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## PROCESS OF PRODUCING MOLYBDENUM CONTAINING ALLOYS

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The present invention relates to the new and useful process for the addition of molybdenum-silicon compounds to 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 instrumentalities and combinations pointed out in the appended claims.

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

Heretofore it has been customary to add molybdenum and silicon to ferrous metals in the ladle by using ferro-molybdenum or other molybdenum compounds and ferro-silicon or other silicon compounds, such as calcium silicide, all of which require special care to produce a homogeneous resulting alloy. It has also been proposed to add molybdenum and silicon to molten iron or steel by using a mixture of molybdenum trioxide and silicon, but this process has not come into commercial use due to the nature of the reaction which takes place at the temperature of the molten iron or steel, and also because it disperses the slag which it forms causing inclusions of silica slag.

The present invention has for its object the provision of a novel and improved process for the addition of molybdenum-silicon compounds to molten iron or steel. By this process the solution of the added ingredients is made more rapid than heretofore, a more homogeneous alloy results, and the slag inclusions are avoided. The invention also provides a single compound which introduces a useful ratio of molybdenum and silicon into the molten metal, such as iron or steel, and giving the added commercial advantage that foundry practice can be simplified. Furthermore, this invention provides for the addition of molybdenum-silicon compounds which react exothermically at the temperature of the molten metal, rather than absorbing heat from the metal which is disadvantageous in practice. The invention also has for its object the provision of a simple, effective and relatively inexpensive process for the addition of predetermined relative amounts of molybdenum and silicon to molten metals.

In general, the process of the present invention comprises adding a molybdenum silicide, with or without an excess of silicon, to the molten metal, and this addition may be made to the molten metal in the ladle, or elsewhere. While I prefer

to use the molybdenum silicide  $MoSi_2$ , other molybdenum silicides may be used, such as  $Mo_2Si_3$ , and the like (Honigschmid, Karbide and Silizide; Wedekind and Pintsch, German Patent No. 294,267; Felder-Clement A. G., German Patent No. 359,785; Watts, Bull. University of Wisconsin #145, pp. 294, 295 (1906)).

While various processes may be used for the preparation of the molybdenum-silicon 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, aluminium and some flexing agent, such as fluorspar. The mixture is then ignited in a suitable crucible, and after the slag has been tapped off, there remains a complex molybdenum silicide containing the desired proportion of molybdenum and silicon, together with a small amount of iron which is probably present as a ferro-molybdenum-silicon complex.

The relative amounts of these substances may be varied widely, dependent upon the desired composition of the resulting product, but as a typical example I may use the following:

	Kilograms
Molybdenum in roasted molybdenite concentrates	100
Ferrosilicon (75%)	60
Aluminium	55
Fluorspar	15

A typical analysis of the product of the reaction of such a mixture is:

	Percent
Mo	57.60
Si	30.00
Al	.21
$SiO_2$	2.54
CaO	3.60
$Al_2O_3$	6.98

If desired, an excess of silicon may be added so as to introduce a larger proportion of silicon into the final alloy, and the resulting alloying material is then probably composed of one of the molybdenum silicides and an excess of silicon fused together into a coherent mass. Similarly, an added quantity of iron may be included in the mixture, if desired.

After the mix has been ignited and the slag tapped off, the resultant mass of molybdenum silicide with or without an excess of silicon can be crushed to form smaller lumps of the alloying