



THOMAS S. BLAIR, OF PITTSBURG, PENNSYLVANIA.

Letters Patent No. 85,053, dated December 22, 1868.

IMPROVEMENT IN THE MANUFACTURE OF STEEL.

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, THOMAS S. BLAIR, of the city of Pittsburg, in the county of Allegheny, and State of Pennsylvania, have invented a new and useful Improvement in the Manufacture of Steel; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to the manufacture of steel by means of the new article known as "pig-bloom" or "pig-scrap," according to the manner in which it is produced by the process invented by Ellershausen, Guzman, and Stayner, and recently patented or about to be patented by them.

"Pig-bloom" or "pig-scrap," so called by the inventors, consists of a conglomerate of cast-iron and an oxide or oxides, (usually the oxide of iron,) intimately mixed together, while one of the ingredients, (cast-iron or ore) is fluid, and the other is solid, so as to form at once in the mixing a somewhat loose-textured yet solid (as distinguished from fluid) mass.

I need not here detail the process or method of making the "pig-bloom" or "pig-scrap," as it is particularly described in the patent before referred to; but

In order to enable others skilled in the art to use my invention, I will proceed to describe the manner in which it is to be used and operated.

In order to the successful conduct of the process I am about to describe, it is important that the "pig-bloom" or "pig-scrap," whichever is used, should contain such a relative proportion of cast-iron and oxide as to yield a steel of the required degree of hardness, because different qualities of cast-iron and different kinds of ore yield in this respect different results. I therefore first make a small amount of "pig-scrap," and subject it to the process hereafter described, to test the result, before preparing the "pig-bloom" or "pig-scrap" in large quantity.

Having thus determined the proper formula for mixing the cast-iron and ore, (or oxide,) to give the desired result, I proceed to make a large quantity of "pig-bloom" or "pig-scrap" for use in the making of steel by my improved process, taking care to have the oxide and cast-iron mixed as intimately as possible.

If "pig-scrap" is used, which is in small pieces, of loose texture, it is carefully picked over, and those pieces which are seen to contain any raw cast-iron, being rejected, the residue, when cooled, is screened, so as to remove any loose ore from the mass. The pieces are then placed in crucibles, and treated as a substitute for blistered steel or wrought-iron in the manufacture of cast-steel, the process being conducted in similar crucibles and furnace, and in the same manner as is practised in making crucible-steel, excepting that "pig-scrap" or "pig-bloom," broken up, is used instead of blister-steel or wrought-iron.

By first making a few sample ingots of steel from the "pig-scrap," which has been carefully selected

and screened, as before described, the character of the resultant steel is ascertained, and any error in the proportion of ingredients used in preparation of the "pig-scrap" is corrected, in conducting the process on a larger scale, by adding charcoal in the crucible, if the test steel-ingots are found too soft, or wrought-iron if they have proved too hard.

Instead of melting the "pig-scrap" in crucibles, as above described, it may be melted down in an open furnace, in which case the "pig-bloom," which is a loose, spongy mass, may be used, but in this case, in order to insure success, care must be taken, in making the "pig-bloom" or "pig-scrap," not to have an excess of oxide, but to have such a relative proportion of ore and cast-iron as will allow of the mass being melted; as otherwise, the ore, being in excess, would remove the carbon, and the mass would not melt by such treatment.

Another modification of my process is to take the "pig-scrap" or "pig-bloom," broken up into small pieces, and introduce it from time to time, in small quantities, into a bath of molten cast-iron, until the desired degree of carbonization is attained.

In this process the pieces of "pig-scrap" or "pig-bloom," (each of which is a conglomerate of cast-iron and ore, and some parts of which are in a transition state nearly approaching to malleable iron,) serve to dilute the carbon of the cast-iron, and at the same time the oxide of iron, which was mechanically imprisoned in the conglomerate, aids in the process of dilution.

Thus the process of making steel by diluting the carbon is carried on with both malleable iron and oxide of iron at the same time; whereas, heretofore, it has been found impracticable to use the oxide of iron for this purpose, because, when free, it destroys the furnace. It may, however, be used by my method, as above described, with safety to the furnace, and greatly facilitates the reduction of the quantity of carbon.

Another advantage peculiar to this process is, that the material introduced into the cast-iron bath is of so open, porous, and spongy a texture, as to be more rapidly melted, and is, besides, in a chemical condition better adapted to produce the desired result than manufactured wrought-iron.

This method also cheapens the manufacture of steel, as the process or processes necessary to the manufacture of wrought-iron are omitted, the "pig-bloom" or "pig-scrap" being used without being previously converted into malleable iron.

Still another modification of my process is as follows:

Instead of introducing the raw "pig-scrap" or spongy pieces of "pig-bloom" directly into the bath of molten cast-iron, I charge it (the pieces of "pig-bloom" or "pig-scrap") into a separate heating-furnace, which may be situate near to the furnace containing the bath of molten cast-iron. It is there exposed to a high temperature, and allowed to remain at a white heat for some time, so as to sweat out the impurities, and it



is then transferred, with as little loss of heat as possible, into a bath of molten cast-iron, in which it is melted more rapidly than manufactured wrought-iron would be, owing to the open, spongy, and loose texture of the "pig-bloom."

This method has the disadvantage of not introducing the iron-ore into the bath, as it has become chemically incorporated with the mass, in which it was before mechanically present, by reason of the heat of the furnace, and hence it will be a less expeditious as well as more costly process than that before described, but it will be found better suited for making extra qualities of steel, and for utilizing materials too impure for other modes of treatment.

This last-described method obviates the necessity, hitherto experienced in the ordinary processes of steel-manufacture, of using none but the finest quality of materials, at the highest cost, because my treatment removes a much larger amount of impurities than can be removed by the processes heretofore employed.

The furnaces and appliances used in my process, as described in its various modifications, may be such as are ordinarily employed in the manufacture of steel, and therefore need no further explanation here.

By the above-described application of "pig-bloom" or "pig-scrap" to the manufacture of steel, the operation is greatly simplified in detail, and reduced in expense.

Crucible-steel can be produced with great facility, the method I have described giving complete control of the process.

In the open-furnace treatment which I have described, the product of a blast-furnace can be run, at about equal cost, into cast pig or into "pig-bloom" and "pig-scrap," and from these two articles, thus produced directly from the blast-furnace, the steel-ingot is manufactured with only one after-heating.

In this specification the term "wrought-iron" is used to designate malleable iron which has been worked; whereas the "pig-bloom" or "pig-scrap" used in my process, after it has been exposed to a high heat, becomes malleable, but is not wrought, retaining the open, spongy texture, which wrought-iron or worked iron does not possess, and which renders the use of the "pig-bloom," either before or after it is converted into malleable iron, peculiarly adapted to the manufacture of steel in the manner I have above described.

Having thus described my improvement,

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

1. The manufacture of cast-steel in the crucible, from "pig-bloom" or "pig-scrap," substantially as hereinbefore described.

2. The manufacture of steel by melting down, in an open furnace, "pig-bloom" or "pig-scrap," composed of a mixture of cast-iron and an oxide or oxides, in such relative proportion of metal and oxide, as to give the necessary ratio between the oxygen, carbon, and iron, to produce the desired result, substantially as hereinbefore described.

3. The manufacture of steel from cast-iron, by adding to the cast-iron, in a melted state, a conglomerate composed of cast-iron and oxides of iron, substantially as hereinbefore described.

4. The production of steel from cast-iron and malleable iron, by melting the cast-iron, and fusing in it a sponge of wrought-iron, obtained from "pig-bloom" in the manner hereinbefore described.

In testimony whereof, I, the said THOMAS S. BLAIR, have hereunto set my hand.

THO. S. BLAIR.

Witnesses:

W. BAKWELL,  
R. C. WRENSHALL.