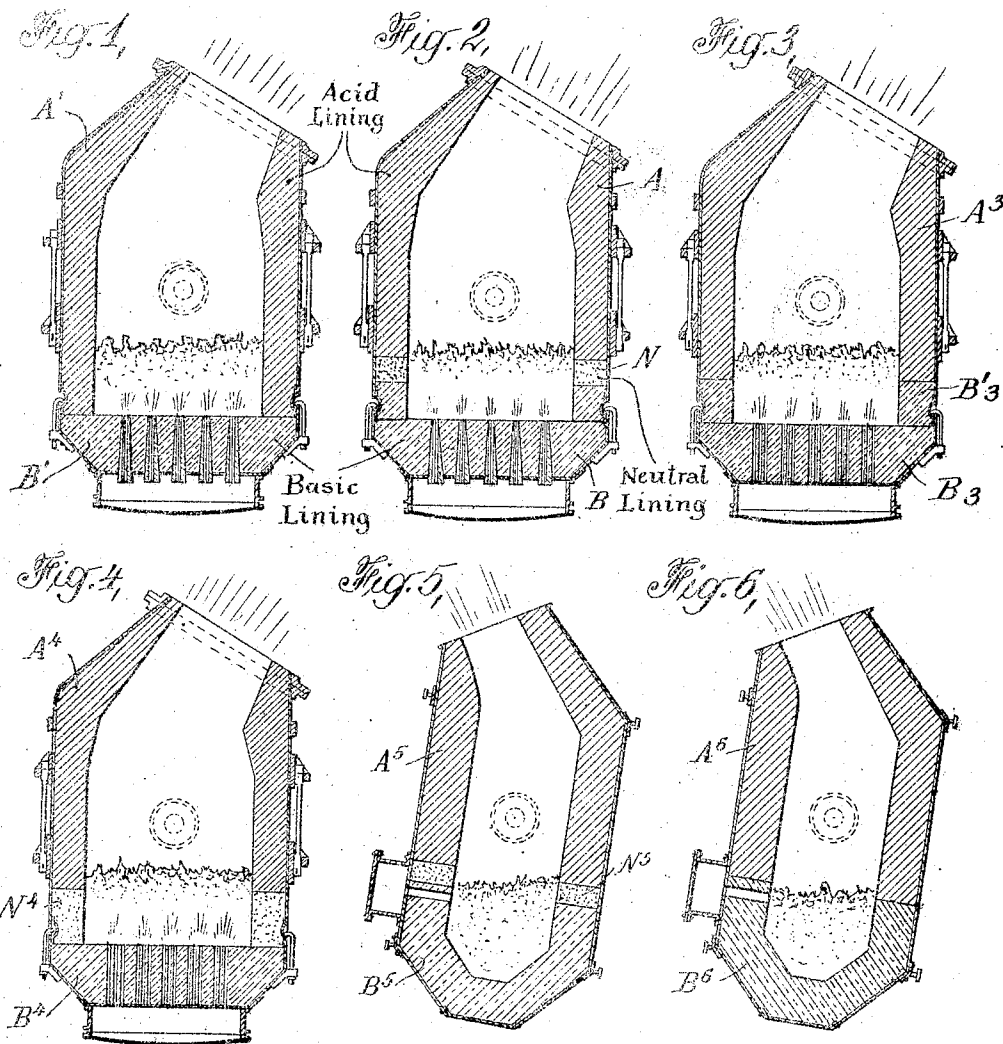


R. S. McCaffery.
 BESSEMERIZING IRON.
 APPLICATION FILED NOV. 13, 1918.

1,388,655.

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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, State of Wisconsin, have invented certain new and useful Improvements in Bessemerizing Iron; 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 bessemerizing of iron, and has for its object the provision of certain improvements in the acid process of bessemerizing.

The acid Bessemer process is now carried out in an acid (silicious lined) converter, with an acid (silicious, or aluminous, or both) bottom through which the air blast is introduced by twyers, to oxidize the charge of pig iron, which, in general, is essentially carbon-, manganese-, silicon-bearing iron. The accepted theory is that a silicious slag is formed; and the linings of the bottom and side walls of the converter are made acid to resist the corrosion of this acid slag. Even when formed of acid materials, the bottom lining of the converter is, in practice, rapidly corroded, and wears away much faster than the side-wall lining, and it is on this account that it is customary in converter construction to make the entire bottom of the converter removable, so that a bottom with a badly corroded lining may be quickly replaced by a new one.

The corrosion or rapid wearing away of the bottom lining of the converter, in the acid Bessemer process, has heretofore been attributed to the interaction therewith of the acid slag formed in the process. The acid slag, however, floats on the top of the molten metal and comes in contact with the bottom lining to a very limited extent during the blow. Furthermore, the acid lining on the side walls of the converter, with which the acid slag is in close contact, is corroded to a much less extent than the bottom lining. It is conceived by me that the rapid corroding of the bottom lining is due to other agencies than the acid slag as follows:

The air blown into the converter unites immediately with the iron and manganese of the molten bath to form oxids of iron and manganese. These oxids react on the silicon, carbon, etc., present in the molten bath and

oxidize these latter substances. The silica which is thus formed by the oxidation of the silicon combines with the oxids of iron and manganese to form silicate slags which are generally quite acid in character and float on the bath. However, the molten bath itself, in contact with the bottom of the converter, contains oxids of iron and manganese which are basic. Such basic materials contained in the molten bath itself will react with an acid lining and corrode the same. The present invention is based on the discovery that it is such basic products, formed in the molten bath during the bessemerizing, which react on the present acid bottoms of the converters and rapidly corrode them.

The present invention comprises carrying out the bessemerizing of cast or pig iron under acid slag-forming conditions in a converter having in part, a non-acid lining. The non-acid part of the lining may be formed of basic refractory materials, such, for example, as magnesite, dolomite, lime, oxid of iron, zirconia, and the like, or of neutral refractory materials, such, for example, as chromite, bauxite, and the like. The non-acid part of the lining may, furthermore, be composed of mixtures of neutral and basic refractory materials. Suitable binding agents or materials, such as clay, silicates, oxids, tar, pitch, and the like may be employed to hold together the neutral or basic refractory materials, or mixtures of such materials, of which the said lining is made, in accordance with the principles of the present invention.

The invention, accordingly, involves the carrying out of the acid Bessemer process in a converter having a non-acid lining for such parts thereof as the aforementioned basic products come in active or intimate contact with. Generally, the invention contemplates the provision of a non-acid lining for those parts of the converter which, in the present day practice of lining converters with acid material, are most rapidly corroded. The corrosion of the (acid) converter lining is most rapid where the oxygen of the blast comes in contact with the molten iron and oxidizes the iron and manganese. Generally speaking, this is right in front of the twyers. Thus, in accordance with the principles of the present invention, the twyer region or twyer zone of the converter is provided with a non-acid lining, and such non-acid lining may, if desired,

be extended to all parts of the converter in contact with the molten metal during the blow. However, the principal advantages of the invention are obtained by carrying out the acid Bessemer process in a converter having a non-acid lining for such parts thereof as come in intimate contact with the basic products present in the molten metal, and I do not desire or intend to limit the invention to the provision of a non-acid lining for every part of the converter with which the aforementioned basic products might perhaps come in contact, since the broad aim of the invention is to reduce the corrosion which results from the present day practice of carrying out the acid Bessemer process in an acid lined converter, and an effective reduction of the corrosion can be brought about by lining with non-acid material those parts of the converter which have heretofore been most rapidly corroded.

As hereinbefore pointed out, the acid Bessemer process, as now practised, is carried out in a converter having an acid lining, usually a silicious lining. The present invention contemplates no change in the character of those portions of the converter's lining which come in contact with the acid slag. Such portions of the lining must be composed of acid materials, for reasons well recognized in the art.

The non-acid lining, provided in accordance with the present invention, may be made up of neutral refractory material, or of basic refractory material, or a mixture of neutral and basic materials, held together by suitable binding agents, as previously stated. Since it is usually not advisable to have a basic lining in contact with an acid lining in any furnace subjected to high temperatures, I prefer, where a basic lining, or a non-acid lining containing basic material, is provided, in accordance with the present invention, to separate the basic lining from the acid lining, provided to resist the action of the acid slag, by the interposition of a zone of neutral refractory lining.

The invention is equally applicable to either the bottom-blown type or the side-blown type of converter, and, in fact, to any type of converter in which an air blast is blown through a body of molten iron.

In the case of a bottom-blown converter, the twyer region comprises substantially the bottom of the converter. When bessemerizing in this type of converter, the principal advantages resulting from the practice of the present invention are obtained by carrying out the acid Bessemer process in a converter whose bottom only is lined with non-acid material. However, it is to be understood that the invention also contemplates the provision of a non-acid lining for such portions of the side wall of the converter as may be subjected to the action of the basic

products formed in the molten bath during the process. Where this non-acid lining contains basic material, I prefer, for reasons aforesaid, to provide a lining of neutral refractory material intermediate this basic lining and the acid lining which is provided for the purpose of resisting the action of the acid slag formed during the operation.

In the accompanying drawings, Figures 1 to 6, inclusive, are sectional elevations of well known types of converters in which the invention has been embodied.

Fig. 1 diagrammatically represents a bottom blown converter in which the bottom or twyer region of the converter has a basic lining B', while the body of the converter has an acid lining A'. In the converter represented in Fig. 2, the basic lining B extends upwardly a short distance from the bottom and is separated from the acid body lining A by an intermediate lining N of neutral refractory material. In the converter of Fig. 3, all that part of the converter in contact with molten metal during the blow is of basic refractory material. This converter thus has a basic bottom lining B, and a basic side wall lining B', conforming approximately in height to the normal depth of the molten metal during the blow. The remaining body portion of this converter has an acid lining A₃. In the converter of Fig. 4, the side wall lining N₄, approximately conforming in height to the normal depth of the metal during the blow, is of neutral refractory material and is intermediate the acid body lining A₄ and the basic bottom lining B₄. In the converters of Figs. 1 and 2, the twyers are separately formed and the lining is made by ramming the basic refractory material around them, while in the converters of Figs. 3 and 4, the twyers are formed in the lining itself.

Figs. 5 and 6 diagrammatically illustrate side blown converters. As shown in Fig. 6, the bottom and sides of the converter in contact with the molten metal during the blow are lined with basic material B₆, while the remaining body portion of the converter has an acid lining A₆. In Fig. 5, the basic bottom and side wall lining B₅ is separated from the acid body lining A₅ by an intermediate neutral lining N₅.

I am well aware that basic linings have been, and, in fact, are practically always, used in bessemerizing when the slag produced is basic, or, in other words, when the so-called basic process is employed. The present invention does not, however, relate to bessemerizing under basic slag-producing conditions, but, on the contrary, the invention is concerned specifically with bessemerizing under conditions which produce an acid slag,—the so-called acid process. I do not, therefore, claim generally the use of a neutral or basic lining, but rather the carry-

ing out of the acid Bessemer process in a converter whose twyer region, or those parts of which are in contact with the molten metal during the blow, are lined with non-acid material, as more particularly set forth in the appended claims.

I claim:

1. The process of refining iron which comprises bessemerizing a bath of molten metal, without basic additions, in a converter provided with an acid lining, except in the region contacting with the basic products which may be liberated during the performance of the process; substantially as described.

2. The process of refining iron which comprises bessemerizing a bath of molten metal under acid slag-forming conditions in a converter provided with an acid lining, except in the region contacting with the basic products which may be liberated during the performance of the process; substantially as described.

3. A converter for bessemerizing iron under acid slag-forming conditions having an acid lining, except for such parts thereof as come in contact with the basic products which may be liberated during the bessemerizing process; substantially as described.

4. A converter for bessemerizing iron under acid slag-forming conditions having an acid lining, except for such parts thereof as come in contact with the basic products which may be liberated during the bessemerizing process; said parts having a non-acid lining containing basic material; substantially as described.

5. A converter for bessemerizing iron under acid slag-forming conditions having an acid lining, except for such parts thereof as come in contact with the basic products which may be liberated during the bessemerizing process; said parts having a non-acid lining made up of basic and neutral refractory materials held together by a binding agent; substantially as described.

6. A converter for bessemerizing iron under acid slag-forming conditions having an

acid lining, except for such parts thereof as come in contact with the basic products which may be liberated during the bessemerizing process, said parts having a non-acid lining containing basic material and a lining of neutral material intermediate said non-acid lining and said acid lining; substantially as described.

7. A converter for bessemerizing iron having an acid lining, except in its twyer region, which region has a non-acid lining containing basic material; substantially as described.

8. A converter for bessemerizing iron having an acid lining, except in its twyer region, which region has a non-acid lining containing basic material and a lining of neutral material intermediate said non-acid and said acid linings; substantially as described.

9. A converter for bessemerizing iron having twyers in the body structure thereof with the twyer region lined with non-acid refractory material and side walls lined in whole or in part with acid refractory material; substantially as described.

10. A converter for bessemerizing iron having twyers in the body structure thereof with the twyer region lined with basic refractory material and side walls lined in whole or in part with acid refractory material; substantially as described.

11. A converter for bessemerizing iron having its twyer region lined with non-acid refractory material and side walls lined in part with acid refractory material, and a non-acid refractory lining intermediate said non-acid lining and said acid side wall lining; substantially as described.

12. A converter for bessemerizing iron having its twyer region lined with basic refractory material and side walls having an upper lining of acid refractory material and a lining of neutral refractory material intermediate said basic lining and said upper acid lining; substantially as described.

In testimony whereof I affix my signature.

RICHARD S. McCAFFERY.