UNITED STATES PATENT OFFICE.

JACOB REESE, OF PITTSBURG, PENNSYLVANIA.

BASIC PROCESS FOR THE MANUFACTURE OF HOMOGENEOUS INGOT IRON AND STEEL.

SPECIFICATION forming part of Letters Patent No. 284,574, dated September 4, 1883.

Application filed July 3, 1882. (No specimens.)

To all whom it may concern:

Be it known that I, JACOB REESE, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Basic Processes for the Manufacture of Solid Homogeneous Ingot-Iron and Steel from Phosphoric Metal; and I do hereby declare the following to be full, clear, and exact description thereof.

In the Bessemer basic process phosphoritic metal is treated in a basic-lined converter, and in the presence of a basic bath until the silicon, carbon, and phosphorus are eliminated. The metal is then deoxidized and poured into the ladle, and from thence into the ingot-molds. When the metal has been blown, the silicic and phosphoric acids resulting from the oxidation of silicon and phosphorus will be found in the slag which floats on the surface of the metal. In the act of deoxidizing the metal by means of manganese care must be taken to prevent the manganese from coming in contact with the slag, as it would rob the phosphoric acid of its oxygen and permit the phosphorus to return to the metal. Several methods have heretofore been proposed in order to remove this difficulty; but I shall hereinafter describe another means of securing this end. When the oxides have been removed, the molten metal still contains a considerable amount of gases, and if, as in the ordinary practice, the metal is poured out immediately after it is deoxidized, the resulting ingots will be porous.

The object of this invention is to remove these two difficulties. This I effect by removing the dephosphorized metal from the presence of the phosphoritic slag and placing it in a silicious-lined open-hearth furnace, and therein deoxidizing it in the presence of a high heat produced from other fuel than that contained in the metal, and then subjecting the deoxidized metal to a dead-melt while in a state of rest. By holding the metal in a state of rest at a high temperature the gases escape from the metal and the ingots will be comparatively free from porosity.

In carrying out this invention the metal may be melted in a cupola; or it may be run direct from a blast-furnace into a basic-lined converter, and there blown with an air-blast (while in the presence of a basic bath) until the silicon and the carbon are removed, and then still further blown, in the absence of carbon or carbonic oxide, until the phosphorus is oxidized and held in the slag. The metal is then run into an open-hearth furnace, (which has been previously heated,) care being had to practically exclude the phosphoritic slag. When the metal has been placed in the furnace, it is then deoxidized by adding thereto a proper amount of manganese or silicon in the form of ferro-manganese or a silicious pig. If ingot iron is desired the final additions should be as low in carbon as possible, and when steel is desired the final additions should contain the required amount of carbon in addition to the manganese or silicon. After the metal has been deoxidized it is kept in the furnace about thirty (30) minutes, in order to eliminate the gases; but if the metal contains carbon, and does not contain over two hundredths of one per cent. of silicon, the carbon will be attacked by the oxide, (which will be formed on the surface of the metal,) and this will cause the metal to boil and prevent the state of rest essential to the elimination of the gases. Therefore, in order to secure the state of rest, when I deoxidize by the use of manganese, I also charge it with silicon, which may be done at the same time the manganese is charged, or after deoxidation has taken place. And when I deoxidize with silicon, in addition to the amount of silicon required to deoxidize the metal, I add a sufficient amount to protect the carbon from oxidation for thirty minutes, in order to retain the metal in a state of rest. When silicon is present in the molten metal in a greater quantity than twenty hundredths of one per cent., it protects the carbon from oxidation, because silicon has a much greater affinity for oxygen than carbon has, and as the surface of the metal becomes oxidized the silicon will reduce the oxide of iron and form silicic acid or a silicate of iron. Thus the silicon which is charged to protect the carbon is itself oxidized and may be reduced to twenty-five hundredths of one per cent. before tapping the metal. When the metal has been deoxidized, and subjected to a dead-melt at a state of rest for thirty minutes,

it should be then tapped out into the ladle, and from thence run into ingots or castings, as may be required. The amount of silicon required for deoxidizing or for protecting the carbon and holding the metal in a state of rest is fully explained in Letters Patent No. 245,657, granted to me on the 16th day of August, 1881. In the basic process, the carbon, silicon, and phosphorus having been entirely eliminated and the sulphur greatly reduced, the fusion-point of the resulting metal is raised to nearly 5,000° Fahrenheit. Such metal will chill much quicker than metal made by the Bessemer acid process, and is much more liable to occlude the gases and produce porous ingots than when the fusion-point is lower by reason of the metal containing a greater amount of impurities.

By the use of this invention as soon as the metal has been freed of its impurities it is (minus the slag) run into a hot furnace, and while kept in a highly-fluid state is deoxidized and held in a state of quietude until the gases escape, by which means I am enabled to produce ingot-iron free from silicon, phosphorus, and porosity, and practically free from carbon and sulphur.

In blowing ten tons of metal in a basic vessel in the manner herein proposed four blows may be made in an hour. Therefore I prefer to use two open-hearth furnaces, so that the converter may be used steadily, and thus kept in a heated condition. By this method the blown metal would be put into the furnaces alternately and ten tons of ingot iron or steel produced every fifteen or twenty minutes. In either case the furnace or furnaces should be large enough to hold the contents of the converter.

A basic lining may be used in the open-hearth furnaces; but I prefer to use a silicious lining, as it is less trouble to make, of less expense, and suits as well, as I find when the metal has been desiliconized and dephosphorized no reduction of the silicic acid of the lining takes place when the metal is held in a state of rest, as there is no carbonic oxide passing through the metal, which would effect a reduction.

In this application I do not claim a process of purifying iron by subjecting the molten metal to an air-blast while held in a basic-lined vessel and in the presence of basic additions, two such processes having been already patented by me June 19, 1883, No. 279,596, and February 13, 1883, No. 272,085; nor do I claim, broadly, the process of freeing a metal from its gases by subjecting it to a dead-melt while in a state of rest, one such process having been already patented by me May 22, 1883, No. 277,929; nor do I claim that the treatment of molten metal in a previously-heated open-hearth furnace is broadly new; but

What I do claim is—

The within-described process for the production of solid homogeneous basic iron and steel, which consists, essentially, in, first, melting the metal; second, running the melted metal into a basic-lined converter, and there subjecting it to an air-blast while in the presence of a basic bath until the silicon, carbon, and phosphorus are eliminated; third, running the metal (minus the slag) into a previously-heated open-hearth furnace, and there deoxidizing it by the addition of proper materials, and, fourth, subjecting the metal after deoxidation to a dead-melt while said metal is in a state of rest, substantially as described, whereby the deoxidizing agent is prevented from coming in contact with the slag and the escape of gases from the metal effected, as set forth.

JACOB REESE.

Witnesses:

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