(No Model.)

C. P. WILLIAMSON.

PROCESS OF AND APPARATUS FOR MANUFACTURING PIG IRON.

No. 538,004. Patented Apr. 23, 1895.

Fig. 1.

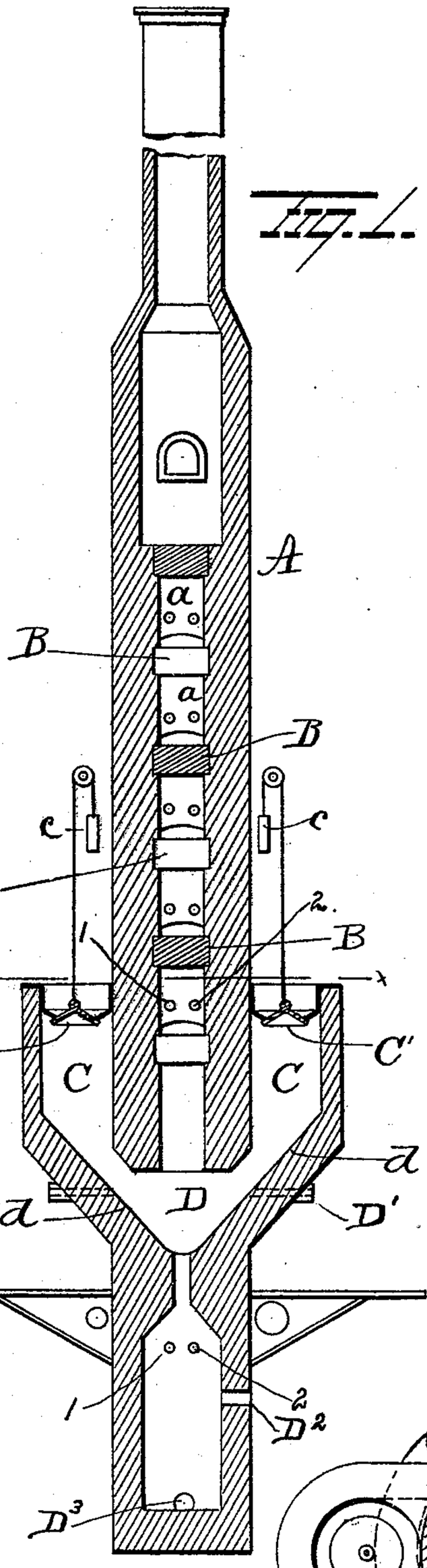

Fig. 2.

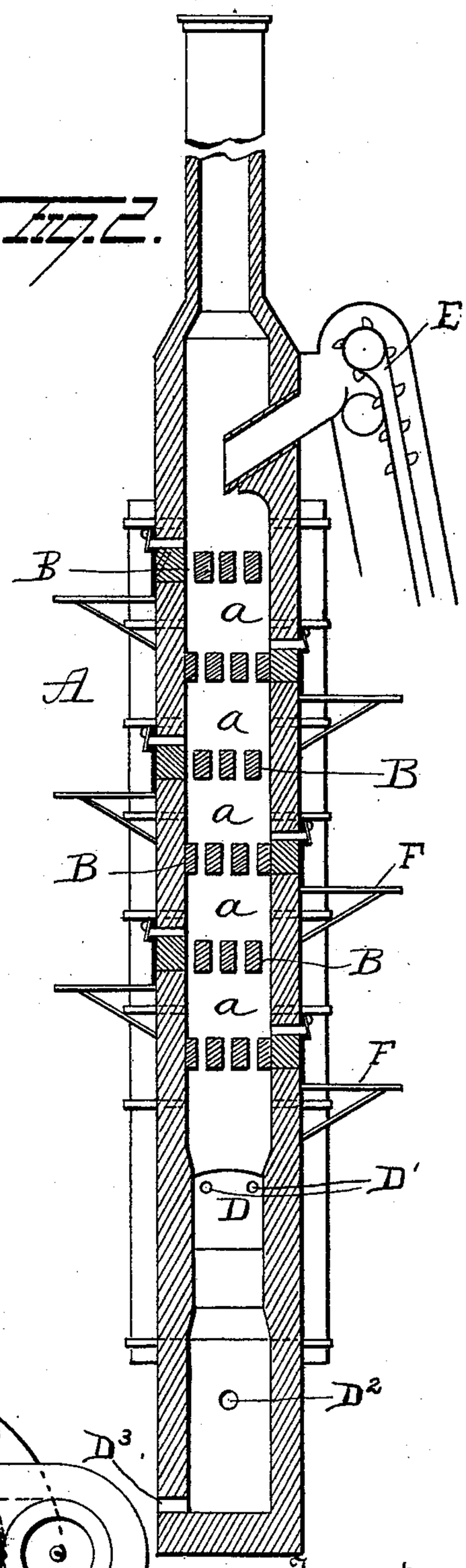

Fig. 3.

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CHARLES P. WILLIAMSON, OF BIRMINGHAM, ALABAMA.

PROCESS OF AND APPARATUS FOR MANUFACTURING PIG-IRON.

SPECIFICATION forming part of Letters Patent No. 538,004, dated April 23, 1895.

Application filed June 27, 1894. Serial No. 515,873. (No model.)

To all whom it may concern:

Be it known that I, CHARLES P. WILLIAMSON, of Birmingham, in the county of Jefferson and State of Alabama, have invented certain new and useful Improvements in Processes of and Apparatus for Manufacturing Pig-Iron; 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 relates to an improvement in the process of and apparatus for the manufacture of pig iron and it is in the nature of a modification of the process disclosed in application Serial No. 490,473 and the apparatus disclosed in application Serial No. 484,909, made by me and now pending in the Patent Office.

The object of the present invention is to introduce and provide means for the introduction of solid fuel under a descending shower of ore and to mix a sufficient flux with the solid fuel to take care of all impurities if desired, whereby to effectually complete the fusion of ores, supply carbon thereto and prevent the oxidation of melted iron, and it consists in certain procedure and features of construction which will be hereinafter described and pointed out in the claims.

In the accompanying drawings Figure 1 is a vertical section through the furnace. Fig. 2 is a similar section taken at right angles to the view shown in Fig. 1. Fig. 3 is a horizontal section on line *x*—*x* of Fig. 1.

A, represents a furnace having the usual chimney at the top and hearth at the bottom. The furnace is divided into a series of combustion chambers *a*, *a*, *a*, one located above another as shown in Figs. 1 and 2.

Bars or bridges B, B are formed at the bottom of the several combustion chambers, they constituting the division line or partition between the chambers. As shown in Fig. 2 the bars are arranged with spaces between them for the passage of material and the bars and spaces alternate in adjacent sets so that the bars in one set are immediately beneath the spaces of the set next above and so on throughout the height of the furnace, the object of this arrangement being to cause a retardation of the ore when it reaches the bottom of one combustion chamber before it drops through the next so that in the course of the several siftings which take place in the descent of the fuel from top to bottom of the furnace every particle of ore is fully exposed to the direct action of heat and massing of the ore is avoided. In other words the material is caused to shower down through the several combustion chambers from one set of bars or bridges to the next below, during which flights it is subjected to the direct contact of burning fuel.

The fuel is preferably introduced from the opposite sides of each combustion chamber by means of air and gas pipes 1 and 2 respectively and is discharged for ignition at or near the center thereof.

So much of the furnace is disclosed in my former inventions. In addition to these features however, in my present invention, I provide means for the introduction of solid fuel through which the molten metal filters and by means of which the metal is charged with carbon and oxidation is prevented.

C, C, represent two hoppers into which the solid fuel is placed and from which it is discharged beneath the shower of dropping metal just prior to its entrance into the crucible. There may be any number of these hoppers and they preferably have covers C′ C′ so constructed that the fuel may be thrown in over them and only allowed to descend when the weight of the fuel counterbalances the weight of the suspended weights *c c* connected therewith, said weights acting as valves for automatically controlling the passage of the fuel into the hoppers. These valves or covers may be operated by levers, or gearing. The bottom of the hoppers slope as *d d*, and cause the fuel to gravitate into the space D immediately above the crucible which is in the direct passage of the molten metal when it drops into the last combustion chamber. The intense heat from the top of the crucible immediately below this solid fuel ignites and keeps the latter burning. The metal filters through the carbonaceous material and in so doing becomes charged with the carbon which is emitted therefrom. This space or chamber D is provided with sight holes D′ D′ which are not only used as sight holes, but also they are

utilized in preventing the clogging of the passage connecting the hopper C with the space or chamber D, by inserting a bar to remove any obstruction. The opening D^2 at the bottom of the crucible is the iron notch for drawing off the melted iron, and the one next above, D^3 is used for drawing off the slag or cinder. This solid fuel may have a suitable flux mixed therewith to take care of the impurities, if so desired.

Conveyer E has been adopted for elevating the material and discharging it into the upper end of the furnace, and brackets F F, outside of the furnace, are provided for easy access to the different parts of the furnace from the outside.

From the construction described, it will be observed that the material upon being fed through the charging pipe into the upper end of the furnace first drops upon and through the upper set of bars or bridges, more or less accumulating in pyramidal piles upon the blocks or bridges at first and then dropping off as the accumulation becomes excessive, thus showering down through the combustion chamber immediately below until it reaches the next obstruction in the form of the next set of blocks or bridges where the material is naturally retarded again owing to the alternate arrangement described. The ore then drops again as before to the next set below and so on, always showering in small disintegrated lumps through the several chambers the purpose of this being to prevent the material from accumulating in large masses and the better to expose the individual particles to the action of the gases and the burning fuel in each of the several combustion chambers. The quantity of fuel or gas is regulated for each chamber as required to effect the desired results, the action being of course to deoxidize the material in the upper chambers and to fuse it in the lower ones and finally charge it with carbon. The gases evolved from the smelting which takes place in the lower chambers and from the solid fuel, ascending into the chambers above, assist in the deoxidizing and carbonizing and as this constitutes a material portion of the gas used, it is left with the operator to turn on a greater or less supply of gas in the chambers above, as required to effectually treat the ore in its passage to the crucible.

Having fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The herein described method of reducing and separating ore consisting in dropping the ore through a series of separated combustion chambers, the material being passed from one chamber to the next below in the form of a shower of small particles distributed horizontally throughout the area of each chamber, supplying suitable deoxidizing and reducing gases to each of these several chambers whereby the material is first deoxidized and then fused, and finally passing the molten material through carbonaceous material, substantially as set forth.

2. The herein described method of reducing and separating ore consisting in passing it through a series of superimposed combustion chambers in a finely divided state, obstructing it temporarily between the several chambers and keeping up a continuous supply of carbonaceous solid fuel between the lowest combustion chamber and the crucible at the bottom whereby carbon is supplied to the metal, substantially as set forth.

3. The herein described method of reducing and separating ore consisting in dropping it through a series of superimposed combustion chambers, obstructing and retarding the descending ore temporarily in the bottom of each of these chambers, supplying each of the several chambers with gases for deoxidizing and fusing the ore, filtering the molten material through a carbonaceous solid fuel whereby it is charged with carbon and utilizing the gas evolved in the lower chambers for assisting in the deoxidation which takes place in the chambers above, substantially as set forth.

4. A furnace consisting in an outer wall, a series of combustion chambers therein, one located above another, obstructing devices located between these combustion chambers, means for supplying gases in suitable quantities to each of the several chambers for deoxidizing and smelting the ore, and means for supplying a continuous feed of carbonaceous solid fuel at a point where the molten metal must filter through it whereby it becomes charged with carbon, and oxidation prevented substantially as set forth.

5. The combination with a furnace wall, said furnace divided into superimposed combustion chambers, said chambers separated by suitable grate bars, and pipes leading to each chamber for discharging air or gas therein, of a solid fuel hopper containing carbon located beneath the series of combustion chambers through which carbon the molten metal filters, and a crucible beneath the solid fuel hopper, substantially as set forth.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

CHARLES P. WILLIAMSON.

Witnesses:
J. B. SIMPSON,
H. D. WILLIAMSON.