Patented May 26, 1925. 1,538,893

UNITED STATES PATENT OFFICE.

WALTER BIRKETT HAMILTON, OF BIRKDALE, AND THOMAS ALLEN EVANS, OF MANCHESTER, ENGLAND.

MANUFACTURE OF IRON AND STEEL ALLOYS.

No Drawing. Application filed November 2, 1923. Serial No. 672,274.

To all whom it may concern:

Be it known that we, WALTER BIRKETT HAMILTON, of Birkdale, in the county of Lancaster, England, and THOMAS ALLEN EVANS, of Cheetham Hill, Manchester, in the county of Lancaster, England, both subjects of the King of Great Britain, have invented new and useful Improvements in the Manufacture of Iron and Steel Alloys, of which the following is a specification.

The present invention has reference to improvements in the manufacture of iron and steel alloys. In the specification of Letters Patent No. 1,432,289 granted to us, there is described a process for the manufacture of such alloys in which a mixture of aluminum and ordinary commercial chrome ore is employed.

In the practice of such process it is desirable to use a certain excess of the thermo reducing agent beyond the quantity theoretically required to reduce the reducible metallic oxides contained in the ore. This is especially the case if the silica content be high. The reason for this is that the chromite and aluminum are intimately mixed when introduced into the furnace, and although when the reducing action is taking place, the aluminum can more easily reduce the iron oxide and the chrome oxide than the silica, at the same time the action of the aluminum cannot be entirely selective and a considerable portion of the silica present is reduced.

It is found in practice that the silicon so resulting finds its way into the bath of metal. This is detrimental to the quality of the metal, at any rate for many of its uses.

We will suppose that it is found that sufficient silicon has been reduced to render the percentage content of that element in the alloy produced as high, for example, as 3%. If the aluminum were able to selectively reduce only the reducible metallic oxides, then by leaving out the chemically equivalent amount of aluminum necessary for the reduction of such a quantity of silicon such silicon would no longer be found in the alloy produced.

In practice it is found that so diminishing the quantity of aluminum does not entirely prevent silicon being found in the alloy produced and further that the percentage of chromium in the alloy is diminished.

The object of the present invention is to provide a process whereby ores containing substantial proportions of silica can be employed and the ultimate product contain the desired amount of chromium without silicon in undesirable quantities.

A further object of the present invention is that the process shall be capable of being carried out by ordinary steel works' hands with the consistent production of metal that will conform to the desired specification.

According to our present invention we employ a quantity of aluminum in excess of the quantity chemically equivalent to the reducible metallic oxides in the ore but we intimately mix with it not the whole quantity of the chromite but approximately only 80% thereof, the remaining chromite being kept separate from the mixture and used in the following manner:—

This 20% or thereabouts of the chromite is added to a suitable reception slag (which as described in the aforesaid patent may be a silicious lime slag) which is brought to a highly fluid condition before adding the mixture containing the 80% or thereabouts of the chromite and all the aluminum.

The reception slag accordingly contains a known proportion of chromium oxide. These percentages 20 and 80 are subject to considerable variations with different chrome ores. The aluminum is in such quantity that it will be sufficient to reduce practically all, if not all, the reducible oxides, including the silica, contained in such portion of the chromite as is admixed with the aluminum. The portion of the chromite added to the reception slag and with which no aluminum is previously mixed should be sufficient to utilize the silicon produced by reduction of the silica content of that portion of the chromite with which the aluminum is admixed.

The silicon reduced from the silica expends itself in reducing the oxide of chromium added to the reception slag. The process is carried out preferably in an electric furnace. The furnace is charged with a suitable metal, viz, iron or steel, which may be melted therein, the slag which is ordinarily first formed being preferably removed. If preferred, the furnace may be charged with molten metal. The choice of the metal will be determined by the percentage of carbon desired in the alloy. As was indicated in the specification of the Letters Patent referred to above, it is possible to obtain an alloy con-

taining as low as 0.1 per cent of carbon notwithstanding the use of an electric furnace with carbon electrodes, as the slag, while permitting the iron and chromium resulting by reduction to pass through, protects the molten bath of metal from contamination by the electrodes.

Our present invention is not limited to the case where the reducing agent added to the chrome ore is aluminum, as we have usefully applied our invention to the case where aluminum mixed with silicon has been the reducing agent.

Further, if desired instead of mixing the reducing agent and such portion of the chrome ore as we have described as being mixed therewith, we may charge the same separately and in any order but we prefer to charge the same in intimate admixture. Although it is contemplated that the same ore will be used both for adding to the reception slag and for admixing with the thermo reducing agent and that this will contain silica in substantial proportions, it should be observed that it is not necessary that the ore added to the slag should contain the same percentage of silica as that contained in the ore admixed with the thermo-reducing agent, or any silica.

What we claim as our invention and desire to secure by Letters Patent is:—

1. A process of making an alloy containing iron and chromium, consisting in charging a furnace with suitable metal, forming a reception slag which carries an ore containing chromium and iron oxides, adding to the furnace an ore containing chromium and iron oxides and substantial proportions of silica admixed with a sufficient quantity of a reducing agent exothermic in respect to said oxides to reduce substantially all the reducible oxides including the silica, contained in the ore so added, whereby the silicon reduced from the silica expends itself in reducing the chromium oxide contained in the reception slag, thereby to produce an alloy containing the desired percentages of iron and chromium and substantially free from silicon, substantially as described.

2. A process of making an alloy containing iron and chromium which consists in charging a furnace with suitable metal, forming a reception slag with which an ore containing chromium and iron oxides is mixed, charging into the furnace further quantities of such an ore and a reducing agent exothermic in respect to said oxides, the quantities of the ore mixed with the slag and charged into the furnace, respectively and of the reducing agent, being all so proportioned that the silicon reduced in said further charge expends itself in reducing the chromium oxide contained in the reception slag, whereby an alloy of the desired percentages of iron and chromium and substantially free from silicon is obtained, substantially as described.

3. A process of making an alloy containing iron and chromium, which consists in charging a furnace with suitable metal, forming a reception slag containing chromium and iron oxides, adding to the furnace an ore containing chromium and iron oxides and a reducing agent exothermic in respect to said oxides, the percentages of chromium contained in the slag to that contained in the mixture with the reducing agent being approximately 1 to 4, whereby the silicon reduced by the reducing agent expends itself in reducing the chromium contained in the reception slag.

4. A process of making an alloy containing iron and chromium, which consists in charging a furnace with suitable metal, forming a slag containing approximately 20% of the total quantity of chromium to be added, bringing said slag to a highly fluid condition, and adding thereto a mixture containing approximately 80% of said total quantity of chromium with iron oxides and a reducing agent exothermic in respect to said oxides, whereby the silicon reduced by the reducing agent expends itself in reducing the chromium contained in the reception slag.

In testimony whereof we have signed our names to this specification.

WALTER BIRKETT HAMILTON.
THOMAS ALLEN EVANS.