A. G. COOK.

Cupola Furnace.

No. 52,684. Patented Feb. 20, 1866.

Fig. 1.

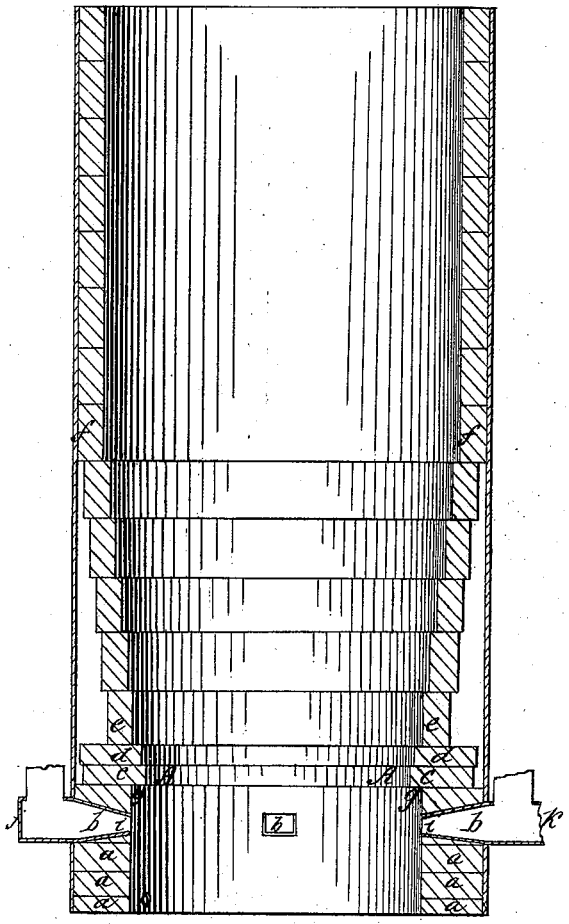

Fig. 2.

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AM. PHOTO-LITHO. CO. N.Y. (OSBORNE'S PROCESS.)

UNITED STATES PATENT OFFICE.

ANSON G. COOK, OF BURLINGTON, VERMONT.

IMPROVED CUPOLA OR BLAST FURNACE.

Specification forming part of Letters Patent No. **52,684**, dated February 20, 1866.

To all whom it may concern:

Be it known that I, ANSON G. COOK, of Burlington, in the county of Chittenden, in the State of Vermont, have invented a new and Improved Mode of Constructing the Lining of Cupola or other Furnaces; 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 being marked thereon.

The nature of my invention consists in the form of the lining of the cupola, of the manner of construction, in the manner of applying and introducing the blast of air into the cupola, the form of tuyeres and manner of reducing the tuyere-mouth for treating of different kinds of iron, and the manner of operating it so as to render the castings of a desirable degree of purity, hardness, or malleability, and in these several features combined.

In the accompanying drawings, Figure 1 shows a longitudinal cut-section of my cupola. Fig. 2 shows a cut-section of the bush for reducing the size of the tuyere-mouth.

In all cupolas previous to my invention great difficulty has arisen from not being able to force the blast to the center of the contained mass of fuel and metal. If it could be done at the first part of the charge, to melt the last part of it the pressure of the blast would have to be doubled, which doubles the power required to drive the bellows. This creates such a forced blast around the tuyeres or blast-openings (and as in cupolas where there is a slight "bosh," as some term it, which forms the upper part of the tuyeres or blast-openings,) that the melted iron or metal that drips over the bosh comes directly in contact with the forced blast, which carbonizes one portion of the iron more than another; therefore the iron does not mix, which results in poor castings. The difficulty of forcing the blast to the center of the cupola is caused in a great degree by the immense pressure of the fuel and metal upon the bed of fuel, which closely compresses it, preventing the free passage of the blast through it. These difficulties are entirely obviated by the first, second, and third features of my invention in combination.

The first feature of my invention consists in contracting the lining of the cupola three inches from the inner surface of the hearth-lining and at a point three inches above the upper part of mouth of tuyeres; (but it may be more or less than three inches, and the substance of my invention remain the same.) This point I designate the "waist."

The second feature of my invention consists in the receding form of the lining, by offsets in each course of brick from the waist upward, fifty-four inches, (but may be more or less and my invention be the same,) which receding form I designate the "brace," and is in combination with the waist. These offsets form lateral support for the contained mass of fuel and metal, which prevents it from resting upon the bed of fuel.

The third feature of my invention, in combination with the waist and brace, consists in the form of tuyeres and manner of reducing the size of their mouths or openings, and the manner of applying and introducing the blast of air into the contained mass of fuel and metal. I introduce it in four columns by tuyeres set at equidistant points, and not less than three inches below the bottom of the waist, (but may be more and my invention remain the same.) The blast enters in a condensed form, the tuyeres are slanted slightly downward, which carries the blast to the center, then takes an upward central course. By my mode of introducing the blast it does not require more than one-half the pressure of blast of all other cupolas now in use.

Great difficulty has arisen previously in the use of cupolas in producing, from a mixture of several kinds of iron, one iron; also in the manufacture of car-wheels, to have a good fine chill, at the same time a soft and tough wheel. I entirely obviate all this difficulty by my mode of operating a cupola of my invention, in combination with the waist, brace, form of tuyere, and mode of applying and introducing the blast of air into the cupola, all of which I shall explain more fully hereinafter.

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

Figure 1 of the accompanying drawings is a longitudinal cut-section of my cupola. Fig. 2 is a horizontal cut-section.

I take the shell of a common cupola that is

sixty-four inches in diameter inside. I commence by laying common square fire-brick edgewise, one end toward the center of the cupola, the other touching the inside of the shell. I lay three courses in this way, as represented at *a a a a a*, Fig. 1. Then I insert the four tuyeres, (three are represented at *b b b*, Fig. 1,) equidistant from one another, through an opening in the shell of the cupola toward the center, but not as far as the inner surface of the lining by one and one-half inch, which prevents their burning off.

The form of my tuyeres is represented at *b b*, Fig. 1—size, four by five inches at mouth, seven by nine at outside.

When iron is very hard I reduce their size at mouth by inserting through the opening *k*, Fig. 1, the small hollow tube represented at Fig. 2, which, when pushed to the mouth of tuyere, where it is made to fit, reduces the size of tuyere-mouth in proportion to its thickness.

I then lay two more courses in the same manner, which carries the lining three inches above the upper part of mouth of tuyere. I then lay the next course in the same manner, except that I contract it three inches from the last course, *c c*, Fig. 1. This leaves a space between the course and shell, which I fill with pieces of common brick and mortar. I then lay the next course in the same manner, receding from the former one-half inch, *d d*, Fig. 1. I then lay the brick endwise, using common arch-brick, receding one inch from the former, as seen at *e e*, Fig. 1, filling the space behind it, as before. I continue in this manner with five more courses, as seen between *e e* and *f f*, Fig. 1. This carries the lining to the inner surface of the shell. I then continue course after course until the top of cupola is reached.

The waist A A and brace *d f d f*, with its lateral supports, sustain almost wholly the mass of fuel and metal. This prevents it from resting on the bed of fuel, and allows the use of bituminous coal and coke, as well as anthracite coal, by allowing free passage of the blast through the fuel and metal, as the waist being at such a distance above the upper part of tuyere-mouth as to allow the coal to fill the space under the waist at *q q*, Fig. 1. The coal therefore fills the space to the tuyere-mouth. This coal becomes ignited as soon as the rest of the bed; therefore, as the iron melts it cannot but pass through the burning coal at the sides of the cupola, the same as at the center. What of the melted metal drips over the waist can but run through the burning coal; therefore, it cannot carbonize more at this point than any other.

The fuel-bed is so free from pressure from the mass of fuel and metal that in melting fifteen, twenty, or twenty-five tons of iron, the last part of the charge will melt as fast and even faster than at first. So in my cupola I have often to open the slides in outside of tuyere-box *k*, Fig. 1, to reduce the force of blast inside of the cupola.

In my cupola, where the lining is the thickest the heat is greatest, and where the lining is thinnest the space is required for the mass of metal and fuel—the least heat by the thickness of the lining at A A and *a a a a a a*.

At least one-third less fuel is required to melt more iron and in less time than any other cupola, for the reasons described.

The fourth feature of my invention consists in the operation and management of my cupola in combination with the waist, brace, and manner of applying and introducing the blast of air into the cupola, thereby rendering the castings of a desirable degree of hardness, purity, and malleability when complete.

To make soft and impure iron pure and hard, and to carbonize at will any iron, I work on a low degree of heat by putting in a bed of fuel about sixteen inches in depth, (measuring from top of tuyere,) which with my form of tuyeres and mode of introducing the blast will produce the chilling quality in any iron, magnetic or hematite, for casting rollers for rolling-mills or car-wheels; also, by increasing my bed of fuel to a depth of twenty-five or thirty inches, iron filled with black lead and that with sulphur, no matter how hard, I produce, by my mode of operating, such a degree of heat and blast which produces such chemical results that the iron comes out of the cupola of the purest, toughest, and most refined quality, which results cannot be accomplished by any other cupola.

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

1. Contracting the lining of the cupola from the inner surface of the hearth at a sufficient distance above the mouth of tuyeres to allow the coal or fuel to fill the space between the top of tuyeres and waist, which prevents the melted iron or metal from coming in contact with the blast of air, except as it passes through the burning coal, thereby wholly preventing the carbonization of one portion more than another, substantially as hereinbefore described.

2. In combination with the waist, the receding form and construction of the lining by offsets, which forms the brace for supporting the mass of fuel and metal, and prevents it from resting on the bed of fuel, for the purpose of using bituminous coal or coke, by allowing a free and even circulation of blast through every portion of the contained mass of fuel and metal, substantially for the reasons hereinbefore specified.

3. The form of tuyeres, the manner of reducing the size of mouth of tuyere, for the treatment of very hard iron, the manner of applying or introducing the blast of air into the cupola, through tuyeres of the size and dimensions described, and the relative position

of tuyeres to the waist, in combination, substantially as hereinbefore specified.

4. The mode of operating the cupola, in combination with the other features of my invention, by which I melt iron or metal by such a degree of heat as I desire, by using the bed of coal or fuel of such depth as will produce, with all kinds of iron, such chemical results as I desire, substantially as hereinbefore described.

ANSON G. COOK.

Witnesses:
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