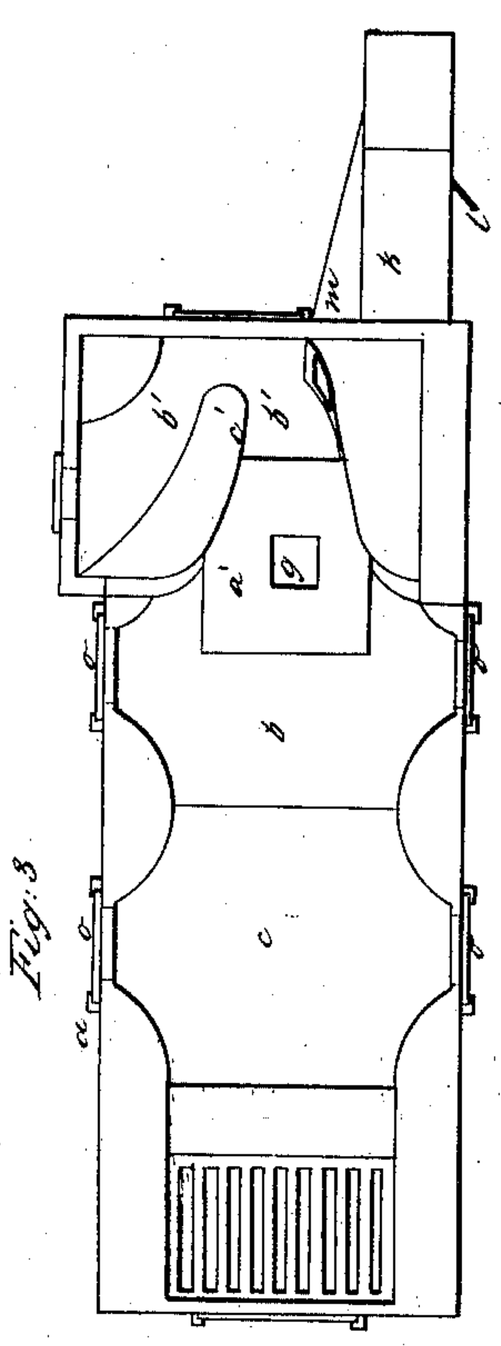
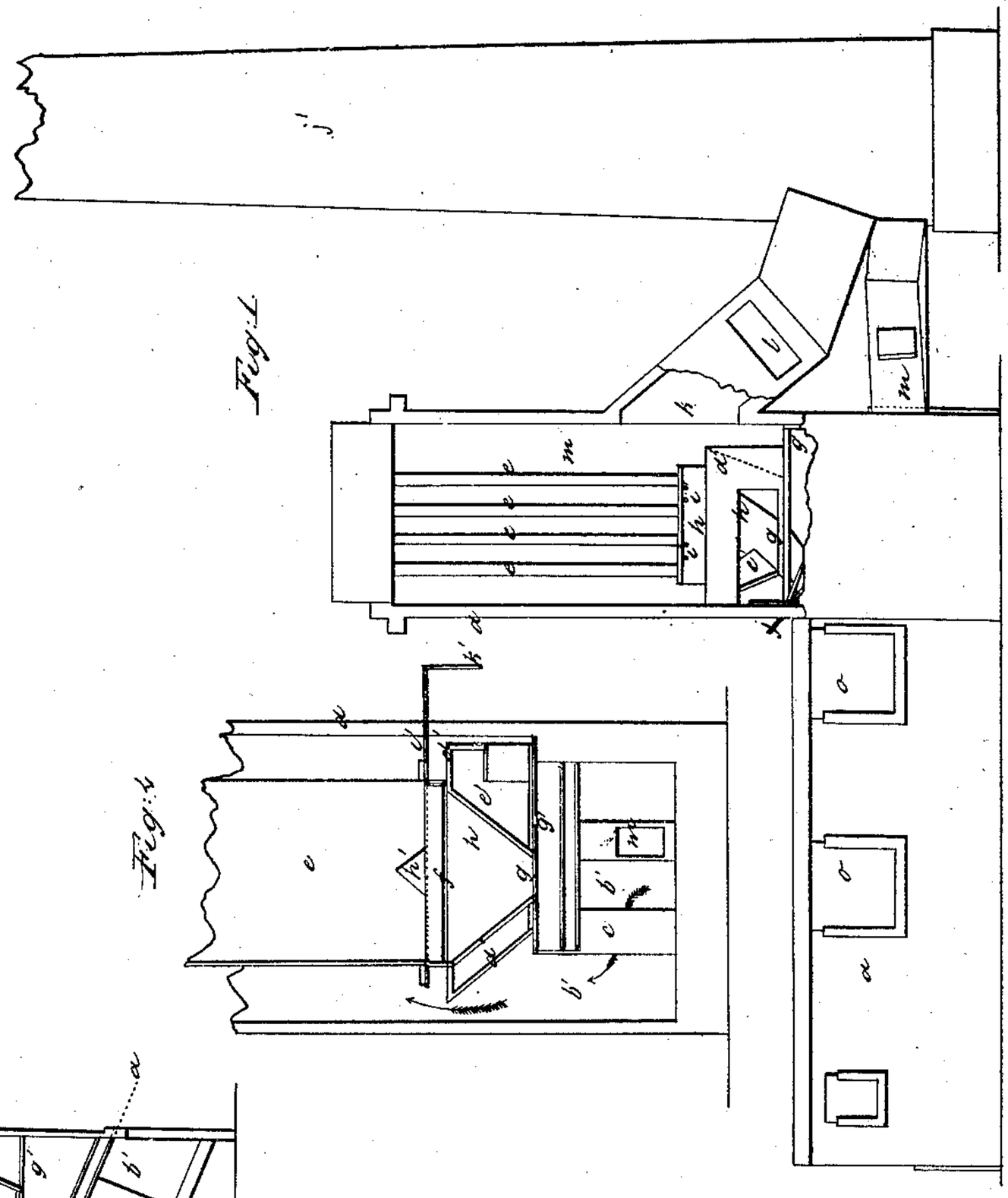
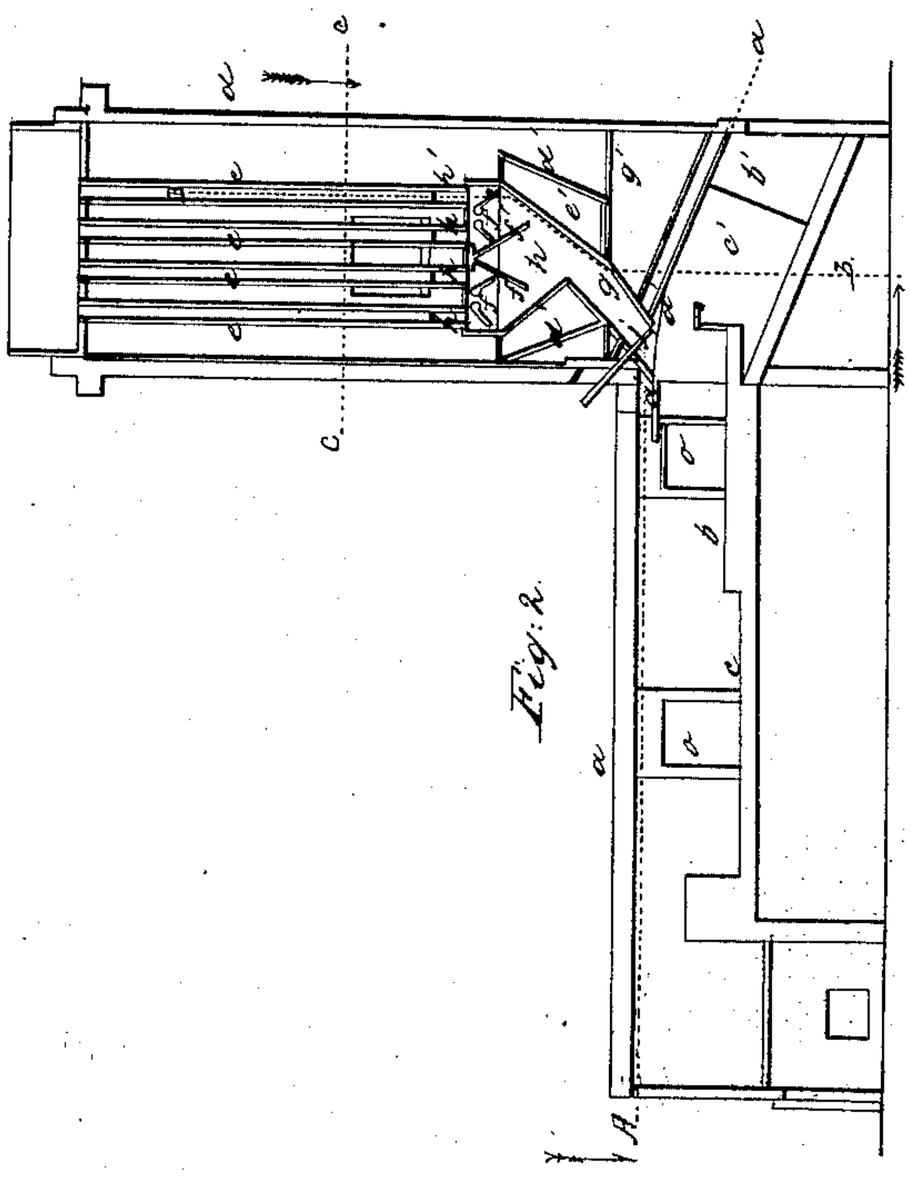
J. Renton.

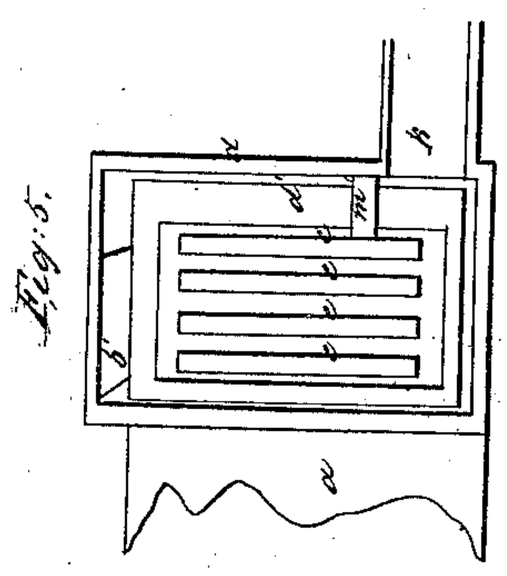
Making Wrought Iron Direct.

No. 8,613. Patented Dec. 23, 1851.









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UNITED STATES PATENT OFFICE.

JAMES RENTON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN APPARATUS FOR MAKING WROUGHT-IRON DIRECT FROM THE ORE.

Specification forming part of Letters Patent No. **8,613,** dated December 23, 1851.

To all whom it may concern:

Be it known that I, JAMES RENTON, of Newark, New Jersey, have invented certain new and useful Improvements in Apparatus for Making Wrought-Iron Direct from the Ore; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, making part of this specification, in which—

Figure 1 is a side elevation of my improved apparatus, with the side wall of the stack removed to exhibit the internal arrangement. Fig. 2 is a longitudinal vertical section; Fig. 3, a horizontal section taken at the line A *a* of Fig. 2; Fig. 4, a cross vertical section taken at the red line B *b* of Fig. 2; Fig. 5, a horizontal section at C *c* of Fig. 2.

The same letters indicate like parts in all the figures.

My invention is of improvements on the apparatus for making wrought-iron direct from the ore, as described in Letters Patent granted to Alex. Dickerson on the 22d of July, 1850. In the said apparatus of the said Dickerson the ore is deoxidized in an annular chamber formed between two concentric cylinders placed over the working-bottom of a puddling or reverberating furnace, onto which the ore is discharged after it has been deoxidized, the heated products of combustion from the furnace being carried up through the central tube and around on the outside of the deoxidizing annular chamber. This apparatus is attended with several serious practical difficulties. In the making of iron according to this method it is of the first importance that the products of the combustion and atmospheric air be excluded from the chamber containing the ore that is being deoxidized, as will be obvious to the iron-master; and it is also important that the lower part of the deoxidizing-chamber be protected from the very intense heat which is generated at or directly over the working or puddling bottom; and it is also important that the ore when deoxidized be freely discharged onto the working-bottom, as required, and without permitting the entrance to the chamber of the products of combustion. In the apparatus of the said Dickerson there is no adequate provision for meeting the requirements above enumerated. The deoxidizing-chamber being an annulus surrounding the central flue, there is no practical mode of combining therewith inclined planes to conduct the deoxidized ore to the working-bottom, which will not impede the passage of the products of combustion to the central flue, and in consequence of this he has been compelled in practice to place the deoxidizing-chamber and its inner and exterior flue directly over the working-bottom, with holes governed by stoppers in the bottom for the discharge of the ore and to exclude air and the gaseous products of combustion. This exposes the lower part of the deoxidizing-chamber and the stoppers or valves for governing the discharge of the ore and for regulating the draft to a heat so intense as to destroy them in a short time, while at the same time the heat is not equally and economically applied to the deoxidizing-chamber, as indicated above.

The object of my invention is to overcome the defects of the apparatus described in the said Dickerson patent and to meet the requirements above indicated; and to these ends the nature of the first part of my invention consists in arranging in a vertical stack a series of flat tubes, (or a series of small tubes arranged in rows as the equivalent thereof,) into which the ore is charged at top, and which are heated by the passage of the products of combustion around and among the several tubes, when such arrangement of deoxidizing-tubes is combined with a reverberatory or other furnace, by means of an ore-box into which all the series of tubes discharge, and which box is provided with the requisite means for conducting the deoxidized ore to the puddling or working bottom without losing its heat, and without exposure to air, thus effectually protecting the lower part of the deoxidizing-tubes from the too intense heat, protecting the ore from the action of the products of combustion while being deoxidized, affording an easy means of discharging the deoxidized ore onto the working or puddling bottom, while the products of combustion can be readily carried to and around the whole series of tubes to act on the entire surface of each and every one of the series equally and economically.

My invention also consists in combining with each of the flat deoxidizing-tubes a double-

inclined plane, arranged near the lower end thereof and in the middle, for the purpose of causing the entire charge of ore in each tube to descend equally, instead of descending more rapidly in the middle than at the sides; and my invention also consists in combining with the deoxidizing-tubes and ore-box a series of stationary and a series of movable inclined planes for the purpose of regulating the delivery of the deoxidized ore from the tubes onto the working-bottom.

In the accompanying drawings, *a* represents a reverberatory furnace of the usual construction, in which *b* represents the preparatory and *c* the puddling or working bottom. At the rear end there is a stack, *d*, in which is arranged a series of flat vertical tubes, *e*, called the "deoxidizing-tubes." These tubes are made of iron. (I do not limit myself to the use of this kind of metal.) They are connected together at top by a plate which forms the bottom of a feeding-trough from which the ore is supplied to the tubes. If desired, the tubes may be provided with movable covers at top; but this is not indispensable. At the bottom the tubes are also connected together by another plate, which forms the top of what I denominate the "ore-box," *h*. The spaces between the tubes and around them must be sufficient for the free passage of the heated products of combustion by which they are heated. The front and back plates of the ore-box incline inward toward each other, and then form an inclined spout, *g*, which runs forward for the discharge of the ore onto the preparatory bottom *b*, from which it is afterward transferred to the working bottom *c* by the operator, who can have access to it through doors *o* in the side of the furnace. The spout *g* is provided with a sliding damper or shutter, *j*, by which the aperture of the said spout can be closed to prevent the ore, when desired, from falling onto the preparatory bottom. The lower end of the spout *g* passes through a hole in a plate, *a'*, which is a continuation of the roof of the furnace, so that the products of combustion from the furnace pass under this plate into a flue, *b'*, which extends around the rear end of a plate or wall, *c'*, and then up around a casing, *d'*, which surrounds the ore-box, leaving a space or dead-work, *e'*, to protect the ore-box from the intense heat. The products of combustion then pass around and among the tubes and act on the entire surface of each and every tube of the series, and then escape through the flue *k*, near the bottom of the stack *d*, into a chimney, *j'*, the flue *k* being provided with a damper, *l*. There is a vertical wall, *m'*, which closes up the space from the bottom between that side of the stack *d* through which the flue *k* passes and the first of the series of tubes to prevent the products of combustion from passing directly to the flue *k*. If the damper *l* of the flue *k* be closed, the products of combustion, instead of passing into the stack *d*, will be made to escape through a flue, *m*, directly into the chimney. This flue *m* should also be provided with a damper, which is to be closed when the deoxidizing-tubes are to be heated.

The dead-work *g'* below *e'* should be extended to the wall of the stack *d*, to prevent the products of combustion from passing directly to the flue *k*, and to cause them to pass around in the flue *b'*, and thence up in the stack to heat the deoxidizing-tubes before they escape through the flue *k* into the chimney *j'*.

Each deoxidizing-tube *e* is provided with a double-inclined plane, *h'*, at or near the lower end, the two inclined surfaces meeting in the middle. This reduces the capacity of the lower end of the tube, where the ore is discharged after it has been deoxidized, and presents an impediment to the discharge from the middle of the tube, and thus causes the whole charge of ore in the stack to descend equally. Without this double-inclined plane the ore in the middle of the tube would descend more rapidly than at the sides, so that either the ore at and near the edges would remain too long in the tubes, or the part of the charge at and near the middle would be discharged before being properly deoxidized.

In the middle of the series of deoxidizing-tubes, and below them, are two inclined planes, *f' f'*, connected together at their upper ends and attached to the plate of the ore-box, to which the lower ends of the tubes are secured. These two planes incline outward from each other and toward the two inclined plates of the ore box, thus together forming guides for the deoxidzed ore as it is discharged from the tubes, and forming two throats for the passage of the ore to the spout *g;* and in addition to this there is a series of adjustable planes, *f*, one for each tube and attached by one edge to a spindle, *i'*, which turns in appropriate supports in the masonry, and one end of which extends outside of the stack, and is there provided with a handle *k'*. There is one of these adjustable planes for each tube, and with its rod along one edge of the delivery-aperture of its appropriate tube, and when partly opened, as represented in Fig. 2, they form planes of opposite inclination to the front and another to the back of the ore-box, and one to each of the planes *f'*. By changing the inclination of the movable planes *f* the discharge of the ore from the tubes can be governed at pleasure, and, if desired, entirely stopped. By the combination of all the planes it will be seen that an equal discharge of ore from each tube can be secured; but without them more ore would be discharged from the tubes farthest from the sides of the box.

Fire being made in the furnace in the usual manner, the ore, properly reduced in size by grinding or otherwise, is put into the feeding-trough at the top of the stack *d*, from which the tubes *e* are filled. The products of combustion from the furnace passing around and among the series of tubes heat the ore therein and keep it exposed to the required temperature to deoxidize it. The tubes, being flat, expose the ore to

the action of the heat in thin vertical strata exposed on all sides, so that it can be deoxidized with the greatest economy. At the commencement of the operation the adjustable inclined planes are thrown up to keep the ore in the tubes until a sufficient quantity near the lower end of the tubes has been deoxidized, and then the lower ends of the tubes are opened to permit the ore to descend by gravity into the ore-box, and thence through the spout onto the preparatory bottom, from which it is at the proper time transferred by the operative to the working bottom to be worked into loops; and while the looping process is going on the deoxidized ore is descending onto the preparatory bottom and fresh ore continues to be supplied to the deoxiziding-tubes at top. In this way the process of making iron direct from the ore can be continued for any desired length of time. After the ore has been deoxidized it is transferred to the puddle or finishing operation without losing any portion of the heat which it has received, and during the whole of the deoxidizing operation it is effectually protected from the injurious presence of atmospheric air and the products of the combustion, while at the same time it is free to pass from the deoxidizing-tubes when in a proper condition. The waste heat from the puddling or other furnace is made available for preparing the ore for the final process of being reduced to the metallic state, while at the same time the deoxidizing part of the apparatus is effectually protected from the destructive action of the intense heat which must be employed for the final reduction of the ore to the state of wrought-iron, whether by the process of puddling or otherwise.

Instead of the flat tubes I have contemplated using, a series of round tubes may be substituted for each flat one, thus having rows of series of tubes; but I prefer the use of flat tubes, as above described. I have also contemplated making the flat tubes of corrugated metal to increase the amount of surface to be exposed to the action of the heat; and I have also contemplated coating the exterior of the tubes with fire-clay or with other refractory earthy substance, but so far I have found the metal surface to be sufficiently durable for a good practical and economical result.

I do not wish to limit myself to the use of a puddling-furnace for the final operation; nor to the use of mineral coal, as the same result in kind may be produced by a bloomery.

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

1. The arrangement of a series of flat vertical tubes (or the equivalent thereof) in a vertical stack, substantially as described, when these are combined with a puddling or other furnace, substantially as described, by means of an interposed ore-box, substantially as and for the purpose specified.

2. Combining with each of the deoxodizing-tubes, as described, and at the middle and near the lower end thereof, a double-inclined plane, substantially as described, to insure the equal descent of the charge of ore, as described.

3. In combination with the series of deoxidizing-tubes and the ore-box, substantially as described, the employment of a series of stationary and a series of adjustable inclined planes, substantially as described, to regulate and insure the equal discharge of the ore from each and from the whole series of tubes, as described.

JAS. RENTON.

Witnesses:
WM. H. BISHOP,
CHARLES N. BAMBURGH.