UNITED STATES PATENT OFFICE.

JOHN McCONNELL, OF CHICAGO, ILLINOIS, ASSIGNOR TO INTERSTATE IRON AND STEEL COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

PROCESS OF MAKING ALLOY STEEL.

1,420,328. Specification of Letters Patent. Patented June 20, 1922.

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To all whom it may concern:

Be it known that I, JOHN McCONNELL, a citizen of the United States, residing at Chicago, in the county of Cook, State of Illinois, having invented certain new and useful Improvements in Processes of Making Alloy Steel, do hereby declare that the following is a full, clear, and exact description of the same.

The invention relates to a process for making alloy steel, and particularly where vanadium is employed as an alloying metal, and it is especially useful in the production of open hearth steels.

In carrying out the invention there is mixed with the molten basic metal, such as commercially pure steel, as it flows in a molten state from the furnace into the ladle a relatively small charge of a mixture of crushed vanadium and "shot" or comminuted aluminum.

In the production of open hearth steels the furnace is provided with a tap leading to the usual spout by which the molten steel is drawn off into the usual ladle from which it is poured into the ingot molds. While the molten steel is thus being drawn off into the ladle a small quantity of a mixture of crushed vanadium and shot aluminum is mechanically charged into the flowing metal in the spout, this preferably being done by mixing a charge of the crushed vanadium and shot aluminum in a trough and discharging the mixture directly into the open top of the spout at the furnace tap. This mixture is usually composed of about three parts of crushed vanadium to one part of shot aluminum, although these proportions may be varied, and the proportion of the mixture to be used varies according to the character of the alloy steel desired, from 0.10% to 0.25% by weight giving satisfactory results, as a small addition of vanadium greatly increases the tensile strength of the steel, its malleability, its hardness after tempering, and its fatigue resistance, while both vanadium and aluminum in small amounts deoxidize the steel. The crushed vanadium and shot aluminum may be fed into the spout separately though simultaneously, but in practice I prefer to mix them before they are supplied to the flowing metal as better results are obtained. By forming a preliminary mixture the proportions of the alloying components are more certainly ensured, and this enables them to go into the steel much more accurately, besides eliminating the loss or waste of very expensive alloy metals. The temperature of the steel in the spout is sufficiently high to instantaneously melt the added materials, the temperature of the steel in the spout being about 3000 degrees Fahrenheit while crushed vanadium melts at about 3000 degrees Fahrenheit and shot aluminum at about 1200 degrees Fahrenheit, and their liquefaction is aided and hastened by the fact that they are in relatively small pieces, the vanadium being crushed into pieces ranging in size smaller than an egg and the shot aluminum being in the usual small pieces of that commercial form of this metal; in practice, the use of crushed vanadium and of shot aluminum as distinguished from ingot or bar aluminum greatly facilitate the operation and give better results. In this form they quickly liquefy, and the quicker melting or flash of the aluminum causes the vanadium to fuse more quickly and unite more intimately with the steel than when the aluminum is omitted or is added in ingot form; it then melts at a lower temperature and acts to more quickly liquefy the vanadium and produce a more homogeneous product.

In practice the original steel employed may be merely commercially pure or soft steel, or it may contain other alloying metals, such for example as nickel, depending on whether the alloy steel is to be merely vanadium steel or vanadium-nickel steel, and it is to be understood that my invention comprehends such modifications and that the method of applying it would not be modified to obtain the desired result. Further, while I prefer to use vanadium as it deoxidizes the metal in addition to giving the alloying qualities above mentioned, I may use other alloy metals, such for example as zirconium or titanium, which also have the property of cleaning up or removing oxides as well as alloying qualities to improve the steel. In any of these variations, the alloy metal is fed into the spout containing the molten steel in the presence of an element, specifically shot aluminum, which melts or flashes at a lower temperature or more quickly than the alloy metal and so causes the latter to melt more quickly and to unite more intimately with the steel.

I claim:

1. The herein described step in the process of manufacturing open hearth alloy steel

consisting in the admixture with the molten metal as it flows from the furnace into the ladle of a charge of crushed alloying metal and shot aluminum having a lower melting point than the alloy.

2. The herein described process of manufacturing open hearth alloy steel which consists in forming a mixture of crushed vanadium and shot aluminum in about the proportions specified and mechanically charging a small proportion of the mixture into the molten steel as the steel flows from the furnace.

In testimony whereof I affix my signature in the presence of two witnesses.

JOHN McCONNELL.

Witnesses:
J. McRoberts,
George F. Eggert.