(No Model.)

C. P. WILLIAMSON.

PROCESS OF MANUFACTURING PIG IRON.

No. 538,225. Patented Apr. 23, 1895.

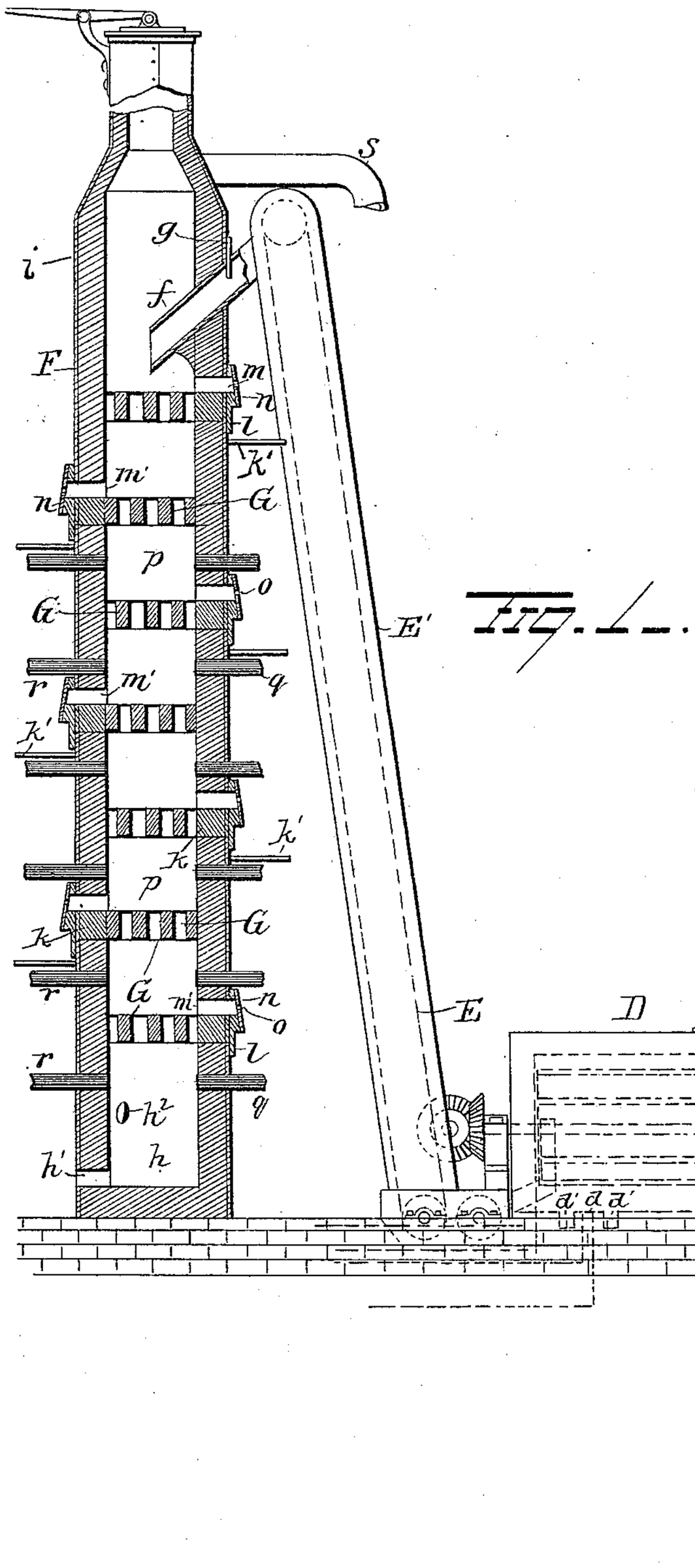

Fig. 1.

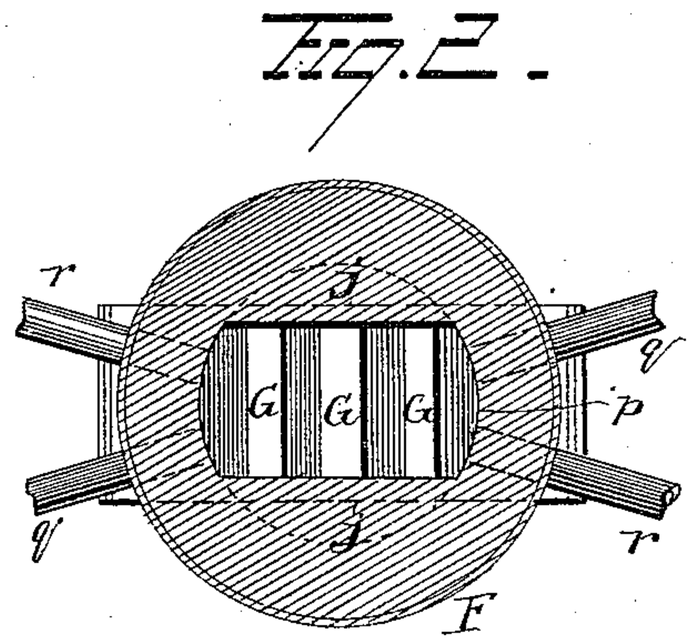

Fig. 2.

Witnesses
G. F. Downing.
S. W. Foster

Inventor
Charles P. Williamson
By K. A. Seymour
Attorney

UNITED STATES PATENT OFFICE.

CHARLES P. WILLIAMSON, OF BIRMINGHAM, ALABAMA.

PROCESS OF MANUFACTURING PIG-IRON.

SPECIFICATION forming part of Letters Patent No. 538,225, dated April 23, 1895.

Application filed November 9, 1893. Serial No. 490,473. (No specimens.)

To all whom it may concern:

Be it known that I, CHARLES P. WILLIAMSON, a citizen of the United States, residing at Birmingham, in the county of Jefferson and State of Alabama, have invented certain new and useful Improvements in Processes of 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 processes of producing pig iron,—the object of the invention being to produce a simple and efficient process for the manufacture of pig iron, with the use of gaseous fuel, at a moderate cost.

A further object is the production of an improved process of manufacturing pig iron whereby the cost thereof and the requisite time for the performance of the process shall be reduced to a minimum.

With these objects in view the invention consists in certain novel steps in the process of manufacturing pig iron, as hereinafter set forth and pointed out in the claims.

In the accompanying drawings: Figure 1 is a view of an apparatus by means of which my improved process can be carried into effect. Fig. 2 is a sectional view of the furnace.

After the proportions of ore and flux, or ores, cinder and flux, shall have been determined and measured by weight or otherwise, they will be fed together into the hopper of a breaker or crusher A, which may be of any preferred form of construction and preferably so disposed that its top will be on a level or approximately on a level with the floor, so that the material can be readily deposited therein, from the carts.

The flux employed may be of limestone, oyster shells or other material containing lime and sometimes it happens that the material under treatment is self-fluxing when of course no additional flux is necessary.

The material (combined ore and flux, or ore, cinder and flux) will be reduced by the breaker to a proper size to be passed between rolls and will be conveyed from the breaker by a chute *a*, to a conveyer A′, by which it will be elevated and deposited into the hopper *b* over crushing rolls B. The crushing rolls and the apparatus for driving them may be of any preferred form of construction. The material will thus be reduced to a fineness best suited to the further process of drying and mixing and will be conveyed from the crushing rolls by a chute *c* to a drier and mixer D of any desired form of construction, which drier may be heated by gas entering at *d*, the air for supporting the combustion of said gas entering at *d′*. After passing through the drier and mixer D, the material will be carried, by a conveyer E and deposited into the charging pipe or inlet *f* of my improved furnace F. As the material, after it passes through the drier, is very fine, I find it advantageous and advisable to inclose the conveyer E by a casing E′, so as to confine the material and prevent it from filling the air surrounding the apparatus.

When circumstances, or more strictly speaking, the lay of the land where the apparatus is situated, will permit, the material may be fed from the breaker, through the crushing rolls and drier to the furnace, by gravity, thus dispensing with the use of the conveyers A′ and E.

The charging pipe or inlet *f* of the furnace is provided with a gate *g* whereby to regulate the amount of material fed into the furnace, so as to insure a continuous supply of material commensurate with the capacity of the furnace without clogging or massing therein. The same result may be accomplished, if desired, by regulating the amount of material deposited into the breaker.

The ore, in its passsge through the furnace will meet the burning fuel and be melted before it reaches the bottom thereof. To insure this result, the material will be retarded in its passage through the furnace,—for the accomplishment of which purpose, the furnace may be constructed in a manner which will now be explained.

The crucible *h* of the furnace, into which the material finds its way after having been melted, is preferably made circular in cross section, and is provided with the usual "iron notch" or outlet *h′* and the cinder "notch" or outlet h^2. The exterior of the furnace, above the crucible, is preferably of the same form and size as said crucible up to the stack and the whole is inclosed in a metallic shell or casing *i*.

Above the crucible *h*, the interior of the furnace is made practically rectangular, in cross section, the ends only of said rectangular portion being slightly curved in conformity with the diametrically opposite walls of the furnace.

The furnace is divided into a number of levels or zones, at each of which, retarding and fuel supply devices are located. In constructing the retarding devices, the inner, diametrically opposite walls of the furnace are made with elongated grooves or recesses *j*, at each level or zone, so as to produce ledges for the support of blocks or bridges of refractory material G, a series of such blocks or bridges being located at each zone and the blocks or bridges of each series being spaced a distance apart preferably somewhat less than the width of said blocks or bridges,—which latter are maintained a proper distance apart by suitable filling or spacing pieces inserted in the recesses or grooves *j*.

The wall of the furnace, at the end of each series of blocks or bridges, is made with a removable section *k*, whereby access may be had to the interior of the furnace to repair or renew the blocks or bridges, the operator standing, for this purpose, on a platform *k'* projecting from the furnace (one at each level or zone), to which platforms access may be had by a ladder or by stairway built adjacent to the furnace. In order to render the removable sections *k* of the furnace wall accessible, the metallic shell or casing *i* will be cut away in alignment therewith, and the opening in the shell or casing thus produced, will be normally closed by means of a gate or door *n*.

In arranging the retarding devices, the blocks or bridges of one series will be arranged over the spaces between those of the next series beneath, and the blocks or bridges being slightly wider than the width of the spaces between them, it will be seen that the material escaping from one block or bridge will fall directly upon a block or bridge of the next lower series.

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 as the second set of bars is preferably arranged to alternate with the uppermost set. It then drops again as before to the next set below and so on, always showering in small desintegrated lumps through the several chambers, the purpose of this being to prevent the material 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 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 chamber and to fuse it in the lower ones. The gases evolved from the smelting which takes place in the lower chambers, ascending into the chambers above, assist in the deoxidizing 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 descent.

In supplying the furnace with heat I prefer to employ gas as a fuel, which will be introduced, together with the necessary supply of air, into each combustion chamber *p* and in the upper part of the crucible below the bottom series of bridges, which space is also, in effect, a combustion chamber, the same as the spaces between the several series of bridges.

With the ends of each combustion chamber, gas inlet pipes *q* communicate and are adapted to direct the gas therein in a diagonal direction, the gas inlet pipe at one end of the combustion chamber being in line with the gas inlet pipe at the other end. The air inlet pipes *r* are arranged in the same manner, so that the gas and air will have a tendency to flow diagonally across the chamber, at different angles, the air and gas combining practically in the center of the chamber, where combustion will take place.

The gaseus fuel may be produced and conveyed to the furnace in any suitable manner and the same gas may be employed to heat the drier and mixer, but in the latter case, it may be found to advantage from an economical point of view, to utilize the unburned gases which may escape from the furnace and for this purpose a pipe *s* may be made to communicate with the upper portion of the furnace in proximity to the stack and adapted to convey the escaping gas to the drier or mixer.

The furnace herein described forms the subject matter of a concurrently pending application for Letters Patent, Serial No. 484,909, filed September 6, 1893, and therefore no claim is made herein to the construction disclosed.

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

1. The method of treating ore whereby to deoxidize and fuse the same, 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, and supplying suitable deoxidizing and reducing gases to each of these several chambers whereby the material is first deoxidized and then fused, substantially as set forth.

2. The method of treating ore whereby to

deoxidize and fuse the same, 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 utilizing the gas evolved in the lower chambers for assisting in the deoxidizing which takes place in the chambers above, substantially as set forth.

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

CHARLES P. WILLIAMSON.

Witnesses:

H. D. WILLIAMSON,

J. D. SIMPSON.