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METHOD FOR PRODUCING CHROMIUM OR ALLOYS OF CHROMIUM.

No Drawing. Application filed May 4, 1921. Serial No. 466,743.

To all whom it may concern:

Be it known that we, Bo MICHAËL STURE KALLING and SVEN DAGOBERT DANIELI, subjects of the King of Sweden, residing at Trollhattan, Sweden, have invented certain new and useful Improvements in Methods for Producing Chromium or Alloys of Chromium, of which the following is a specification.

The present invention relates to a method of producing chromium or alloys of chromium poor in carbon and silicon, and is an improvement in part upon that described in our co-pending application Serial No. 335,670, filed November 4, 1919. In said co-pending application we have described a process of manufacturing chromium alloys which consists in subjecting a chormium alloy rich in silicon, at a suitable temperature, to the oxidizing action of free oxygen blown in through the silicon-chromium alloy while the latter is in molten condition. The principal object of the present invention is to provide a process in which the chromium contained in the end slag resulting from the process described in said co-pending application is utilized in a novel and practical manner.

Analysis made at various periods during the bessemerizing process, of samples of the slag and the alloy simultaneously taken from the converter, have demonstrated the following facts: Samples taken during the early stage of the desilication process, that is, while the content of silicon in the alloy is high, show that the content of chromium in the slag is low. On the other hand, samples taken later on in the bessemerizing process, that is to say, after the content of silicon in the alloy has decreased, show the content of chromium in the slag to have correspondingly increased. By numerous tests of this character it has been demonstrated beyond question that the content of chromium in the slag varies inversely with the content of silicon in the alloy. For instance, when the alloy shows a silicon content of 20%, the slag will be found to contain a chromium content of approximately 1%. When the alloy contains a silicon content of 15%, the slag will contain a chromium content of approximately 3%. When the alloy contains a silicon content of 10%, the slag will contain a chromium content of approximately 6%. When the alloy contains a silicon content of 5%, the slag will contain a chromium content of approximately 10%. And when the alloy contains a silicon content of 1%, the slag contains a chromium content of approximately 15%.

We have also discovered that if, during the bessemerizing process, chrome ore is added to the charge under treatment, the ratio of chromium content in the slag to the silicon content in the alloy is usually high only during a comparatively short time, and that after supplying ore to the charge the ratio between the chromium content in the slag and the silicon content in the alloy will soon return to normal proportions, that is, to the proportions that would have been present if no ore had been added. For instance, if at the stage of the process when the silicon content is about 25%, at which time the converter slag is practically-speaking free from chromium, a quantity of ore is added which will cause a momentary raising of the chromium content of the slag to, say, 15%, and the process continued, it will be found that when the percentage of silicon in the alloy has decreased, for instance, to 15%, the chromium content of the slag will be only about 3%, which is the same content of chromium which would have been present if no ore had been added. These facts indicate that in carrying out the process set forth in our co-pending application hereinbefore referred to, a by-product comprising a slag relatively rich in chromium is obtained, in addition to an alloy poor in carbon and silicon. This slag may, of course, be used as an initial material for producing a chromium alloy to be treated by bessemerizing, but is inferior for this purpose. We have discovered that if, instead of adding chrome ore

to the charge in the converter, a slag taken from a converter during an advanced stage of desilication, when the chromium content of said slag is high, is added to another charge during an earlier stage of desilication, the main part of said chromium content may be obtained as a chromium alloy, if the Bessemer treatment of the last-mentioned charge is interrupted at the stage when the proper balance of silicon content in the alloy and chromium content in the slag is reached. Theoretically there is no reason why this procedure should not be repeated several times during the Bessemer treatment. In practice, however, it has been found that the most satisfactory results are obtained by limiting these manipulations to adding the final slag obtained from a charge under Bessemer treatment, and which slag is relatively rich in chromium, to another charge during the earlier stages of desilication. The preferred procedure is a follows: When a Bessemer treatment is accomplished, the chromium alloy, which is poor in carbon and silicon, is tapped off, but the converter slag, which is rich in chromium, is retained. A proper quantity of molten silico-chromium alloy is then supplied to the same converter, and a Bessemer treatment is performed until the chromium content of the converter slag has been reduced to a minimum, whereupon said slag is tapped off and the Bessemer treatment continued. When the desilication of the silico-chromium alloy has reached the desired stage the bessemerizing is interrupted, and the alloy is tapped off, the slag being retained. A fresh quantity of silico-chromium is then added and bessemerizing continued, and so on until the converter lining is consumed.

In order further to illustrate the present invention and to make clear the progress involved in the same in comparison with the method set forth in our application Serial No. 335,670, the following diagrammatical formulæ showing the course of the process when producing ferro-chromium poor in carbon and silicon are given by way of example:

A. *Working according to the method stated in our application Ser. No. 335,670.*

Ferro-silico-chromium containing 25% of silicon+chrome ore+lime+free oxygen= ferro-chromium poor in carbon and silicon with 65% of chromium+slag containing 15% of chromium.

B. *Working according to the present process.*

(*a*) The first part of the process.

Ferro-silico-chromium containing 25% of silicon+the final slag (end slag), having 15% of chromium, from a preceding treatment+free oxygen=ferro-silico-chromium containing 15% of silicon+slag having 3% of silicon, which slag is tapped off.

(*b*) The latter part of the process.

Ferro-silico-chromium containing 15% of silicon+chrome ore+lime+free oxygen =ferro-chromium poor in carbon and silicon containing 74% of chromium, which is tapped out of the converter,+slag having 15% of chromium, which is retained in the converter till the next blowing.

Thus the result of the processes indicated with (*a*) and (*b*) together:

Ferro-silico-chromium containing 25% of silicon+chromium+lime+free oxygen= ferro-chromium poor in carbon and silicon having 74% of chromium+slag containing 3% of chromium.

While it has not been heretofore possible to obtain as a finished alloy more than 70% of the chromium supplied to the charge under treatment, such alloy being in the form of ferro-silicon-chromium and chrome ore, by means of the present improvement it is possible to increase the output of chromium to 95%.

Having thus described our invention, what we claim is:

1. The process of producing chromium alloys having a low content of carbon and silicon, which consists in subjecting a chromium alloy rich in silicon, at a temperature above the melting point of the alloy, to the oxidizing action of free oxygen in a bessemerizing process, thereby to desilicate the charge, and adding to said charge during the early stage of desilication a slag obtained from a similar charge at a later stage of desilication.

2. The process of producing chromium alloys having a low content of carbon and silicon, which consists in subjecting a chromium alloy rich in silicon, at a temperature above the melting point of the alloy, to the oxidizing action of free oxygen in a bessemerizing process, thereby to desilicate the charge, interrupting said process when the silicon content of the alloy is approximately 25%, adding to said charge a slag obtained from a similar charge at a later stage of desilication, and then continuing the bessemerizing process.

3. The process of producing chromium alloys having a low content of carbon and silicon, which consists in subjecting a chromium alloy rich in silicon, at a temperature above the melting point of the alloy, to the oxidizing action of free oxygen in a bessemerizing process, thereby to desilicate the charge, interrupting said process during the early stage of desilication, adding to said charge a slag obtained from a similar charge at a stage of desilication

when the slag contains a chromium content of 15%, and continuing the bessemerizing process.

4. The process of producing chromium alloys having a low content of carbon and silicon, which consists in subjecting a chromium alloy rich in silicon, at a temperature above the melting point of the alloy, to the oxidizing action of free oxygen in a bessemerizing process, thereby to desilicate the charge, interrupting said process when the silicon content of the alloy is approximately 25%, adding to said charge a slag containing a chromium content of approximately 15%, and continuing the bessemerizing process.

In testimony whereof we have affixed our signatures in presence of two witnesses.

BO MICHAËL STURE KALLING.
SVEN DAGOBERT DANIELI.

Witnesses:
CHR. RECHFRÜS,
JOSEF JOHANSSON.