

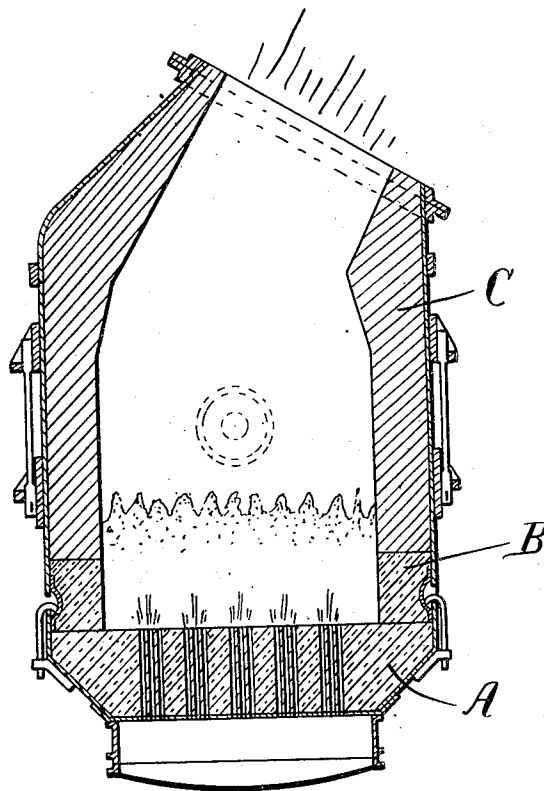
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BESSEMERIZING IRON

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BESSEMERIZING IRON.

Application filed December 29, 1920. Serial No. 433,871.

To all whom it may concern:

Be it known that I, RICHARD S. McCAFFERY, a citizen of the United States, residing at Madison, in the county of Dane and State of Wisconsin, have invented certain new and useful Improvements in Bessemerizing Irons; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to the refining of iron, and in particular to the bessemerizing of pig iron containing chromium.

As far as I am aware, it is the general practice at the present time to bessemerize chromium-containing pig iron in an acid-lined converter. During the bessemerizing process the acid lining is so vigorously attacked and eaten away that the lining life is comparatively short, averaging only about sixty to seventy blows as compared with perhaps one thousand blows in the usual acid bessemer process with iron substantially free of chromium. Basic-lined converters have also, I believe, been employed in bessemerizing chromium-containing pig iron, but it is my understanding that the life of the basic lining is as unsatisfactory as the life of the acid lining.

The present invention contemplates the provision of an improved process of bessemerizing or refining chromium-containing pig iron in which the aforementioned difficulties are in a large measure overcome. In particular, the invention aims to provide an improved process of bessemerizing chromium-containing pig iron which is characterized by the greatly increased life of the converter lining as compared with the life of the converter lining in the heretofore customary processes of bessemerizing such iron.

In the blast furnace smelting of chromium-containing iron ores, such, for example, as the Mayari ore from Cuba which contains relatively large amounts of chromium, the chromium is reduced and goes into the pig iron. In the subsequent refining of this chromium-containing pig iron in a bessemer converter, the chromium is oxidized, probably to chromic oxide (Cr_2O_3), and goes into the slag resulting from the bessemerizing process.

It is well known that chromic oxide acts chemically either as an acid or as a base, depending upon the nature of the substance

with which it reacts. Thus, in the presence of a substance having stronger basic properties, such as lime, chromic oxide acts as an acid. On the other hand, in the presence of a substance having stronger acid properties, such as silica, chromic oxide acts as a base. While this chemical behavior of chromic oxide is well recognized among chemists, I am not aware that the importance of this property of chromic oxide has heretofore been recognized by iron metallurgists, particularly in connection with the difficulties which have heretofore been encountered in bessemerizing chromium-containing pig iron.

As the result of my investigations regarding the bessemerizing of chromium-containing pig iron, I have concluded that the short life of the converter lining, whether acid or basic, is probably due to this chemical property of chromic oxide of acting either as an acid or as a base. Thus, in the acid process of bessemerizing chromium-containing pig iron, it is my belief that the chromic oxide in the resulting slag acts as a base and attacks the silicious or aluminous materials, or both, of the acid lining, with the result that the lining life is very short. On the other hand, when bessemerizing a chromium-containing pig iron in a basic-lined converter, it is my belief that the chromic oxide in the resulting slag acts as an acid and attacks the basic substances in the lining, so that the life of a basic lining could not be expected to be more satisfactory than the life of the acid lining.

It is accordingly conceived by me that the rapid corrosion of the acid, or of the basic, lining of the converter, in bessemerizing chromium-containing pig iron, is due in whole or in large part to the reaction between the chromic oxide in the resulting slag and the more strongly acid, or more strongly basic, as the case may be, constituent of the converter lining, and that the corrosion is materially reduced by lining the converter, or more especially those parts of the converter which come in contact with the slag during the performance of the process, with refractory material composed for the most part of a material possessing in substantially the same degree the dual acid and basic properties possessed by chromic oxide. In other words, in accordance with my present invention, I propose to line those parts of the converter which contact

with the slag formed during the bessemerizing with refractory material which is substantially neutral with respect to chromic oxide, that is to say, material which, under
5 the conditions existing in the molten metal during the bessemerizing, is substantially non-reactive chemically with chromic oxide.

Chromic oxide is itself a refractory material, and the ends of the invention may be
10 attained by the use of chromic oxide as the refractory material for those parts of the converter lining which contact with the chromium constituents of the resulting slag. Chromite, which is a native chromium ore,
15 is admirably adapted for carrying out the invention, and when those parts of the converter lining which contact with the chromium constituents of the slag formed in the performance of the process are lined
20 with refractory material composed in whole or for the most part of chromite, the corrosion of the lining is very materially reduced as compared with the corrosion heretofore experienced with acid or basic-lined con-
25 verters. In addition, certain clays, bauxite, zirconia, zircite and titantic oxide may be found possessing the required neutral properties with reference to chromic oxide for carrying out the invention.

30 In the refining of pig iron obtained from the smelting of the Mayari ore, it is customary to conduct the bessemerizing under conditions which result in the production of a comparatively neutral slag rich in chromium. In other words, the silica content
35 of the slag is very much lower than in normal acid bessemer blows and the lime content of the slag is much lower than in normal basic bessemer blows. Thus, the slag
40 from the bessemerizing of Mayari pig iron is distinguished from the slag of the usual acid bessemer process by its low silica content and from the slag produced by the basic bessemer process by having practically
45 no lime in it. It contains high percentages of chromic oxide, sometimes running up to as high as 38% of that substance, and the heat for the bessemerizing is very largely furnished by the oxidation of the chromium
50 in the (Mayari) pig iron. Because of these characteristics, the refining of the (Mayari) pig iron, as now customarily practiced, might be considered as carried out by a neutral bessemer process with the formation of a
55 slag relatively neutral as compared with the slags produced in the customary acid or basic bessemer processes.

In bessemerizing chromium-containing pig iron in a converter lined in whole or
60 in part with refractory material of a composition substantially neutral with respect to chromic oxide, in accordance with the invention, the chromic oxide formed during the performance of the process will not
65 react with the neutral lining, nor will any

silica formed during the performance of the process react with the lining. For these reasons, the converter lining contemplated by the present invention will have a much longer life than have the linings now cus-
70 tomarily employed in bessemerizing chromium-containing iron.

The principal purpose of the usual acid bessemer process is to remove silicon and carbon from the pig iron. In refining a
75 pig iron containing chromium, the bessemerizing process performs the further function of removing chromium from the pig iron. Phosphorus is not removed by the acid bessemer process, and where it is necessary
80 to remove the phosphorus from the iron the basic bessemer process must be used. In addition to desiliconizing, decarburizing and dechromizing, the present invention makes it possible to remove phosphorus
85 from the pig iron without resort to the basic bessemer process. Thus, when bessemerizing pig iron in a converter lined as contemplated by the present invention, it is
90 practicable to carry out a dephosphorizing blow after the elimination of silicon, carbon, and chromium, and in order to take up the phosphoric acid formed during this after-
95 blow, lime should be added to the molten metal bath to combine with such phosphoric acid, and the neutral lining contemplated by the invention, such as a chromite lining, will not be attacked by the resulting basic slag.

As explained in my Letters Patent of the
100 United States No. 1,338,655, patented April 27, 1920, the corrosion of the twyer region of an acid-lined converter can be materially reduced by bessemerizing the molten metal in a converter having such parts thereof as
105 come in contact with basic products liberated during the bessemerizing process, for example, oxides of iron and manganese, lined with non-acid refractory material. Preferably, this non-acid lining contains
110 basic refractory materials. I have found that an acid-lined converter is similarly attacked and corroded in its twyer region when bessemerizing chromium containing iron under conditions which result in the pro-
115 duction of a relatively neutral slag. For this reason, I prefer, in practicing the present invention, to carry out the bessemerizing of the chromium-containing iron in a converter having those parts thereof which
120 contact with the basic products liberated during the performance of the process, such, for example, as the twyer region of the converter, lined with non-acid refractory material, and in general, it may be found desir-
125 able to include basic refractory material in this non-acid lining. Accordingly, in carrying out my present invention in its preferred and complete form, the bessemerizing of the chromium-containing pig iron
130

will be conducted in a converter having such parts of the body portion thereof as come in contact with the chromium constituents of the slag during the performance of the process lined with refractory material of a composition which is substantially neutral with respect to such constituents and having a non-acid lining for such other parts of the converter as come in contact with the basic products which may be liberated during the performance of the process. Thus, when practicing the present invention in the present day type of bottom-blown converter, the bottom or tuyere region of the converter will be lined with non-acid refractory material, for example, refractory material of a basic character, while the body of the converter will be lined with neutral refractory material, for example, chromite. The accompanying drawing containing a single figure is a sectional elevation of a well known type of converter in which the invention has been embodied.

This figure diagrammatically represents a bottom blown converter in which the bottom or tuyere region of the converter has a basic lining A or a neutral lining containing basic material, the lining of the lower side wall below the metal line also having a basic lining B or a neutral lining containing basic material, while the lining C above the metal line is made up of material substantially neutral with respect to chromic oxide under the conditions prevailing within the converter during the performance of the bessemerizing process.

Throughout the specification and claims, I mean by "rich in chromium" to define a chromium content richer or higher than the chromium content in the usual bessemer slag.

I claim:—

1. The process of refining iron containing chromium which comprises bessemerizing a bath of the molten metal, under conditions which result in the production of a slag rich in chromium and relatively neutral as compared to the slags of the ordinary basic bessemer and acid bessemer processes in a converter having only such parts thereof as come in contact with the slag during the performance of the process lined with refractory material of a composition which is substantially neutral with respect to the chromium constituent of the slag.

2. The process of refining iron containing chromium which comprises bessemerizing a bath of the molten metal, under conditions which result in the production of a slag rich in chromium and relatively neutral as compared to the slags of the ordinary basic bessemer and acid bessemer processes, in a converter having only such parts thereof as come in contact with the slag during the performance of the process lined with re-

fractory material made up for the most part of chromite.

3. The process of desiliconizing, decarburizing and dechromizing iron which comprises bessemerizing a bath of the molten metal, under conditions which result in the production of a slag containing chromium, in a converter having only such parts thereof as come in contact with the slag during the performance of the process lined with refractory material of a composition which is substantially neutral with respect to the chromium constituent of the slag.

4. The process of desiliconizing, decarburizing and dechromizing iron which comprises bessemerizing a bath of the molten metal, under conditions which result in the production of a slag containing chromium, in a converter having only such parts thereof as come in contact with the slag during the performance of the process lined with refractory material made up for the most part of chromite.

5. The process of desiliconizing, decarburizing and dechromizing iron containing a relatively high percentage of chromium which comprises bessemerizing a bath of the molten metal under conditions which result in the production of a slag rich in chromium and relatively neutral as compared to the slags of the ordinary basic bessemer and acid bessemer processes, in a converter having only such parts of the body portion thereof as come in contact with the slag during the performance of the process lined with refractory material of a composition which is substantially neutral with respect to the chromium constituent of the slag.

6. The process of desiliconizing, decarburizing and dechromizing iron containing a relatively high percentage of chromium which comprises bessemerizing a bath of the molten metal, under conditions which result in the production of a slag rich in chromium and relatively neutral as compared to the slags of the ordinary basic bessemer and acid bessemer processes, in a converter having only such parts of the body portion thereof as come in contact with the slag during the performance of the process lined with refractory material made up for the most part of chromite.

7. The process of refining iron containing chromium which comprises bessemerizing a bath of the molten metal, under conditions which result in the production of a slag containing chromium, in a converter having such parts of the body portion thereof as come in contact with the chromium constituents of the slag during the performance of the process lined with refractory material of a composition which is substantially neutral with respect to such constituents and having a non-acid lining

for such other parts of the converter as come in contact with the basic products which may be liberated during the performance of the process.

8. The process of refining iron containing chromium which comprises bessemerizing a bath of the molten metal, under conditions which result in the production of a slag containing chromium, in a converter having such parts of the body portion thereof as come in contact with the chromium constituents of the slag during the performance of the process lined with refractory material of a composition which is substantially neutral with respect to such constituents and having a non-acid lining containing basic material for such other parts of the converter as come in contact with the basic products which may be liberated during the performance of the process.

9. The process of desiliconizing, decarburizing and dechromizing iron containing a relatively high percentage of chromium which comprises bessemerizing a bath of the molten metal, under conditions which result in the production of a slag rich in chromium and relatively neutral as compared to the slags of the ordinary basic bessemer and acid bessemer processes, in a converter having such parts of the body portion thereof as come in contact with the chromium constituents of the slag during the performance of the process lined with refractory material made up for the most part of chromite and having its twyer region lined with non-acid refractory material.

10. The process of desiliconizing, decarburizing and dechromizing iron containing a relatively high percentage of chromium and a relatively low percentage of silicon which comprises bessemerizing a bath of the molten metal, under conditions which result in the production of a slag rich in chromium and relatively neutral as compared to the slags of the ordinary basic bessemer and acid bessemer processes, in a converter having such parts of the body portion thereof as come in contact with the chromium constituents of the slag during the performance of the process lined with refractory material made up for the most part of chromite and having a non-acid lining containing basic material for such other parts of the converter as come in contact with the basic products which may be liberated during the performance of the process.

11. The process of refining iron contain-

ing chromium which comprises bessemerizing a bath of the molten metal, under conditions which result in the production of a slag containing chromium, in a converter having its body portion lined with refractory material made up for the most part of chromite and a non-acid bottom lining containing basic material.

12. A converter for bessemerizing iron containing chromium having only such parts of its body portion as contact with the slag during the performance of the bessemerizing process lined with refractory material composed for the most part of material which is substantially neutral with respect to chromic oxide under the conditions prevailing within the converter during the performance of the bessemerizing process.

13. A converter for bessemerizing iron containing chromium having only such parts of its body portion as contact with the slag during the performance of the bessemerizing process lined with refractory material composed in whole or for the most part of chromite.

14. A converter for bessemerizing iron containing chromium having such parts of its body portion as contact with the slag during the performance of the bessemerizing operation lined with refractory material composed for the most part of a substance which is substantially neutral with respect to chromic oxide under the conditions prevailing within the converter during the performance of the bessemerizing process and having its twyer region provided with a non-acid lining.

15. A converter for bessemerizing iron containing chromium having such parts of its body portion as contact with the slag during the performance of the bessemerizing operation lined with refractory material composed in whole or for the most part of chromite and having its twyer region provided with a non-acid lining.

16. A bottom-blown converter for bessemerizing iron containing chromium having such parts of this body portion as contact with the slag during the performance of the bessemerizing process lined with refractory material composed in whole or for the most part of chromite and having its bottom provided with a non-acid lining containing basic material.

In testimony whereof I affix my signature.

RICHARD STANISLAUS McCAFFERY.