

UNITED STATES PATENT OFFICE.

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PROCESS OF MANUFACTURING CARBURIZED METAL.

SPECIFICATION forming part of Letters Patent No. 441,174, dated November 25, 1890.

Application filed July 27, 1889. Serial No. 318,937. (No specimens.)

To all whom it may concern:

Be it known that we, HORACE W. LASH and JAMES JOHNSON, citizens 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 the Process of Manufacturing Carburized Metal, of which improvement the following is a specification.

The invention described herein relates to certain improvements in the production of wash or carburized metal and steel or wrought-iron direct from the ore. According to the present practice, this wash or carburized metal is reduced in the blast-furnace—a very effective apparatus, but expensive in construction and operation.

The object of this invention is to provide for the production of this class or kind of metal direct from the ore in an ordinary cupola-furnace.

In the practice of our invention ore and carbonaceous material—such as coke, coal, charcoal, &c.—are ground up separately to a comparatively fine state of division. The ground ore and carbonaceous material are then thoroughly mixed together and then placed in a grinding-pan or other suitable mill and subjected to a further grinding operation.

The percentage of carbonaceous material employed depends upon the degree of carburization required in the metal to be produced and varies from thirty to fifty per cent., (30% to 50%,) more or less, by weight, of the ore—that is to say, thirty to fifty pounds (more or less) of carbonaceous material for every hundred pounds of ore. During the grinding of the ore and carbonaceous material together sufficient liquid—such as water or oil—is added in sufficient quantity to form a comparatively thick self-adherent paste or amalgam, and the grinding is continued until the materials are pulverized and thoroughly ground into each other, so as to insure in the subsequent treatment of the amalgam an equal and simultaneous heating of adjacent particles, thereby preventing the combustion of the carbon before the ore has been sufficiently heated to readily part with its oxygen. In reducing this material the cupola or like

furnace is charged with lump coke or other suitable fuel to a height of twenty to twenty-four inches (more or less) above the tuyeres and the blast turned until the coke has been raised to a state of incandescence, forming a hot bottom for the subsequent charge. A fresh layer of coke is then thrown in and the pasty amalgam hereinbefore described as it comes from the grinding-pan is loosely shoveled in on the charge. In charging the amalgam one shovelful of fuel—such as coke or charcoal—is thrown in to about every four shovelfuls (more or less) of amalgam, or sufficient to bear the burden and prevent the amalgam from packing down and clogging the furnace. The amalgam and fuel are charged in alternately, as described, until the mass rises to the furnace-door. In about fifteen minutes after charging, the blast being continued, the metal will commence to come down and the charge gradually sink. From this stage the process is a continuous one, the ore being reduced and the molten metal tapped off as often as necessary to prevent it from entering the tuyeres, and fresh amalgam and fuel being shoveled in as the charge sinks down. As soon as the reduction is fairly under way, the cupola will make as fast as two men can attend to the charging. The fuel added not only serves to keep up the requisite heat and prevent the clogging, as before stated, but also aids in the carburization of the metal. If desired, a flux, as limestone, &c., may be added to the material during the preparation of the amalgam, as hereinbefore described, the percentage of the flux to be added being determined by the amount of silica to be reduced and of sulphur to be overcome; or, if preferred, the flux may be charged with other materials into the cupola.

The molten metal may be charged by means of a ladle or by a runner or spout direct into an open-hearth furnace or other converting apparatus and there used, as a highly-carburized molten bath, for the manufacture of steel, thus avoiding the great wear and tear on an expensive furnace incident to the usual method of melting the metal for the bath in said furnace; and this method of charging molten metal direct into the open-hearth fur-

nace effects a great saving in time and consequently in output, as one charge is being melted while another is in process of reduction; or the carburized molten metal may be
5 run into a puddling-furnace and there worked in the usual manner, or it may be run into pig-beds, as in the usual blast-furnace practice.

We claim herein as our invention—

10 1. As an improvement in the art of producing metal direct from ore, the method herein described, which consists in reducing the ore and carbonaceous material to a pasty homogeneous amalgam, and then charging such
15 amalgam and a carbonaceous fuel into a cupola-furnace, substantially as set forth.

2. As an improvement in the art of producing metal direct from ore, the method herein described, which consists in reducing the ore,
20 carbonaceous material, and a flux to a pasty

homogeneous amalgam, and then charging such amalgam and a carbonaceous fuel into the cupola-furnace, substantially as set forth.

3. As an improvement in the art of reducing metal direct from ore, the method herein
25 described, which consists in reducing the ore, carbonaceous material, and flux to a pasty homogeneous amalgam, charging such amalgam and a carbonaceous fuel into a cupola-furnace, charging the reduced molten metal
30 direct into a converting-furnace, and there treating the metal in the usual manner, substantially as set forth.

In testimony whereof we have hereunto set our hands:

HORACE W. LASH.
JAMES JOHNSON.

Witnesses:

DARWIN S. WOLCOTT,
R. H. WHITTLESEY.