Patented Jan. 11, 1949 2,458,651

UNITED STATES PATENT OFFICE

2,458,651

PROCESSES FOR PRODUCING LOW CARBON CHROMIUM STEELS

Herman B. Schulz, Chicago, Ill., assignor to Carnegie-Illinois Steel Corporation, a corporation of New Jersey

No Drawing. Application September 25, 1947, Serial No. 776,158

3 Claims. (Cl. 75—12)

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This invention relates to processes for producing low carbon chromium steels in arc-type electric furnaces and particularly to methods for maintaining a low carbon content during introduction of alloying materials to the steel.

Unless remedial measures are taken, it is known that chromium in stainless or other chromium bearing steels may combine with carbon and the chromium carbide thus formed precipitates at grain boundaries. The steel is thus depleted of alloyed chromium in such regions and becomes subject to intergranular corrosion. There are several means known for preventing precipitation of chromium carbide, one of which is by reduction of the carbon content to a very low value, less than 0.03 per cent.

Likewise processes applicable to electric arc furnace operations are known by which the carbon content of steel can be reduced to sufficiently low values for preventing chromium carbide precipitation. An example of such a process is that of blowing oxygen into a molten bath of metal and slag to oxidize the carbon. A process of this nature is described and claimed in Chelius Patent No. 2,226,967, except I have found that the process is capable of producing much lower carbon contents than disclosed in any of the examples given therein. However, difficulties are encountered in maintaining the low carbon content during subsequent addition of the alloying materials.

The principal object of the present invention is to provide improved methods for treatment of electric arc furnace steels subsequent to removal of carbon to low values (less than 0.03 per cent) for maintaining carbon content at such values during addition of chromium or manganese or both to the steel.

In practicing the present invention, a charge consisting of ferrous material, commonly in the form of ordinary or stainless scrap and nickel oxide, and which may include metallic nickel or ferro-chromium, and the usual fluxes is melted in an arc-type electric furnace. As soon as a molten pool appears in the charge, oxygen is blown into the pool through suitable lances inserted in the pool. The temperature is thereby rapidly increased to around 3100° F. and the carbon is oxidized, and after a period reaches a very low content (around 0.015 per cent). It has also been found that similar low carbon contents can be obtained if air, or preferably dried air, is substituted for oxygen in the process.

I prefer, insofar as possible, to introduce the oxygen to the slag, instead of to the metal directly, although introduction of oxygen agitates

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the bath to the extent that there is no clear interface between the metal and the slag. On account of the high temperatures encountered, preferably the furnace lining is chromite, although magnesite or other materials may also be suitable.

The original slag formed during the carbon oxidation is voluminous and of a highly oxidizing character, but otherwise of uncertain composition. Prior practice has been to replace the original oxidizing slag at this stage with a second slag which is reducing in character. Chromium and manganese are then added to the steel through the reducing slag. This has been thought necessary in order to prevent oxidation of these alloying metals and losing them in the slag.

I find that such prior practices cause the metal of very low carbon content to pick up additional carbon to the extent that the chromium alloy is not immune to chromium carbide precipitation. Sources of carbon pick-up may be from the furnace electrodes or from the alloying materials. In accordance with the present invention I find that carbon pick-up can be minimized without serious oxidation of the alloying metals by using as the second slag a mildly oxidizing slag of controlled composition.

The original slag is therefore removed by any well known technique and replaced by a slag formed of the following, per 25 tons of heat:

	Pounds
Burnt lime	600 to 800
Silica sand	300 to 400
Fluorspar	about 100

During the change of slags there is some oxidation of the iron in the bath and thus the new slag contains in addition an appreciable quantity of ferrous oxide and is mildly oxidizing.

After the second slag has been introduced, the furnace is again brought to a temperature around 3100° F. and chromium and manganese added as desired. Preferably the chromium is in the form of ferro-chrome containing not more than 0.03 per cent carbon and is added in batches at spaced intervals. Preferably manganese is added partly in the form of electrolytic manganese introduced to the bath in the furnace and partly in the form of ferro-manganese containing about 0.10 per cent carbon subsequently introduced to the ladle. Such ferromanganese is introduced in sufficiently small quantities, such that the carbon content of the finished product does not exceed 0.03 per cent. It is seen that either or both of these alloying materials may be added as

desired and it is not intended to limit the invention to any particular contents of these materials.

Only a small amount of silicon or other strongly reducing material may be introduced to the metal during or before alloying with chromium and manganese, since their introduction at this stage tends to increase carbon content. Any such reducing materials introduced during this stage is in sufficiently small quantities that the oxidizing character of the slag is not materially affected. If silicon is desired in the finished product, it is ordinarily added subsequently during tapping of the heat into a ladle.

The process of the present invention provides a simple and effective means for obtaining and maintaining the carbon content of steel in electric arc furnaces at very low values while alloying constituents are added. While I have disclosed but certain process steps, it is apparent modifications may arise. Therefore I do not wish to be limited by the disclosure set forth, but only by the scope of the appended claims.

I claim:

1. In the production of electric arc furnace steels, wherein a bath is formed consisting of molten steel and a highly oxidizing slag, carbon is oxidized from the steel to a content of less than 0.03 per cent, and chromium is subsequently introduced to the steel, a method of maintaining a low carbon content in the steel while chromium is being introduced comprising replacing the original highly oxidizing slag with a mildly oxidizing slag consisting of 600 to 800 pounds burnt lime, 300 to 400 pounds silica sand, and about 100 pounds fluorspar per 25 tons of heat, and introducing chromium through said mildly oxidizing slag at a temperature of around 3100° F.

2. In the production of electric arc furnace steels wherein a bath is formed consisting of molten steel and a highly oxidizing slag, carbon is oxidized from the steel to a content of less than 0.03 per cent by introduction of oxygen, and chromium and manganese are subsequently introduced to the steel, a method of maintaining a low carbon content while chromium and manganese are being introduced comprising replacing the original highly oxidizing slag with a mildly oxidizing slag consisting of 600 to 800 pounds burnt lime, 300 to 400 pounds silica sand, and about 100 pounds fluorspar per 25 tons of heat, and introducing chromium and manganese through said mildly oxidizing slag at a temperature of about 3100° F.

3. A process for producing low carbon chromium steels comprising the steps of melting a charge of ferrous metal and fluxes in an electric arc furnace, introducing oxygen to the molten charge, thereby oxidizing the carbon to a content of less than 0.03 per cent in the steel and forming a highly oxidizing slag, replacing the original slag with a mildly oxidizing slag consisting of 600 to 800 pounds burnt lime, 300 to 400 pounds silica sand, and about 100 pounds fluorspar per 25 tons of heat, and introducing chromium through said mildly oxidizing slag at a temperature of about 3100° F.

HERMAN B. SCHULZ.

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The following references are of record in the file of this patent:

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