

# UNITED STATES PATENT OFFICE.

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## METHOD OF MANUFACTURING BASIC BESSEMER STEEL.

SPECIFICATION forming part of Letters Patent No. 706,089, dated August 5, 1902.

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*To all whom it may concern:*

Be it known that I, SAMUEL McDONALD, a citizen of the United States, residing at Youngstown, in the county of Mahoning and State of Ohio, have invented or discovered a certain new and useful Improvement in Methods of Manufacturing Basic Bessemer Steel, of which improvement the following is a specification.

This invention relates to the removal of phosphorus from the charge of a Bessemer converter—that is, to the production of basic Bessemer steel—and has for its object to enable the operator to perform that process more expeditiously than it has been performed heretofore. In securing this object in the manner hereinafter described the operator is enabled also to obtain a product of better and more uniform quality than can be obtained by the method now generally adopted and to control the temperature of the metal at the time of casting.

The process of making basic Bessemer steel which has heretofore prevailed is substantially this: The Bessemer vessel is lined with magnesian lime, a quantity of well-burnt lime is placed in the bottom of the vessel, and the metal which is to be converted is introduced in molten condition. The charge is then blown in the ordinary manner until the carbon is eliminated, this stage being indicated by the drop of the carbon-flame. Instead of terminating the blow on the drop of the carbon-flame, which is the practice in making ordinary or acid Bessemer steel, the blow is continued for an interval of time, which is termed the “afterblow.” During this interval the reaction between the charge and the basic substances within the converter continues and brings about the substantial elimination of phosphorus and other foreign substances, which elimination constitutes the production of “basic” steel. Spiegeleisen or ferromanganese is then added, as in the ordinary Bessemer process, and the finished steel is then cast. The process thus described is attended with practical difficulties of such magnitude that it is not to-day a commercial success. One difficulty is to determine the duration of the afterblow. While the substantial removal of carbon is clearly indicated by the “drop of the flame” in the mouth of the

converter, there is no pronounced indication of the substantial removal of phosphorus. It is necessary, therefore, to make tests of each charge when the operator judges the afterblow to have continued for sufficient time, and if the amount of phosphorus is still too great the blow must be renewed. Such testing and blowing again consume time and retard the production. Another defect is due to variations in the temperature of the charge on the completion of the process, these variations being due to delays which are occasioned by testing, reblowing, and repairing the converter-lining, for to obtain the best results the steel should be cast at a temperature slightly above a certain minimum. Another defect is due to the fact that when spiegeleisen or ferromanganese is introduced into the metal in the converter or ladle it tends to react with the slag and to effect a reintroduction of phosphorus into the composition of the metal.

My improvement consists in providing a receiving tank or furnace of sufficient size to contain at one time the charges from a number of converters. Into this tank I pour the charge of each converter, and from it I take the metal for casting. I test each converter charge in turn, as in the former practice; but instead of holding each charge subject to the result of the test and renewing the blow if too much phosphorus remains I turn the charge without delay into the receiving-tank and determine the treatment of the next succeeding charge by the result of the test of the charge which has preceded it. Thus if the test of a given charge reveals the presence of too much phosphorus, though I have already introduced that charge into the receiving-tank, I continue the treatment of the next charge not only for such time as is deemed sufficient to reduce to the proper degree its phosphorus element, but for an additional time, and I thereby eliminate so much phosphorus from that charge that when it shall be introduced into the receiving-tank the phosphorus element of the entire contents of the tank shall not exceed the proper amount. It is obvious that instead of testing each charge as it goes to the receiving-tank I may test the contents of the tank after the introduction of each converter charge



and determine the treatment of succeeding converter charges by the results of these tests. By adopting this method of treatment I avoid the delay incident to the former practice as I have described it. My receiving-tank is preferably a furnace, and being able to control the heat applied to it I am able to maintain the metal in the tank at the proper casting temperature.

It will be understood that in practicing my invention I may either begin to withdraw metal from the receiving-tank after it has been filled and continue to withdraw metal until it is again empty or I may keep adding new converter charges while withdrawing metal for casting. I find it desirable to have two receiving-tanks, such as I have described in connection with a Bessemer plant, and to draw from one while filling the other. By employing the receiving-tank I am able to remove the phosphorus-containing slag before the introduction of spiegeleisen or ferromanganese, and I may thus avoid any deleterious effects of chemical action of the slag upon these substances.

I claim as my invention—

1. In the manufacture of basic Bessemer steel, the method herein described, which consists in pouring successive converter charges into a common receptacle from which the metal is taken to be cast, testing each charge in turn, and varying the duration of each succeeding blow according to the result of the preceding test, substantially as described.

2. In the manufacture of basic Bessemer steel, the method herein described, which con-

sists in blowing a moderate percentage of the total product to be produced in suitable manner for the elimination of phosphorus so far as may be, charging the same into a heat-maintaining receptacle of capacity suitable to hold the entire amount of product desired, taking a test thereof, blowing another moderate percentage of the total product and continuing the afterblow for such length of time that when mixed with the charge previously blown, the phosphorus element of the mixture will be at the desired low degree, charging this second moderate percentage into the receptacle and continuing such testing and further blowing, regulating each successive blow by the results of the previous test until the desired quantity is produced, substantially as described.

3. In the manufacture of basic Bessemer steel, the method herein described, which consists in subjecting successive charges to basic Bessemer treatment, testing each charge in turn and varying the duration of the treatment of succeeding charges according to the results of the preceding tests, pouring the charges so treated into a receiving-furnace, and bringing the metal contained in the furnace to a casting temperature, substantially as described.

In testimony whereof I have hereunto set my hand.

SAMUEL McDONALD.

Witnesses:

DARWIN S. WOLCOTT,  
F. E. GAITHER.