UNITED STATES PATENT OFFICE.

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MANUFACTURE OF FERROCHROMIUM.

1,346,728. Specification of Letters Patent. Patented July 13, 1920.

No Drawing. Application filed January 7, 1918. Serial No. 210,697.

To all whom it may concern:

Be it known that I, WILLIAM LAWRENCE TURNER, a subject of the King of England, and residing at Atherstone, in the county of Warwick, England, have invented Improvements in the Manufacture of Ferrochromium, of which the following is a specification.

This invention has reference to the production of the metallic alloy known as "carbon free ferro-chromium," produced by the process known as the alumino-thermic process which is usually sold and used in metallurgy for the manufacture of ferro alloys or steels; and this invention has for its object primarily, to produce such ferro-chromium at a relatively low cost, and also to obviate certain disadvantages and defects of the process heretofore employed, for its manufacture, which are inherent in it.

The actual manufacture of carbon free ferro-chromium from chromium iron ore by the alumino-thermic process, as hitherto carried out, has been accompanied by many difficulties, by reason partly of the refractory nature of this ore, intensified by the inclusion in it of considerable percentages of magnesia, alumina, lime, and other more or less inert matters, which do not necessarily take part in the reaction; and furthermore, it is known that the yield of chromium, or the efficiency of the reduction, is poor, even when great care is taken in a variety of ways which are adopted to make the reaction take place at all. For the more satisfactory carrying out of the reaction referred to, it has been proposed to use with chrome iron ore a quantity of chromium oxid, and also to pre-heat, to a moderate degree, the thermic mixture, for the purpose of generally assisting the reaction.

Now according to and for the purposes of this invention, a proportion of bi-chromate or chromate of potassium (or bi-chromate or chromate of sodium) is mixed with the chemically equivalent mixture of chromium iron ore, and aluminium or equivalent reducing medium. I find that by the use and application of this bi-chromate or chromate in the chemical equivalent mixture, the reaction is caused to take place readily and satisfactorily, increasing the efficiency and yield of the chromium from the chrome iron ore; while in addition, the chromium of the bi-chromate or chromate, is also yielded up in the alloy produced.

The alumino-thermic mixture may be moderately preheated, for the purpose of assisting the reaction and increasing the efficiency.

Regarding the carrying out of this invention of the production of carbon free ferro-chromium from chromium iron ore by the alumino-thermic process, the following is an example:—In an alumino-thermic mixture if to 120 parts by weight of chromium ore (the latter containing about 50% of sesquioxid of chromium) there be added 24 parts of bi-chromate of potash, together with the necessary equivalent quantity of aluminium or other reducing metal, and the mixture be heated to a dull red heat, and then set into reaction in the well known way, the product—the carbon free ferro-chromium—will contain from 70% to 75% of chromium; the yield of chromium from the chromium containing material in the alumino-thermic mixture being in the neighborhood of 85%. While this result may be obtained by the use of the percentages referred to, by employing other proportions, having regard to the nature of the particular ore being worked, satisfactory yields may be secured.

The actual reaction which takes place as a result of the addition of bichromate of soda (or potash) to the mixture of chrome ore and aluminum is largely a matter of surmise, but I hold that the available oxygen is all combined with the aluminum to form Al_2O_3 and thus there will be a large amount of additional heat imparted to the reaction, which actually seems to be borne out in practice. By this I mean to say that the sodium oxid is decomposed by the aluminum with liberation of sodium in the metallic form, and the latter in turn acts as a reducing agent in the aluminothermic reaction. The chromium reduced from the bichromate passes, as desired, into the regulus formed by the reaction of the aluminum with the chrome iron ore.

To simplify the matter it may be well to regard the bichromate as a compound of chromic acid and oxid of sodium and to treat each separately.

Thus, regarding bichromate of soda, $Na_2Cr_2O_7$, as Na_2O and $2CrO_3$, we have,

$$2CrO_3+4Al=2Al_2O_3+2Cr. \quad (1)$$
$$3Na_2O+2Al=Al_2O_3+6Na. \quad (2)$$

The first reaction is complete, while the second is only partially so as owing to dense fumes of soda arising from the reacting

mass, it is obvious that part of the metallic sodium liberated is oxidized on escape into the atmosphere. In all probability part of the sodium, being in the nascent state, enters into combination as a reducing agent with the metallic oxids present and is converted into sodium oxid, Na_2O.

It would be possible to substitute for the bichromate or chromate of potassium above referred to, anhydrous bi-chromate or chromate of sodium; but owing to the fact that the sodium salts are more or less prone to absorb moisture under certain conditions, where this has taken place, the reaction may be interfered with, and generally not be so satisfactory.

The bichromate of soda, may be regarded as having the chemical formula $Na_2O.CrO_3)_2$, and assuming that the Na_2O is volatilized in the reaction, there will remain three heat producing atoms of oxygen to each atom of chromium, whereby the heat units developed for available use is great.

What is claimed is:—

1. The herein described process which consists in mixing a chromate of the alkali metals, chromium iron ore and a reducing metal, and heating the mass for effecting the reaction.

2. The herein described process which consists in mixing substantially 120 parts by weight of chromium iron ore, 24 parts by weight of a bichromate of the alkali metals, and a chemically equivalent portion of a reducing metal, and heating the mass to effect the reaction.

3. The herein described process, which consists in preheating a thermic mixture containing a bichromate of the alkali metals and a reducing metal to cause chemical reaction to be set up, and introducing into the mass a chromium iron ore in the presence of the heat and reaction and further heating the mass.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILLIAM LAWRENCE TURNER.

Witnesses:
A. M. HANNAY,
SOMERVILLE GOODALL.