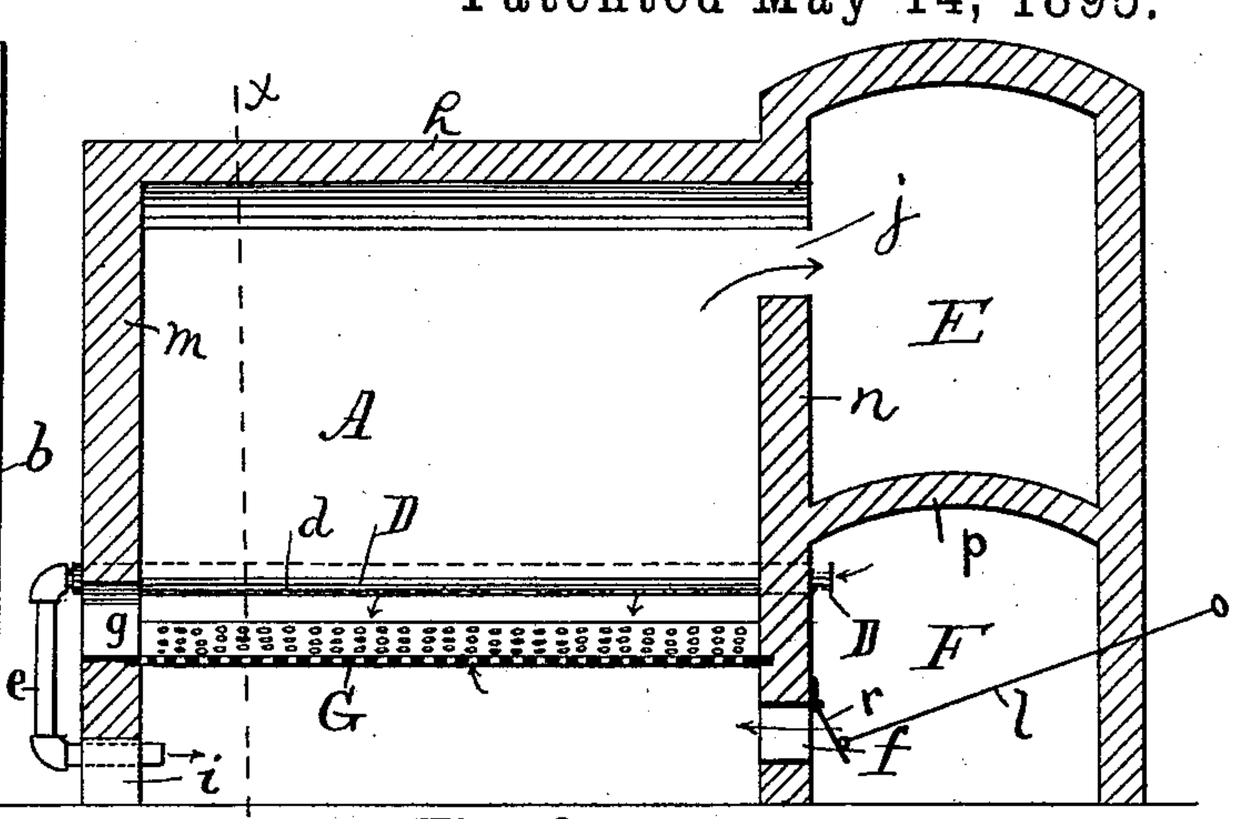

Fig. 2.

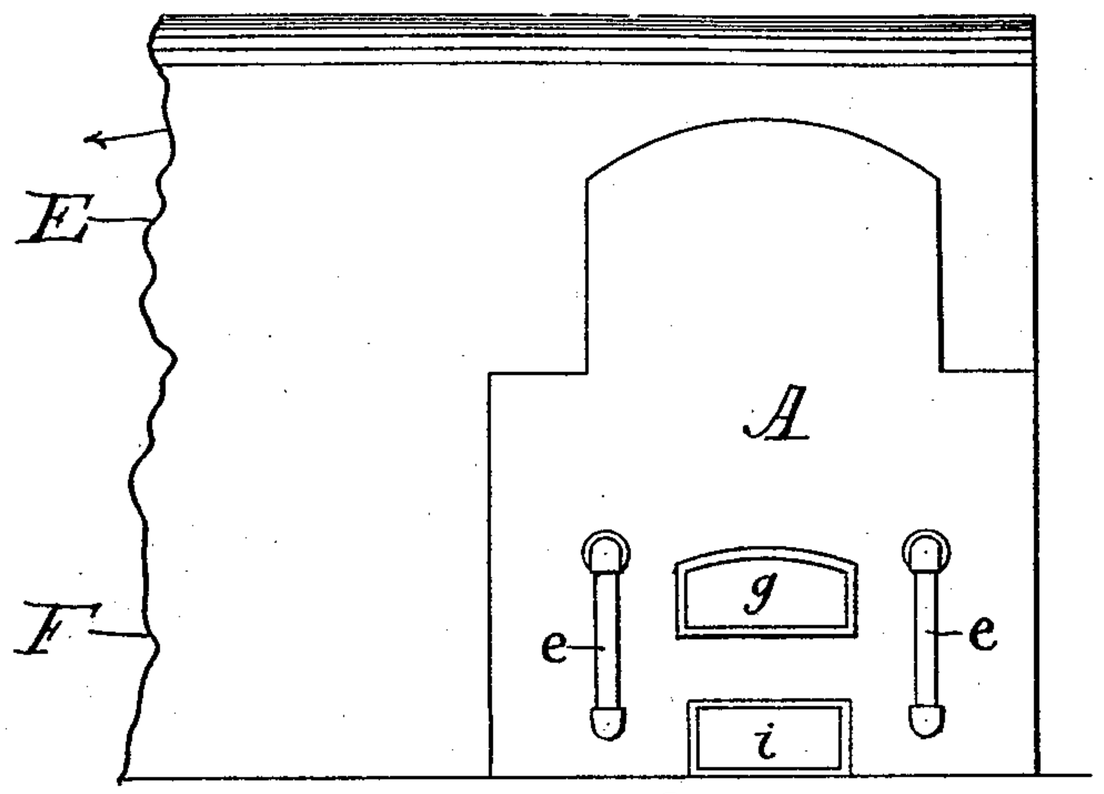

Fig. 3.

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H. G. Palmer

Inventor:
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by S. W. Bates
his atty.

(No Model.) 2 Sheets—Sheet 2.

F. L. BARTLETT.

AUTOMATIC SMOKELESS METALLURGICAL FURNACE.

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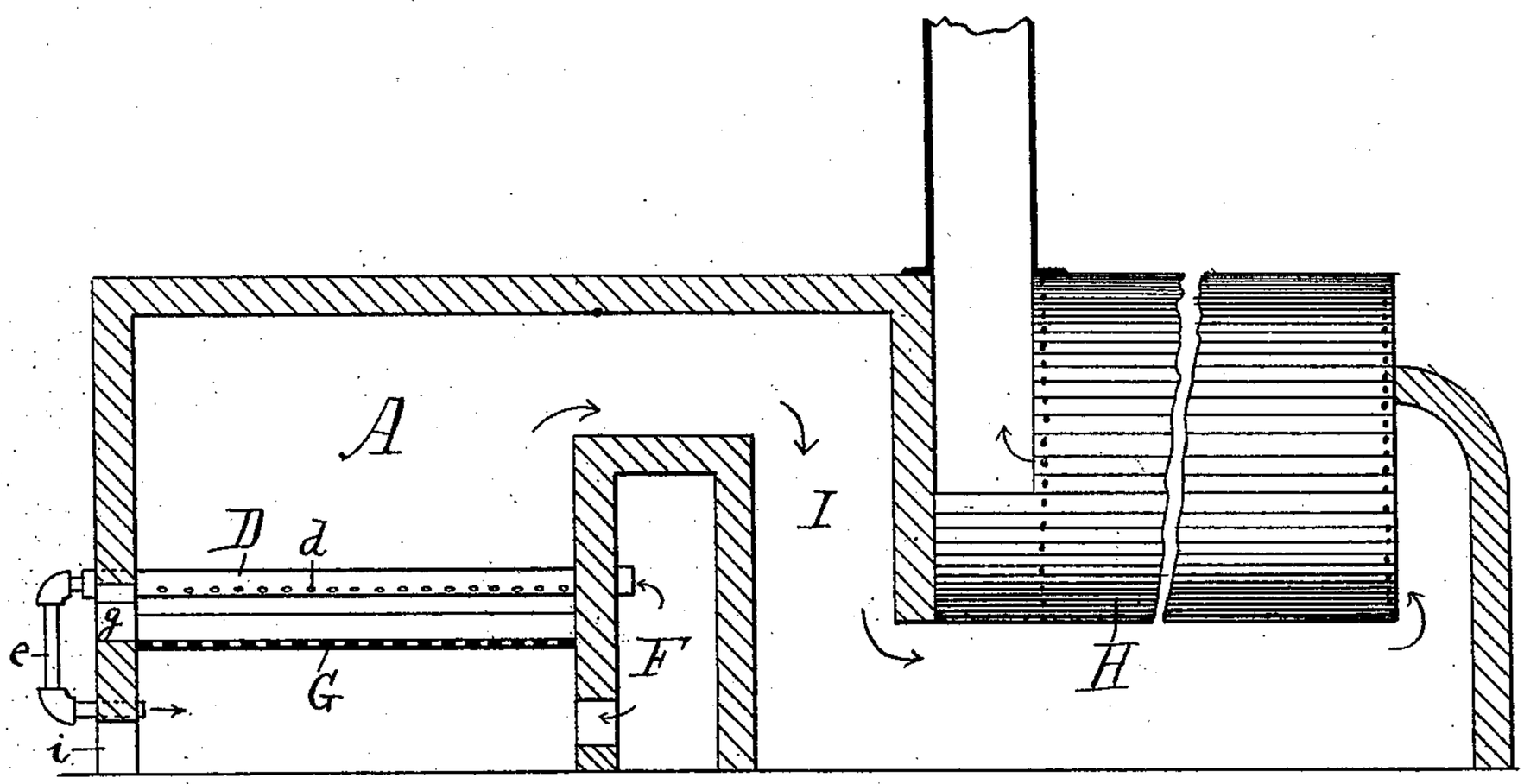

Fig. 4

Witnesses:
H. A. W. Howard.
D. J. Sullivan.

Inventor
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UNITED STATES PATENT OFFICE.

FRANK L. BARTLETT, OF CAÑON CITY, COLORADO.

AUTOMATIC SMOKELESS METALLURGICAL FURNACE.

SPECIFICATION forming part of Letters Patent No. 539,021, dated May 14, 1895.

Application filed December 21, 1893. Serial No. 494,281. (No model.)

To all whom it may concern:

Be it known that I, FRANK L. BARTLETT, a citizen of the United States, residing at Cañon City, in the county of Fremont and State of Colorado, have invented certain new and useful Improvements in Smokeless Furnaces; and I do hereby 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.

My invention has for its object the complete combustion of the cheaper grades of fuel such as fine culm, saw dust, and like material, converting the same into gas and coke and burning it with an air blast, thus completely consuming the volatile products of the fuel and preventing the formation of smoke.

The invention is also designed to be applied to the treatment of certain classes of ores which require to be volatilized.

The invention consists of a furnace so arranged that the coal or other fuel is first coked by the heat of the furnace, and the gases are burned in a sheet of hydrocarbon flame over the grates in combination with a carbon flame produced by the burning of the coked material on the grates. The two kinds of flame are thus mingled and burned together forming an intense heat capable of effecting the complete combustion of the hydrocarbon fuel without smoke.

In the accompanying drawings I have illustrated a furnace which is well suited to carry out my invention.

In the drawings, Figure 1 represents a cross-section on the line *x x* of Fig. 2. Fig. 2 is a central longitudinal section on the line *y y* of Fig. 1. Fig. 3 is a front elevation. Fig. 4 is a sectional view showing the furnace as applied to a steam-boiler.

A represents the furnace proper the same consisting of the end walls *m n* and the side walls *a a* with the arch or dome *h*.

On each side of the furnace and outside of the walls *a a* is a buttress *b* and between the upper part of the buttress and the wall *a* is formed a pocket *c* for the reception of the coal or other fuel. The lower portion of the pocket *c* has a narrow or contracted outlet beneath the wall *a* and connecting with the furnace proper immediately above the grates G.

At the lower outlet of the pocket *c* there is an air blast pipe to furnish air for the combustion of the gases. As here shown I place this air pipe over the opening so that the fuel as it descends will pass directly under it, and I make use of the pipe to support the side walls *a a*. The pipe D is perforated with numerous holes and I prefer to arrange them with one row of holes directly underneath so that they will blow vertically downward and with another row pointing obliquely downward on the inside of the furnace. The grate G is finely perforated and that portion which lies next the opening of the pockets is sloped or inclined inward, as I prefer to construct it, so that when the coal or coke falls on it from the pocket, it will slide downward toward the center of the grate. The central portion of the grate is made horizontal so that the cinders and ashes as they collect here may be readily removed by means of the door *g*. The door *i* communicates with the ash pit.

Means are provided for supplying air under pressure to the blast pipe D and to the ash pit beneath the grate.

Air is taken from the air duct F which extends at right angles to the furnace. The pipe D connects with the upper part of this air duct and the short pipe *f* connects it with the ash pit. The pipe *f* is controlled by a damper *l*. I provide for a hot blast under the grate by connecting the forward end of the air pipe D with a pipe *e* which returns into the ash pit.

An exhaust flue E is constructed, as herein shown, over the air duct F and the products of combustion from the furnace pass into it through the opening *j*.

The operation of my furnace is as follows, viz: A fire is first started on the grate G and coal is charged into the pockets *c c*. Blast is turned on in the flue F and when the furnace is sufficiently heated the coal in the lower portion of the pockets becomes hot enough to throw off hydrocarbon gases. These gases are prevented by the coal in the pockets from passing upward and they are consequently driven downward under the blast pipes D D

and into the furnace, mingling with the jets of air which come from the pipes and burning in a sheet of hydrocarbon flame. The coal as it works downward, parts with its gases and becomes coked so that when it reaches the grate it is reduced to the condition of pure carbon and burns with a smokeless carbon flame on the grate. The hydrocarbon flame of the expelled gases and the carbon flame of the coke, burning as they do together and in contact with each other produce an intensely hot flame which is absolutely smokeless for the reason that the smoke has no opportunity to form. The two flames being blown from opposite sides toward the center meet there and react on each other to form an intense combustion. The effect of these side blasts blowing toward each other from opposite sides is, first, to prevent the fine stuff from blowing over into the flues where it would ordinarily be carried by the up blast through the grates, and, second, the horizontal side blast impinges the flame down and onto the flame coming up through the grates. As the coal is consumed fresh coked coal slides down on to the grates and is burned by the air blast which comes through the perforated grate, thus making the feed automatic and continuous. The pipes D D become highly heated so that the air blast issuing from them is very hot and the surplus heated air passes on through the pipes to the space under the grates, thus heating the blast there, so that a hot blast is delivered at all points.

In burning coal for heating purposes only, as for steam boilers, forges, reverberatory furnaces, &c., no attendance is required except occasionally to bar up any clinker which forms on the grates and draw it out of the door *g*.

The rate of combustion is determined by the amount of blast used and as stated, no smoke is produced because the coal is first coked and the gases burned in combination with the coked coal, the air blast under the grate rendering the formation or the escape of smoke impossible. The combustion of the coal is very complete and very little clinker or ash is left on the grate. The heat can also be maintained at a perfectly even temperature at all times since the coal feed is continuous and uniform.

In using the furnace for the purpose of heating steam boilers a flue is run direct from the dome of the furnace to a point under the boilers and the furnace can be placed, if desired, some distance from the boilers to be heated since the gas flame produced extends a long distance into the exhaust flue.

In Fig. 4 I have illustrated the furnace as applied to a steam boiler, H being the boiler and I the flue leading thereto.

If desired, the furnace may be placed directly under the boiler without any intermediate flue.

For puddling furnaces, hearth or reverberatory furnaces, the heater can be placed in direct connection and when used as a forge the iron may be heated directly on the hearth of the furnace.

For roasting ores, making pigment, or volatilizing lead, zinc or other volatile metals, the crushed ore may be mixed with the coal and charged into the pockets or it may be thrown through the door *g* onto the hearth, but I consider the former method the preferable one. After burning, the clinker or scoria which is formed in the operation may be removed through the door of the furnace.

The furnace herein described is well adapted to the manufacture of zinc oxide or zinc-lead pigment as no smoke is produced to contaminate the product.

While I have particularly set forth the construction of a furnace which is well fitted to carry out my invention it is obvious that many modifications may be made while yet keeping within the limits of the invention as set forth in the claims, and I therefore desire it understood that I do not wish to limit myself to the exact construction herein shown by way of illustration.

If the coal is in too large lumps to pass under the pipe D it may be broken up by a hand bar or by other mechanical means.

I claim—

1. The herein described method of burning coal which consists in confining the coal in a chamber, coking the coal by heat externally applied thereto, causing the coked coal and the expelled gases to pass continuously through said opening in a thin layer and forcing air through said layer of coked coal at said opening, whereby said gas is burned in contact with said coked coal.

2. The herein described furnace having coal pockets on opposite sides, feed openings in the bottom of said pockets connecting them with the combustion chamber of the furnace, an air blast pipe adjacent to each of said openings having jets directed inward toward the center.

3. The herein described furnace having a coal pocket in the side thereof, a feed opening in the bottom of said pocket connecting the same with the combustion chamber of the furnace, an air blast pipe immediately above said opening and having jets directed vertically downward and jets directed inward toward the center of said furnace.

4. The herein described furnace having a coal pocket at the side thereof separated from the combustion chamber by a wall, a narrow opening in the lower portion of said pocket through which the coal enters the furnace in a thin layer, a perforated air blast pipe forming one side of said opening and a grate on which said coal falls.

5. The herein described furnace having a coal pocket on each side thereof connecting with the combustion chamber of said furnace by a narrow opening, an inwardly inclined grate immediately below each of said openings, an air blast pipe forming the top of each

of said openings, the said air blast pipes having a series of holes discharging directly downward, and a series of holes directed inward substantially parallel with said inclined grate.

6. The herein described furnace having a pocket for receiving the fuel, said pocket having a narrow opening through which the fuel is discharged into the furnace in a thin layer and a perforated air blast pipe forming the upper part of said opening.

7. The herein described furnace having a side wall resting on a perforated air blast pipe, a buttress outside of said wall, the space between said buttress and said wall forming a coal receiving pocket having an opening beneath said pipe connecting with the combustion chamber of the furnace and a perforated grate on which the fuel falls after passing through said opening.

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

FRANK L. BARTLETT.

Witnesses:
JOS. W. WILSON,
HENRY LLOYD.