

UNITED STATES PATENT OFFICE

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METALLURGY

Arthur Linz, New York, N. Y., assignor to Climax Molybdenum Company, New York, N. Y., a corporation of Delaware

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1 Claim. (Cl. 75-122)

The present invention relates to a new, useful and improved process for the addition of boron to metals and particularly to molten ferrous metals.

Objects and advantages of the invention will be set forth in part hereinafter and in part will be obvious herefrom, or may be learned by practice with the invention, the same being realized and attained by means of the processes, steps and combinations pointed out in the appended claim.

The invention consists in the novel steps, methods, procedures, combinations and improvements herein described.

Heretofore it has been proposed to add boron to molten metals, the result of this addition being additional advantageous properties and particularly an increase in the hardenability of the resultant alloy and relatively small quantities of boron have been effectively utilized for this purpose. As is well known, however, boron is an element characterized by a high affinity for oxygen, nitrogen, and oxygen containing gases and therefore one of the difficulties of introduction of boron into a molten metal mass has been the oxidization of part of the boron, at least. Furthermore, since only a small quantity of boron has been found desirable for such use, another problem is the necessity of providing rapid and uniform dispersion of the boron throughout the molten mass.

In the prior proposals the boron has been introduced into the molten mass for example in the form of ferro-boron or as an admixture with other metals such as aluminum, calcium, titanium and ferro-silicon.

The object of the present invention is to provide a novel and improved process for the addition of boron into molten metal such as iron or steel while preventing oxidization of the boron. A further object of the invention is to provide for incorporating boron into molten iron or steel or like metals while obtaining a rapid dispersion throughout the molten mass of the boron, thus reducing the opportunity for oxidization of the boron. It is also an object of the present invention to provide a novel and improved process by which a definite ratio of boron can be accurately added to the molten metals such as iron or steel.

The invention further provides the process of producing a boron-containing compound which is adapted to be added to a molten bath of metal to provide ready and rapid dispersion of the boron therethrough while avoiding losses by oxidization.

According to the process of the present in-

vention, boron is added to a molten mass of metal in the form of a mixture with a molybdenum silicide.

In my prior Patent No. 2,290,194 I have disclosed a process for producing molybdenum silicide for admixture with a molten mass of metal and the present invention particularly relates to the formation of a boron-molybdenum silicide mixture or complex which can be added to a molten metal. By this means not only will the advantages disclosed in said prior patent be obtained in making a quick solution in the molten mass of molybdenum and silicon, but also the boron carried by the molybdenum silicide will be dispersed quickly in the molten mass and dissolved therein without substantial exposure to oxidization by virtue of this fact and also by virtue of the fact that the silicon in the silicide will help prevent oxidization of the boron.

Various processes may be used for the preparation of the molybdenum-silicon-boron addition agent which may be used in the alloying process of the present invention. I preferably mix a molybdenum oxide such as roasted molybdenite concentrates or pure molybdenum trioxide with ferro-silicon and a fluxing agent such as fluor-spar, with aluminum, together with either boric acid, sodium tetra borate, or other compound forming a source of boron. This mixture is then ignited in a suitable crucible and after the slag has been tapped off the desired proportion of molybdenum and silicon, together with boron is present in the form of a molybdenum-silicon-boron complex. The relative amounts of the substances in this complex may be varied widely depending upon the desired composition of the resultant product and particularly how much boron is to be introduced into the final alloy.

It is desired, preferably, to produce a final addition product which will be molybdenum silicide containing from $\frac{1}{16}$ to 1% to 2.50% of boron. A typical analysis of the addition product produced by the reaction of such a mixture is:

	Per cent
Mo	60
Si	30
B	1.5
Al	.2
Al ₂ O ₃	4.7
CaO	1.5
SiO ₂	2.1

If desired an excess of silicon may be added to the mixture so as to introduce a larger proportion of silicon into the final alloy and also pre-