

# United States Patent Office.

JAMES DAVENPORT WHELPLEY AND JACOB JONES STORER, OF BOSTON,  
MASSACHUSETTS.

*Letters Patent No. 102,740, dated May 3, 1870.*

## IMPROVEMENT IN THE MANUFACTURE OF WROUGHT IRON FROM ORE, CINDER, OR SLAG.

The Schedule referred to in these Letters Patent and making part of the same.

*To all to whom these presents shall come:*

Be it known that we, JAMES DAVENPORT WHELPLEY and JACOB JONES STORER, both of Boston, in the State of Massachusetts, have invented a new and useful Improvement in the Manufacture of Wrought Iron from Ore, Cinder, or Slag, and in the manipulation thereof.

Our process is as follows:

Upon the usual prepared cinder-hearth of a puddling or boiling furnace, heated to a bright red heat, we charge a quantity of pulverized ore, cinder, or slag, prepared as described in our patent No. 95,295, issued September 28, 1869, antedated September 16, 1869, with the addition only of finely-pulverized carbon or carbonaceous material, in amount necessary for the removal of all or most of the oxygen from the ore, cinder, or slag, so as to revive the iron contained therein; or, in amount sufficient not only to revive it, but to carbonize it to any desired degree. We then throw upon this charge a quantity of slag, cinder, or ore, broken into pieces of about egg-size, or smaller, and then place in the furnace, preferably upon this mass, the required auxiliary amount of cast or pig-iron for the best results, say twenty-five to fifty per cent., more or less.

As the heat of the furnace is raised to melt the cast or pig-iron, the carbon in the pulverized material first introduced begins to remove the oxygen contained in the ore, cinder, or slag, thus initiating the deoxidizing or reviving of its iron, while the earthy impurities are combined with the fluxes, when such are present, and with the materials of the second charge.

The pig-iron, melting, (or it may be run in melted from another furnace,) flows upon the mass, and is well stirred in with it, with the ordinary puddlers' tools. Boiling then takes place, as is usual in puddling or boiling furnaces, with the combined result of the separation of the impurities from the ore and pig, and the usual action of the carbon upon the oxide of iron.

Under certain conditions we dispense with the second charge, the broken ore, cinder, or slag, and find that the desired effect is produced by the action of the fix or fettling, which, by fusion, is mingled with the pulverized mixture and cast-iron.

In our patent No. 95,295 we described a process of making wrought iron directly from the ore, cinder, or slag.

By delicate and skilful manipulation, and careful and nice adjustment of the proper fluxes, we obtained good results in that process; but these necessary conditions being urged as objections to the general adoption of the process, because of the present lack of the requisite skill and knowledge on the part of workers of

iron, we have made, and herewith present, an improvement in the process, against which such objections cannot be sustained.

Unless, in the process above alluded to, the fluxes are of a character to readily combine with and remove the earthy impurities of the ore, cinder, or slag at a low heat, and unless considerable experience and skill has been attained by the workman, the minute particles of revived or carbonized iron seem to envelop and hold them entangled, especially silica or silicate of lime, so that they cannot be eliminated, or only partially so, except by exposure of the mass to high and continued heat, which not only causes a waste of iron, but demands an increased consumption of fuel and labor.

The advantages of the improvement herein claimed are, that the auxiliary molten cast-iron stirred into the mass envelops and seemingly absorbs and dissolves the particles of iron revived from the ore, cinder, or slag, while the earthy impurities are eliminated by the process of boiling. The ore, cinder, or slag, pulverized with coal alone, without fluxes, is easily worked by this addition of pig-iron; the slag furnished by the fettling or lining of the furnace being sufficient, if not too much of the powdered material be used, to flux and eliminate the earthy impurities to the degree which is usually arrived at in the manufacture of wrought iron from pig.

We have in some instances fritted or melted together the ore, cinder, or slag with the appropriate fluxes, preparatory to working the mixture with cast-iron, as described above, which we have afterwards pulverized with the proper proportion of carbonaceous matter for obtaining the desired result.

In the ordinary method of puddling iron, there is an excessive waste of the ore used for fettling or lining, about one ton of ore being consumed in the production of three tons of wrought iron.

A small portion of the iron in the ore is revived by the carbon in the pig-iron, and thus partially makes up the loss of weight consequent upon the elimination of the earthy impurities of the pig, and a portion of the ore becomes useful as a detergent of these earthy impurities; but the principal portion melts, and is tapped off as cinder, without having served either purpose.

In making wrought iron by our method, as above described, a large proportion of the iron is revived from the fix or fettling by the carbon in the pulverized material first thrown upon the hearth, while enough remains unaffected by the carbon to serve as a detergent of the impurities in the mixture and cast-iron.

The general effect of this pulverized mixture is to



revive iron from all the forms and mixtures of oxide of iron that may be present in the furnace, the whole being eventually intermingled in the process of fusion and manipulation of the charge.

With a certain degree of success this process was worked in a puddling or boiling furnace, heated in the usual manner, with all the fuel burned upon the grate-bars, or heated with gases; but, for the best results, we find it preferable to employ pulverized fuel as the principal or sole agent of combustion, applied and burned in the manner described in our patent No. 53,208, dated March 13, 1866; reissue No. 3,857, dated March 1, 1870, and in the form of furnace described in our patent No. 101,067, dated March 22, 1870.

The advantages of applying the pulverized-fuel process, above alluded to, to this method of reviving iron from ore, cinder, or slag, are a great economy of fuel, and a more perfect control of the chemical action of the flame, and the degree of heat desired; but we also find that the use of a hearth composed of cinder, ore, or slag, in the manner usual in puddling or boiling furnaces, is a valuable improvement in the process of reviving iron from ore or cinder, when pulverized and mixed with carbon and fluxes, even when cast-iron is not used as an auxiliary, for reasons sufficiently explained above.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. The use of cast or pig-iron as an auxiliary to the obtaining of wrought iron from a mixture of ore, cinder, or slag and carbon, by the process and manipulation, and for the purpose and in the manner substantially as described.

2. The combination of the process herein described, with the form of furnace and process described in our patent No. 53,208, dated March 13, 1866; reissue No. 3,857, dated March 1, 1870, and patent No. 101,067, dated March 22, 1870.

3. The use of a furnace-hearth composed of cinder or oxide of iron, in combination with the process of reviving iron from ore, cinder, or slag, prepared and manipulated substantially as described.

4. The process herein described for obtaining wrought iron, the same consisting in the treatment of a mixture of either ore, cinder, or slag and carbon with cast-iron, substantially as set forth.

JAMES D. WHELPLEY.  
JACOB J. STORER.

Witnesses:

CHARLES M. NICKERSON,  
FRED W. LONGLEY.