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MANUFACTURE OF FERROCHROMIUM ALLOYS.

No Drawing. Application filed February 2, 1922. Serial No. 533,650.

To all whom it may concern:

Be it known that I, WILLIAM BOWMAN BALLANTINE, a subject of the King of England, residing at London, England, have invented certain new and useful Improvements in the Manufacture of Ferrochromium Alloys (for which I filed application in Great Britain on January 19, 1921), of which the following is a specification.

This invention is for improvements in or relating to the manufacture of high chromium low carbon ferrochromium alloys.

In the production of low carbon chrome-iron or chrome-steel containing relatively high, for example, 9–20 per cent of chromium, it is the common practice to add low carbon ferro-chrome to the molten steel. As low carbon ferro-chrome is exceedingly costly, the utilization of low carbon chrome steel (rustless steel), or chrome iron (rustless iron) is at the present time restricted to a few finished articles, which necessarily are sold at a high or relatively high price, thus holding back the development and use of rustless iron or rustless steel in other and lower priced trades and in consequence seriously retarding the scope of the rustless steel or rustless iron industry.

Ferro-chrome which is the basic alloy required to produce rustless iron or rustless steel is usually obtained by reduction of chromite ore. As produced by direct reduction of the prepared ore in the electric furnace the alloy invariably contains a considerable proportion of carbon, perhaps four per cent or more, and in order to obtain an alloy with a low carbon content special refining methods at present are called for, such as treatment of the impure (high carbon) alloy in an arc-furnace with special ores, such as chromite, lime and fluorspar, etc. On the other hand, the preparation of pure ferro-chrome alloys or ferro-chrome alloys of low carbon content by direct reduction of chromite or like ores with a thermo-reducing agent, such as aluminum, is expensive in operation by reason of the cost of such metallic reagents and of the large losses incidental to the process.

In the specification belonging to my prior Patent, No. 1,386,981, of August 9, 1921, a process is described for the production of low-carbon ferro-chrome alloys by submitting a crude ferro-chrome of high chromium and carbon content to decarburization in a converter of the Bessemer type. The present invention has for its object to provide an improved process for the production of superior ferro-chrome alloys by means of the electric furnace without the use of a converter whereby the cost of producing a high chromium low carbon ferro-chrome alloy is reduced to the lowest practicable point.

By superior ferro-chrome alloys are meant alloys comprising chromium and iron and containing low or neglible quantities of carbon and/or silicon or other impurities, but containing a high percentage of chromium, say about 55 to 60 per cent or over.

According to this invention, a process for the manufacture of superior ferro-chromium alloys in the electric furnace is characterized by submitting therein a molten iron-chromium mixture or combination of higher content in oxidizable impurities to an oxidizing blast, for example, to a blast of air.

This oxidizing blast may be blown through the metal or may be directed upon the surface of the molten mass so as to play upon the surface of the metal. In a surface blow when the slag forms, the blast should be directed so as, as far as possible, to clear away the slag and impinge directly upon the metal.

Such blast may be introduced through pipes or conduits composed of, or lined with, a refractory, and appropriately disposed in the side, or sides of the furnace, or through the electrode or electrodes, such electrode or electrodes having a hole bored centrally through the same and lined with a refractory or being fitted with a tube of refractory material or a combination of both.

The blast may also be used to carry into the furnace such flux in powdered form as the character of the metal under treatment may require, from a metallurgical point of view, and the supply of such flux may be controlled according to the pressure and volume of the blast or by independent means.

The electric furnace used is preferably adapted for tipping so as to provide for rapid delivery of the charge when the latter is considered finished (i. e., when by testing samples of the metal of the percentage of carbon and other impurities contained therein is found to have been lowered to the point desired.)

The current may be passed before, after and or during the passage of the blast, or

intermittently, as may be required, provided that the reaction temperature necessary for the manufacture of low-carbon ferro-chrome be duly maintained.

The temperature of the molten mass is one of the controlling factors of the operation. It is well known to metallurgists and those skilled in the art, that the conditions of the process of oxidation of any given metal or metalloid may vary according to temperature. Similarly where two metals are alloyed together, at any given temperature, the one metal may oxidize in the presence of an oxidizing blast, before the other, whereas at another and different temperature the reverse action may take place and this applies where there are appreciable percentages of metalloids present in such alloy also.

It must be distinctly understood that the use of an electric furnace for carrying out the process, as described is inherently different and distinct from the use of a Bessemer converter as such, inasmuch as the temperature of the molten mass in the electric furnace can be maintained under complete control and the flux, if required, introduced by and with the blast. Moreover, the molten mass can be retained in the furnace for any length of time desired at any given or varying temperatures, whereas in the Bessemer converter this is not possible.

The following examples are illustrative of the results obtained by two methods of procedure according to this invention.

A charge of a crude molten ferro-alloy containing 5.65 per cent of carbon, 6.1 per cent of silicon, 0.28 per cent of sulphur, 64 per cent of chromium and the balance iron, was fused and brought almost to the temperature of ebullition of the slag in an electric furnace.

In one operation, a blast of about 8 lbs. pressure was introduced through iron pipes inserted through the side of the furnace at such an angle as to cause the blast to impinge directly on the molten mass immediately beneath the electrodes. After a blow of 40 minutes, during which the electrodes were used intermittently, the carbon was reduced from 5.65 per cent to 0.25 per cent and the silicon from 6.1 per cent to 0.22 per cent the chromium being 62 per cent.

In the second case, the blast was introduced through a hollow electrode (the bore being lined with a refractory, so that the blast impinged beneath the electrode directly on the molten material beneath the latter. After 37 minutes blowing, the carbon content was reduced from 5.65 per cent to 0.2 per cent and the silicon content from 6.1 per cent to 0.25 per cent and the cromium being 60.8 per cent.

If the blast be blown through the mass of molten metal the electrode or electrodes should be adjustable so as to be withdrawn if desired, and the furnace adapted to be a tipping one or otherwise provided with means to permit the metal when raised to a sufficiently high temperature by the current to be subjected to the blast at any desired angle from the horizontal.

If desired the electrodes may be withdrawn and the blast carried on without any current passing, or vice versa as may be deemed requisite according to the varying temperature which the metal under treatment may require.

I claim:—

1. The process for the manufacture of ferro-chromium alloys of low content in oxidizable impurities which comprises submitting a molten crude ferro-chrome having an added flux to the action of an oxidizing blast in an electric furnace.

2. The process for the manufacture of ferro-chromium alloys of low content in oxidizable impurities which comprises submitting a molten crude ferro-chrome to the action of an oxidizing blast carrying a flux in an electric furnace.

3. The process for the manufacture of ferro-chromium alloys of low content in oxidizable impurities which comprises fusing a ferro-chromium mixture of higher content in such impurities in an electric furnace and directing an oxidizing blast therein upon the surface of the molten metal.

4. The process for the manufacture of ferro-chromium alloys of low content in oxidizable impurities which comprises fusing a ferro-chromium mixture of higher content in such impurities in an electric furnace, bringing the mass almost to the point of ebullition of the slag and directing an oxidizing blast upon the surface of the molten metal.

5. The process for the manufacture of ferro-chromium alloys of low content in oxidizable impurities which comprises fusing a ferro-chromium mixture of higher content in such impurities in an electric furnace and directing an oxidizing blast therein through an electrode upon the surface of the molten metal.

In testimony whereof I affix my signature.

WILLIAM BOWMAN BALLANTINE.