

UNITED STATES PATENT OFFICE.

JEAN MEYER, OF DÜDELINGEN, GERMANY.

METHOD OF CARBURIZING IRON.

SPECIFICATION forming part of Letters Patent No. 524,904, dated August 21, 1894.

Application filed July 7, 1894. Serial No. 516,832. (No specimens.) Patented in France November 3, 1890, No. 209,262; in England November 3, 1890, No. 17,613; in Belgium November 3, 1890, No. 92,558; in Luxemburg November 3, 1890, No. 1,371, and in Germany November 4, 1890, No. 74,419.

To all whom it may concern:

Be it known that I, JEAN MEYER, a subject of the Grand Duke of Luxemburg, at present residing at Düdelingen, Luxemburg, Germany, have invented certain new and useful Improvements in Methods for Carburizing Iron, (for which I have obtained Letters Patent in France, No. 209,262, dated November 3, 1890; in Great Britain, No. 17,613, dated November 3, 1890; in Belgium, No. 92,558, dated November 3, 1890; in Luxemburg, No. 1,371, dated November 3, 1890, and in Germany, No. 74,419, dated November 4, 1890,) of which the following is an exact description.

The present invention relates to a method in accordance with which molten pig iron or any other ferruginous mixture (which has been converted or refined, and decarburized or decarburized and dephosphorized, as the case may be, either in the Bessemer or the basic converter, or in the Siemens-Martin furnace, or in the open hearth furnace, &c.,) is subjected directly in the casting ladle to such a carburization by the introduction of a suitable carburizing substance, that any desired predetermined content of carbon may be obtained to produce steel of any desired and predetermined degree of hardness.

The method consists in uniting the molten metal with briquets of pulverized coal or coke and lime. In order to carry out this method, the carburizing substance should be added in such a form that it may be dissolved immediately and regularly, and also distributed regularly throughout the whole mass of molten metal, and on the other hand, the moment for introducing the carburizing substance into the molten metal should be so chosen that the reaction of the carburization is completely terminated before pouring the metal from the ladle into the ingot molds.

The raw materials for the carburizing substances are pulverized and compressed into briquets, blocks or other forms, after having been previously mixed with another binding substance, which is at the same time purifying. For the carbonaceous substances anthracite coal may be advantageously employed on account of its purity, but coke will answer, and for the purifying and binding

substance, hydrate of lime may be used, which should be as far as possible, exempt from inert matter. The carbonaceous substances are intimately mixed with the purifying and binding matter and worked into a pasty mass, which is allowed to stand for twelve to twenty-four hours before being compressed into blocks or briquets. After the briquets are made they are first dried in the air and then in a drying chamber.

In order to make a pasty mass of, say, one hundred kilograms, I employ about seventy-six kilograms of coal and about twenty-four kilograms of lime, to form eighty-two kilograms of products. To produce ingot iron having a content of carbon from .04 per cent. to 0.1 per cent. of carbon, or medium steel with 0.1 per cent. to 0.4 per cent. of that substance, the whole quantity of blocks or briquets made in the manner described above, is distributed over the bottom of the casting ladle, and then the metal is allowed to flow in a strong jet, care being taken to move the ladle about so as to agitate the contents, and to insure a regular dissolving of the carburizing substance throughout the whole mass of molten metal.

To produce hard steel with a content of carbon exceeding 0.4 per cent. all the blocks or briquets are in a like manner introduced into the casting ladle, but so that only part of them is present before the flow of metal into the casting ladle begins, the remainder being added after the absorption of the first part, and this latter proportion being so determined as to introduce into the metal such a quantity of carbon as may be necessary for imparting the degree of hardness required. When the reaction, which does not require more than from three to five minutes, is completely terminated in the casting ladle, the metal is poured into the ingot mold, where it keeps quite still and does not rise in the slightest degree, so that perfectly soft ingots are obtained. The quantity of briquets to be added depends upon the amount of carbon in the briquets, and on the desired degree of hardness intended to be given to the steel to be manufactured.

Practical tests have shown that for con-

verting a metric ton of pig iron into ingot iron, or hard or mild steel, the following contents of carbon must be added:

For ingot iron, 0.040 to 0.060 per cent. of carbon, one to 1.20 kilograms of briquets; 0.060 to 0.100 per cent. of carbon, 1.20 to two kilograms of briquets.

For soft and hard steel, 0.10 to 0.15 per cent. of carbon 2.50 to 2.80 kilograms of briquets; 0.15 to 0.20 per cent. of carbon three to 3.50 kilograms of briquets; 0.25 to 0.30 per cent. of carbon four to 4.50 kilograms of briquets; 0.30 to 0.35 per cent. of carbon five to 5.30 kilograms of briquets; 0.40 to 0.45 per cent. of carbon seven to 7.50 kilograms of briquets; 0.45 to 0.50 per cent. of carbon 7.50 to 7.80 kilograms of briquets; 1.60 to 1.65 per cent. of carbon twenty to twenty-five kilograms of briquets.

In this process it is desirable to repeatedly test each charge before pouring the metal into the ladle, so as to obtain the accurate amount of the carburizing material required for a certain degree of hardness of the desired product. By the process described, enough heat is generated or developed so that the ashes of the carburizing material are melted in the ladle, and the silica contained in the ashes chemically unites with the lime contained as a binding material in the bri-

quets, so that a fluid slag is produced which unites with any other slag that may form, and this mass quickly separates from the molten metal and floats on the surface thereof, the ashes thus acting as a purifier for the molten metal.

Experience shows that the content of sulphur in the carburized material diminishes to a considerable extent. By this method, steels have been produced with predetermined amounts of from 0.04 to 1.60 per cent. of carbon without the addition of ferro-manganese or spiegeleisen.

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

1. The herein-described method for the carburization of iron, consisting in uniting the molten metal with briquets of pulverized coal or coke and lime, substantially as described.

2. The herein-described method for the carburization of iron, consisting in first forming briquets of pulverized coal or coke with lime, and then uniting the molten metal with the said briquets in the ladle, previous to pouring it into the mold, substantially as described.

JEAN MEYER.

Witnesses:

E. MEGUIN,

A. OSCHMAN.