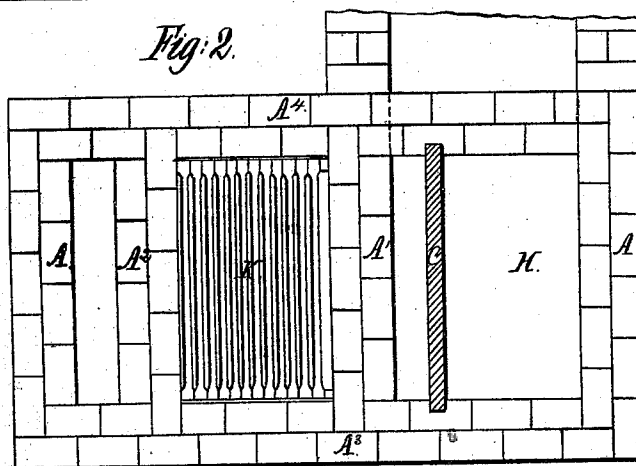
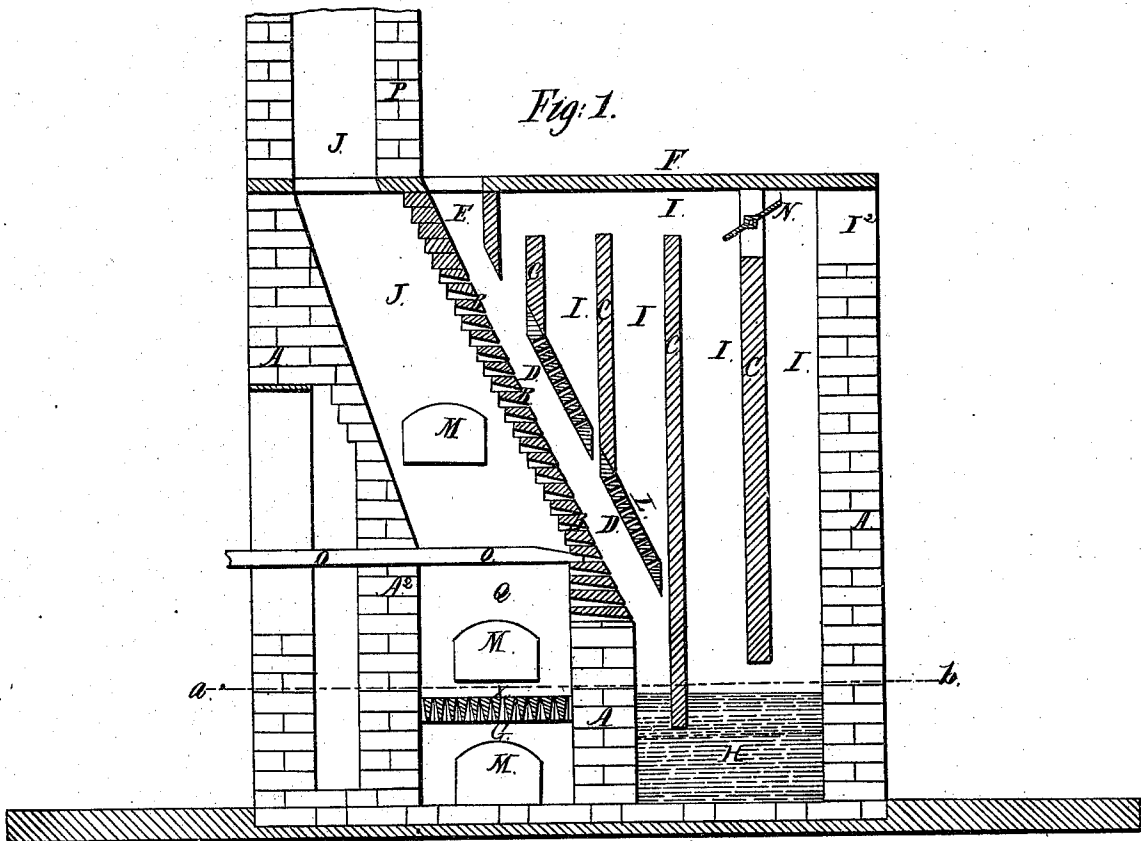


*S. W. Bullock.*  
*Shaft Furnace.*

*N<sup>o</sup> 87,327.*

*Patented Mar. 2, 1869.*



*Witnesses:*  
*Frederick Hobart*  
*S. W. Bullock*

*Inventor:*  
*S. W. Bullock*

# United States Patent Office.

SMITH W. BULLOCK, OF ELIZABETH, NEW JERSEY, ASSIGNOR TO  
HAMILTON E. TOWLE, OF NEW YORK CITY.

Letters Patent No. 87,327, dated March 2, 1869; antedated February 12, 1869.

## IMPROVED FURNACE FOR ROASTING ORES.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that I, SMITH W. BULLOCK, of Elizabeth, county of Union, State of New Jersey, have invented a new and improved Mode of Constructing Furnaces for Roasting Mineral Ores; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction and operation.

### Description of Drawings.

Figure 1 is a vertical section, cut through the centre of the furnace longitudinally.

Figure 2 is a horizontal section, cut through the furnace, just above the grate, from *a* to *b*.

In each section, like letters represent like parts.

A A, end-walls of the furnace.

A' and A<sup>2</sup>, cross-walls.

A<sup>3</sup> and A<sup>4</sup>, side-walls.

B is a perforated wall, of fire-brick, between the ore-chamber and the smoke-flue.

C C C are partition-walls in the gas-chamber.

D D, ore-chamber.

E, funnel, or mouth of ore-chamber.

F, drying-floor.

G, ash-pit underneath the grate.

H, water-tank.

I I I I, gas-flues in gas-chamber.

K, grate-bars.

L L, perforated wall between the ore-chamber and gas-chamber.

M M M, furnace-doors.

N, damper in partition-wall C'.

O O, gas-pipe to admit gas, air, or steam to ore-chamber.

P, chimney.

Q, fire-box.

### Construction.

I begin the erection of my furnace by laying down foundation-walls, as seen in fig. 2.

I now erect walls of brick or stone upon this foundation, as seen in fig. 1.

The two side-walls and the two end-walls, I extend up to the top of the furnace, as seen in the drawings, fig. 1.

The wall A<sup>1</sup>, I build up solid and perpendicular, to about one foot above the grate-bars, as seen at *a*, fig. 1.

At that point I commence a wall, B, of fire-brick, or other material, so formed as to leave, when laid, apertures, or openings, between them, of one-fourth of an inch in thickness, to admit of the introduction of gas, steam, or air, into the ore-chamber at all points, from top to bottom.

The edges of the brick are bevelled, and laid so as to set the upper face of the wall at an angle with the horizon of about fifty degrees, more or less.

The wall A<sup>2</sup>, I build up perpendicular, about two feet above the grate-bars K, and from that point I batter it back to an angle nearly parallel with the wall B.

These two walls, in conjunction with the two side-walls, form the smoke-flue J J, which leads from the grate-bars K to the chimney P.

I erect partition-walls C C C C, which are sustained by the side-walls A<sup>3</sup> and A<sup>4</sup>.

I construct also plates made of fire-clay, and with them form the upper wall of the ore-chamber. These plates are perforated, so as to admit the escape of the gas from the ore-chamber D into the gas-chamber I I I.

I build three iron door-frames, M M M, with doors attached, into the front side-wall, one opening into the ash-pit G, under the grate, one into the fire-box Q, above the grate-bars, and one into the smoke flue J J.

At a convenient distance above the fire-box, I place a damper, N, in the top of the partition-wall C', and make an opening in the end-wall, from the gas-chamber I, so as to admit the escape of the gas from the gas-chamber to such other place as may be desired for further use.

When the walls are all up, as described, and shown in fig. 1, it will be seen that I have a large receptacle for gas and dust.

I cover the whole surface with a flat stone, F, or other material. This forms a floor, to be used for drying ores preparatory to putting them into the ore-chamber, which is heated by the gas escaping from the ores undergoing decomposition in the ore-chamber.

I make and put a set of grate-bars in the space between the walls A<sup>1</sup> and A<sup>2</sup>, about two feet from the ground, and also insert one or more gas-pipes, O O, into the openings between the fire-brick of the wall B, with the outer end of the pipe projecting beyond the end-wall.

Between the walls A and A<sup>1</sup>, I construct a watertight tank, H, as shown in fig. 1.

### Modus Operandi.

Preparatory to using my furnace, in the treatment of sulphuretted ores, I place the fine-ground material to be roasted upon the drying-plate F. I then kindle a fire upon the grate K, and keep up this fire until the wall B becomes quite hot, and until the ore upon the plate F is thoroughly dried. I then fill the ore-chamber D with the dried ore from the plate F, and then open the damper N, and force air, steam, or gas of some kind, according to the character of the ore under treatment, through the pipes O O, by means of a common fan, or otherwise. I continue the fire upon the grate until the ore in the lower part of the chamber D becomes ignited. The damper N is now closed, and the fire upon the grate may now be dispensed with.

As a general rule, the sulphur in the ore, with a supply of oxygen from the air, through the pipes O O, will keep up the combustion until the ores are thoroughly decomposed, and passed down to the tank H; and as the ores above, in the upper part of the furnace, are by this process being gradually roasted, they will, in their turn, as they descend near the lower part of the chamber, become completely decomposed. Now, by continual feeding in the ground ore at the top, and a continual drawing of the roasted ore from the tank at the bottom, I keep a continuous stream of ore passing through the furnace completely decomposed.

The objects sought to be obtained in placing the wall B upon an angle, as described, are these: The angle of the wall B should be just enough to allow the ground ore to slide down gradually, as the bottom of the column is drawn from the water-tank; at the same time nearly all the weight of the ore should rest on the lower wall B. This prevents the ore from packing tight at the bottom of the chamber, which would prevent, in a measure, the passage of the air and gases through the ore; and it also leaves the upper side of the column of ore with comparatively little pressure, but loose and open, so as to allow of the free escape of the gases as they are formed by the decomposition of the ore. The application of heat and oxygen at the same point, on same side of the ore-bed, or column of fine-ground sulphuretted ore, produces almost instantaneous decomposition. This bed being thin and loose, allows free escape of the gases, and as the wall or the bed of the furnace is not sufficiently hot at any time to melt or slag the ores, and the sulphur in the ore being relied upon to support combustion, it is evident, as soon as combustion ceases, that is, as soon as decomposition takes place, the sulphur escapes with the oxygen as sulphurous-acid gas, there will be nothing left in that part of the ore to make heat enough to slag it, and it is now allowed to slide on gradually down to the water-tank.

Where the ores do not contain sufficient sulphur to keep up the heat by a supply of cold air, I keep up a

gentle fire upon the grate, sufficient to heat the air as it passes through the pipes O O, and thus keep a continuous stream or thin column of ore passing through the chambers, slower or faster, at the discretion of the operator. The ready supply of air (or oxygen) to every atom contained in a thin column of ore, from top to bottom, with free ventilation at the opposite side of the furnace for the escape of the gases, avoids all danger of slagging the ore, and at the same time enables me to work rapidly; and by the use of a large gas-chamber, arranged as described, with partition-walls to arrest the current of the gas and fine sand or dust that may escape from the ore-chamber, nothing but the gases passes the chamber, the dust being all precipitated in the tank H, at the bottom of the chamber, particularly when the damper N is closed, so as to force all the gas passing out of the chamber to pass under the wall C', within a few inches of the water in the tank H.

#### *Claims.*

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The application of two or more perforated walls in a roasting-furnace, as and for the purposes set forth.
2. Setting the perforated walls at an inclination with the horizon, for the purposes stated.
3. The application of a pipe, or series of pipes, passing through a fire-chamber, or otherwise, and entering the openings of the perforated wall of a roasting-furnace, as and for the purposes set forth.
4. The application of the gas-chambers I I, and the introduction of the partition-walls C C C C, in a gas-chamber, as and for the purposes set forth.
5. The construction and operation of a roasting-furnace, substantially as and for the purposes herein set forth.

S. W. BULLOCK.

Witnesses:

THEO. J. ALLEN,  
W. D. WADDINGTON.