

UNITED STATES PATENT OFFICE.

NOEL B. WITTMAN, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR TO PITTSBURG
STEEL CASTING COMPANY, OF SAME PLACE.

PROCESS OF DEOXIDIZING MOLTEN IRON IN THE MANUFACTURE OF STEEL.

SPECIFICATION forming part of Letters Patent No. 318,067, dated May 19, 1885.

Application filed April 26, 1884. (No specimens.)

To all whom it may concern:

Be it known that I, NOEL B. WITTMAN, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented or discovered a certain new and useful Improvement in Process of Deoxidizing Molten Iron in the Manufacture of Steel, of which improvement the following is a specification.

- 10 The object of my invention is to facilitate the removal of the oxide of iron from the bath in the Bessemer converter, and to reduce the quantity of ferro-manganese heretofore necessarily added for that purpose, and to thereby
15 render it possible to produce steel low in carbon, and free, when reduced to sheets or other forms, which are subsequently treated, from blisters and other like imperfections arising from gas being inclosed within the metal.
- 20 The pig-iron which is usually employed in the Bessemer process contains about two to two and a quarter per cent. of silicon, which is oxidized by the blast and is converted into silica or silicic acid, which in turn unites with
25 any oxide of iron which may be present in the bath, forming therewith an acid cinder or slag; but as the blow continues and oxidizes the iron, the oxide thus formed combines with the surplus silicic acid in the slag, and changes the
30 character of the latter until it becomes comparatively highly basic. This action continues until the slag has reached such a state that it will not absorb or dissolve any more of the oxide, which will then remain in the bath in
35 that condition, and would be carried therewith into the mold, producing unsound and imperfect ingots, or a large amount of ferro-manganese would have to be added to the bath in order to remove this excess of oxide of iron.
- 40 This excess of oxide occurs more particularly in manufacturing steels low in carbon, and by steels low in carbon I mean such as contain less than .10 per cent. of carbon. In making such steels the blow must be continued until all the carbon and other impurities have been, as far as practicable, removed from the bath, and it is impracticable to add sufficient ferro-manganese to remove all this oxide, for if sufficient ferro-manganese to re-
45 move the oxide of iron in the bath were added the resultant metal would be too high in car-

bon on account of the high percentage of carbon contained in the ferro-manganese.

I now propose to add to the bath in the converter at any stage of the process of blowing 55 a sufficient amount of silicious material—*e. g.*, sand, ganister, or silicious clay containing a high percentage of free silica—to combine with and remove all the oxide of iron which may be formed during the conversion of the bath. 60 The silica thus added will combine with the oxide of iron and form therewith an acid slag. I have found that about fifty pounds (50 lbs.) of silicious material is sufficient for a bath of ten thousand pounds (10,000 lbs.) of cast-iron, 65 and this material may be added at any stage of the operation, but preferably during the latter part of the blow. This silicious material may either be charged into the converter through the mouth or it may be 70 blown in by the blast. As this silicious material combines with and removes to a very great extent oxide that is formed, only sufficient quantity of ferro-manganese need be added, when the converter is turned down, to 75 produce the proper degree of carburization and to neutralize the sulphur. This saving of ferro-manganese amounts in steels low in carbon to thirty-three (33) per cent. of the quantity usually employed in the Bessemer 80 process.

Another important characteristic of this process is the great elimination of gas effected by the charge of silicious material. I have found that when the silicious material is added 85 that a great amount of gas is liberated and discharged from the converter while the metal is being poured into the ladle; but the metal remains perfectly quiet in the ladle and mold after pouring. 90

It has been found that when steel, as usually made, is rolled into sheets, and these sheets are subsequently pickled and afterward cold-rolled in water that the surface of the sheet is full of minute blisters, which render the sheet 95 useless for stamping purposes. These blisters arise from gases which have been confined in the metal and were developed in the subsequent treatment; but sheets made from steel produced by my process are quite free from 100 these blisters.

While I cannot state with certainty the cause

of the retention of the gases in the bath heretofore, I have found that the elimination of the gas is more thorough and effective when the silicious material is added at or about the end of the blowing operation.

I am aware that it is not new to add silicon to a bath of molten steel in the form of silicious pig-metal, consisting of silicon, manganese, iron, and carbon. The silicon in this material acts upon the carbonic oxide in the metal of the bath, thereby decomposing it with the liberation of carbon which unites with the iron to form steel, and the silicon is converted into silica by the oxygen taken from the carbonic oxide, and the silica in turn unites with any oxide of iron or manganese present to form a slag; but I am not aware that silica, either pure or combined with other materials, has ever been added to a bath of molten steel. The silica combines with the slag, changing it from a basic to an acid slag, thereby rendering the slag capable of combining with any oxide of iron, as such, which may be present.

It will be perceived that the silicon and silica—radically different materials—act in different ways. The silicon, combining with the gases, eliminates them, and the silica, combining with the slag, renders it fluid and acid, thereby providing for an elimination of both the oxide of iron and the gases; and any surplus silicon used in the old method not combined with the carbonic oxide unites with the metal, rendering the metal, if the surplus is great, very brittle. The silica, however, will never attack the metal, but will combine only with the slag.

I am aware that a small quantity of a mixture of pulverized sand and salt have been introduced into the bath in a converter through the blast-pipe, the sand being used to increase the heat of the bath and as a carrier for the salt; but I am not aware that silica alone, in the form of sand, ganister, &c., has ever been used to act upon the slag of the bath and for the elimination of the gases in the bath.

I am also aware that silicate of alumina has been added to iron in the finery and puddling operations, and also that a mixture of ground flint and charcoal have been blown into the bath in the Bessemer operation; but I am not aware that silica, either alone or mechanically combined with other materials having no chemical effect upon the metal of the bath, have ever been used in the Bessemer operations.

I claim herein as my invention—

1. In the Bessemer process, the method of eliminating the oxide of iron formed in the bath during the conversion thereof, which consists in adding silicious material containing a large proportion of free silica to the molten bath in about the proportions above stated at or approximately at that period of the operation at which the oxidation of the silicon of the bath ceases, substantially as set forth.

2. In the Bessemer process, the method of producing steel low in carbon, which consists in adding silicious material containing a large proportion of free silica to the molten bath in about the proportions stated for the elimination of the oxide of iron therefrom, and finally adding ferro-manganese to neutralize the sulphur and carburize the metal of the bath, substantially as set forth.

3. In the Bessemer process, the method of eliminating the oxide of iron and the gases from the metal of the bath, which consists in adding silicious material containing a large proportion of free silica thereto in the proportions above described at or about the end of the blowing operation, substantially as set forth.

In testimony whereof I have hereunto set my hand.

NOEL B. WITTMAN.

Witnesses:

R. H. WHITTLESEY,
DARWIN S. WOLCOTT.