F. C. ADAMS.

Cupola Furnace.

No. 77,795. Patented May 12, 1868.

Fig: 1.

Fig: 2.

Fig: 3.

Fig: 4.

Fig: 5.

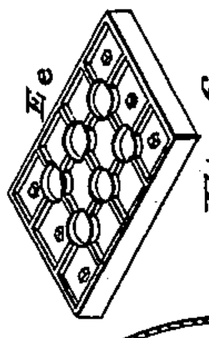


Fig: 6.

Fig: 7.

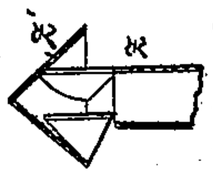
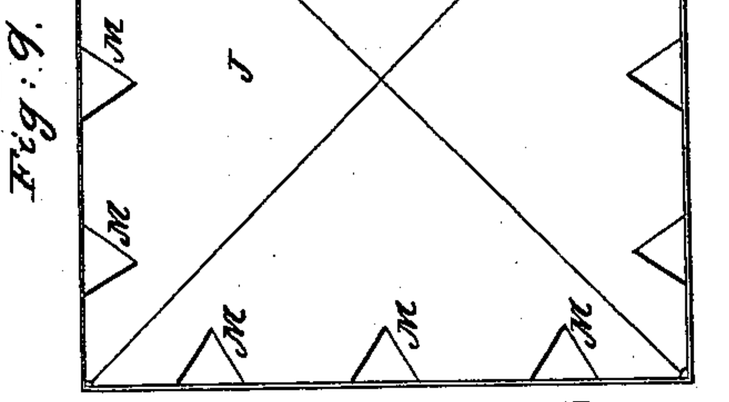


Fig: 8.

Fig: 9.



Witnesses:

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FEDERAL C. ADAMS, OF CINCINNATI, OHIO.

Letters Patent No. 77,795, *dated May* 12, 1868.

IMPROVEMENT IN CUPOLA-FURNACES.

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, FEDERAL C. ADAMS, of Cincinnati, in the county of Hamilton, and State of Ohio, have invented certain new and useful Improvements in Cupola-Furnaces; and I do hereby declare that the following is a full, clear, and exact description of the construction and operation of the same, reference being had to the annexed drawings, making part of this specification, in which—

Figure 1 represents one side of my improved cupola-furnace, the outer case being shown in section.

Figure 2 is a horizontal section through the line *d d*, fig. 1.

Figure 3 is a vertical section, showing the interior of one-half of the cupola.

Figure 4 is a horizontal section, through the line *f f*, fig. 3.

Figure 5 is a perspective view of a portion of the lining.

Figure 6 is a longitudinal section of the same.

Figure 7 is a vertical section of the cap of the centre tuyere.

Figure 8 is a horizontal section of the lower part of the same.

Figure 9 is a top view of the plate, above the heating-chamber A in the chimney.

The general shape of the cupola is as shown in fig. 3, the lining being drawn in from the bottom to a point just above the tuyeres, as shown by the lines *a b* and *a' b'* in said figure. Thence I gradually enlarge the interior toward the top of the cupola, as shown by the lines *b c* and *b' c'*. This form is given to the interior of the cupola for the purpose of retaining the stock above the tuyeres long enough to permit the iron in the stock to become thoroughly melted, and also to prevent the half-melted stock or iron from coming in contact with the tuyeres below, which would be the case if the sides of the lining of the cupola were straight from top to bottom.

Above the cupola proper, I place a heating-chamber, A, figs. 1 and 3, provided with openings B B B, or more, as may be necessary, and a door, C, which is the regular charging-door. Another door, D, fig. 1, is placed below this chamber, near the top of the cupola, to be used for observing and replenishing the stock, when the stock in the cupola is nearly melted down.

This heating-chamber A is to be filled with iron through door C, which is then closed. The heat rising through the stock, strikes the arch E E, and is thrown down again, passing again through the stock to the openings B B, through which it passes off. The iron is thus thoroughly heated before it passes into the cupola proper.

The opening G in the top of the arch is to be used when the cupola is being fired up. The annular wall H H, forming a bottom for a portion of the heating-chamber, is inclined or bevelled, as shown at K K, so that the stock will be discharged therefrom, as it settles down in the centre of the opening.

Below the annular wall, and between the outer case and the lining, and above the chamber for heating the blast, is an air-chamber, F F, to which air is admitted through the apertures I I, fig. 1, from without, or through the apertures from the blast-heating chamber, and from which it is discharged into the cupola, through the openings S S S, under the projecting edge of the annular wall H, for the purpose of igniting the gases that may arise from the melting mass below.

In the chimney above the arch of the upper heating-chamber A, I place a plate, J, fig. 9, which may be made concave or convex, or of flat tile, to resist the heat from below, and to protect the arch from cold air entering from above. This plate is provided with openings M, at the sides, to permit the passage of the smoke.

The cupola is surrounded by a case, L, figs. 1, 2, 3, and 4, so as to form a space, N N, which space is divided by partitions O O^1 O^2 O^3, the partitions O, O^1, and O^3, rising from the bottom, and the partition O^2 descending from the top. The blast passes around these partitions and through the space N, and thus becomes heated. This chamber or blast-heater may be formed between the surface of the inner lining-wall and the cupola-case, by tubes or passages built in the wall.

For the better introduction of the blast, I arrange the tuyeres in various positions, and I make them of various shapes, which will now be more particularly described.

Tuyeres have heretofore been placed around the cupola in horizontal lines, the tuyeres being of the same size, and placed at about equal distances from each other, say from fourteen to sixteen inches apart, and they have also been set on vertical lines, the tuyeres in the latter case being of different sizes. Tuyeres set in the way first named are very apt to be clogged by melted clay or brick, by reason of the rebound or reaction of the blast, and the creation of an intense heat just inside of the tuyere. This mass becomes burnt and set, and the half-melted iron and slag catching upon it, the cupola at length becomes bridged clear across the interior. To avoid this difficulty, I place tuyeres in different parts of the cupola, and instead of one large tuyere, I employ a cluster of tuyeres, consisting of two or more, as shown at P Q R S T and P^1 Q^1 R^1 S^1 T^1. In this way I am enabled to use smaller tuyeres, and to divide the blast, to create greater force to penetrate the stock in different places, and thus to create greater combustion in or near the centre of the furnace. The tuyeres may be placed in an oblique line or lines, as shown in the combinations P Q R S and R S U V, and thus the space for the introduction of the blast may have a greater extent laterally than if the tuyeres were arranged in the same vertical plane. I also introduce tuyeres, as they may be needed, into the spaces between the regular clusters above described, placing these additional tuyeres, which are all of the same size at the outlet, at various heights and in irregular order. Some of these additional tuyeres are shown at Q^2 Q^3 Q^4. By inclining a tuyere at its entrance to the cupola, so that instead of entering in a radial line, it shall be slightly inclined to the right or left, a vertical or spiral motion may be given to the blast, which I have found to be of considerable utility.

Above all the tuyeres, except those shown at P^1 Q^1 R^1 S^1 T^1, I place a row of tuyeres W W W W, figs. 3 and 4, set in a horizontal line, and entering the cupola with an inclination to the right or left, as described in the preceding paragraph, so as to produce a whirling or vertical motion of the blast within the cupola, thus gathering the blast to the centre, and while carrying it up through the contracted portion of the lining, protecting the walls from extreme heat, which would tend to melt them, if the tuyeres were so set that their axes were radial lines.

Another mode is the employment of what I call slotted tuyeres, as shown at X X, figs. 1, 3, and 4. These tuyeres may be from sixteen to twenty-four inches in length or height, and of proportionate width, as shown in the drawings. The advantage of a tuyere in this form is, that it affords but small space at the top for the accumulation of dirt or slag, while it occupies but little room when projected beyond the lining into the cupola, as they may be to any required distance. These tuyeres may be set one above the other, or upon a spiral or circular line around the cupola. They may be arranged horizontally, and in one or more rows, with or without breaking joints, and, if desired, they may be inclined from the outer case to the interior, as shown at X X, fig. 2, so as to give to the blast the vertical motion already referred to.

For the purpose of introducing the blast to the very centre of the cupola, I employ the projecting tuyeres Y Y, and the centre tuyere Z. The tuyeres Y Y may be made stationary, or they may be made so as to be run in and drawn out, as may be desired. These and all other projecting tuyeres are covered with fire-clay, or some non-conductor, to resist the intense heat of the interior.

The centre tuyere Z, figs. 3, 4, 7, and 8, may enter from below or from a projecting tuyere or tuyeres. It is provided with a cap on the top, beneath which the blast issues, and by arranging the supports of this cap at an angle, as shown in figs. 7 and 8, a vertical motion is given to the blast. This tuyere is useful in lighting the fire in the cupola, as it introduces oxygen to the centre of the stock or fuel.

The tuyeres P^1 Q^1 R^1 S^1 T^1 above the contraction in the cupola, are to be used mainly in the early part of the smelting operation, to heat the plate or linings above them, and, by radiation from the latter, the chamber A *a*. In this way the blast becomes more quickly and readily heated. When these tuyeres are not needed, they are closed by the door B *b*. As the melting process goes on, the stock in the cupola settles down toward the bottom, where it becomes very closely packed. In this way dirt and slag close up the space in the fuel, and it becomes more difficult to penetrate the mass with the blast. For this reason, I place more tuyeres below than above, arranging them sometimes in a horizontal line in an increasing and decreasing series, as shown by the tuyeres R^3 R^2 P T S S^2 S^3, figs. 1 and 2.

The outer end of some of the tuyeres I make larger than the inner end, and the slotted tuyeres are made wider at the bottom of the outer end, the purpose, in both cases, being to create a greater force at one place than at another. The discharge-end of the tuyere may be of any convenient shape, and while I have described a variety of modes of arranging them, it is not necessary that all these methods should be used upon the same cupola.

I line my cupola from the bottom of the series of tuyeres W to the top of the cupola, with an iron plate, which may be put together in sections, and a portion of which is shown in figs. 5 and 6. This plate is provided with numerous holes and countersunk depressions and points or projections, as well as with cross-flanges, the purpose of which is to enable fire-clay or some incombustible medium to adhere to the plate and protect it.

This lining, at the contracted portion of the cupola, projects from the inner case, thus forming a chamber or space, A *a* A *a*, which may be used as a blast-heating chamber, and for this purpose may be arranged like the chamber N N. To protect the back of the plates forming the lining when thus arranged, I admit the blast through the openings in the case, shown at C *c*, and discharge it at the opening D *d*, so that the blast may circulate in rear of the plates, protecting them, and becoming heated in its passage.

Having thus described my improvements, what I claim therein as new, and desire to secure by Letters Patent, is—

1. The general shape of the interior of a cupola-furnace, as described, that is to say, gradually contracted from the bottom to a point above the tuyeres, and thence gradually enlarged to the top, as shown.

2. The heating-chamber A above the cupola, provided with openings B and door C, with the base-wall H projecting over the lining, substantially as shown.

3. The air-heating chamber F, under the wall H, and between the lining and the outer case, with the openings for the introduction and discharge of air, substantially as described.

4. The plate J in the chimney, with its smoke-passages, substantially as shown, and for the purpose described.

5. The outer case L, forming a blast-heating chamber, N, surrounding the cupola, substantially as described.

6. The partitions O O^1 O^2 O^3, in the blast-heating chamber N, substantially as and for the purposes described.

7. The space or chamber between the lining E *e*, and the inner case, for the purpose of cooling the back of the lining, or heating the blast, substantially as described.

8. The cupola-lining E *e*, composed of an iron plate or plates covered with fire-clay or other non-conductor, as described.

9. Arranging the tuyeres in a cluster, as shown by P Q R S T.

10. The arrangement of tuyeres on an angular or spiral line, as shown by the combinations P Q R S or R S U V.

11. The tuyeres set at an angle to a radial line, as shown at W, for the purpose of creating a tangential or vertical blast, as described.

12. The arrangement of tuyeres, having the same size at the outlet, one above the other, in regular or irregular order, substantially as and for the purpose described.

13. The tuyeres Y Y, projecting beyond the lining toward the centre of the cupola, as described.

14. The employment, in a cupola-furnace, of slotted tuyeres for the admission of the blast.

15. The slotted tuyeres constructed with the lower part of the outer end wider than the upper part, and projecting beyond the lining, substantially as shown.

16. The horizontal slotted tuyeres, constructed substantially as shown.

17. The upright centre tuyere Z, surmounted by a cap, Z′, whether introduced through the bottom or from the sides of the cupola, substantially as described.

18. So arranging the tuyeres of a cupola-furnace, as to employ a greater number below than above, for the purposes described.

19. The upper row of tuyeres W W W, substantially as and for the purpose described.

20. The combination, in the same cupola-furnace, of tuyeres of different shapes and sizes, and located above and below each other, substantially as set forth.

21. The inclined supports of the cap of the centre tuyere Z, for the purpose of introducing the blast with a vertical motion, as described.

22. In a horizontal series of tuyeres applied to a cupola-furnace, constructing the inlets of unequal size, as described.

23. In a series of tuyeres placed one above the other, making some of them with the outer end of greater diameter than others, while the inner end remains of the same diameter, as described.

24. The horizontal line of tuyeres R^3, R^2, P, T, S, S^2, and S^3, increasing and diminishing, substantially as shown.

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