UNITED STATES PATENT OFFICE.

BYRAMJI D. SAKLATWALLA, OF CRAFTON, PENNSYLVANIA.

PROCESS OF PRODUCING ALLOY STEELS.

1,119,643. Specification of Letters Patent. Patented Dec. 1, 1914.

No Drawing. Application filed April 30, 1913. Serial No. 764,725.

To all whom it may concern:

Be it known that I, BYRAMJI D. SAKLATWALLA, of Crafton, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Processes of Producing Alloy Steels; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to the production of alloy-steels containing one or more of the following alloying elements, namely, nickel, cobalt, chromium, manganese, tungsten, vanadium, molybdenum, titanium, uranium, and the like.

One object of my present invention is to provide a method of producing alloy steels, directly from raw materials containing such alloying elements, without the necessity of reducing such raw materials to the metallic state, either in the form of ferro-alloy or pure metal before mixing such alloying elements with the steel.

Another object of my present invention is to provide a method of producing alloy steels without introducing another undesirable element, such as carbon with the alloying element, into the steel.

A further object is to provide a method whereby alloy steels could be produced with a higher degree of efficiency, reducing the usual loss of the alloying element.

The processes now in general use for producing alloy steels are based on the addition of the alloying element in a metallic state, either as ferro-alloy or pure metal, to the finished steel. This procedure, besides entailing the expenditure of manufacturing a ferro-alloy or pure metal, has the further disadvantage of carrying into the steel a quantity of the reducing agent, such as carbon or aluminum, used for the production of such ferro-alloy or metal, and which is invariably present in it. Further by this method of procedure a loss of the alloying element is experienced, first during the process of manufacturing the ferro-alloy or pure metal and then during its introduction into the finished steel, so that the amount of the element or elements entering into the steel is a very small percentage of the total amount originally present in the raw material. My present invention obviates these defects in as much as it reduces the alloying element from raw materials directly in the body of the finished steel, thus avoiding intermediate losses. Further, I use a reducing agent, namely silicon, which is always used as a deoxidizer in the manufacture of the alloy steels just before the addition of the ferro-alloy or pure metal, and, therefore, does not introduce any new factor, such as increased carbon or presence of aluminum, in the composition of the finished steel.

My improved process is carried out substantially as follows: The raw material containing the alloying elements, generally in the form of an oxid, and consisting of an ore or product of a previous metallurgical operation, after being pulverized, is mixed with ground silicon metal or ferro-silicon or other silicon bearing material and pressed into briquets. For example, in the manufacture of nickel steel, nickel oxid, obtained by roasting the matte, is mixed with approximately two-thirds its weight of 50 per cent. ferro-silicon, ground to between 60 and 80 mesh fine, and one-third its weight of steel turnings. To this mixture is added half the weight of the ferro-silicon used of a mixture consisting of equal parts of lime, fluorspar and soda-ash for the purpose of fluxing the silicic acid formed during the reduction. The whole is then mixed and formed into briquets in the ordinary press. These briquets are charged in an open-hearth furnace a little before tapping the heat of steel to which the nickel is intended to be added. In case of some oxids a binder consisting of silicate of soda should be added for the purpose of briqueting. In certain cases where the action of the slag on the briquets would be great on account of its chemical composition it has been found advantageous to press the mixture into a protective container which may consist of an ordinary steel can.

The suggestion of the use of briquets, consisting of a mixture of carbon with an oxid of the alloying element, for similar purposes is not new, but the practical carrying out of the idea has up to now been impossible, owing to the low specific gravity of such briquets, which would cause them to float on the top of the molten slag covering the steel bath thus preventing their entry into the steel. Further the introduction of carbon, contained in the briquets, into the steel, would be an objection. The replacement of carbon, in such briquets, by aluminum has the same disadvantages, namely that of low spe-

cific gravity and introduction of aluminum in the steel. The use of ferro-silicon in the briquets makes their practical use possible by increasing their specific gravity, which causes them to sink through the layer of molten slag and reach the steel bath. The specific gravity of the briquets can be further increased, to any desired degree, by mixing steel turnings with the briqueting mixture.

Briquets obtained by the above described method are introduced into a molten charge of steel, either in an open-hearth furnace, crucible, or ladle. The briquets sink through the layer of molten slag covering the metal, so that the reaction between the ferro-silicon and oxid, present in the briquet, takes place in the bath of metal, and not on the top of the molten slag, so that the alloying element reduced to the metallic state by the silicon is most advantageously absorbed by the steel.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. The method of producing alloy steel, consisting in reducing in a molten mass of steel, a raw alloying element associated with a ferro-silicon reducing agent.

2. The method of making alloy steel, consisting in reducing the steel to a molten mass, and then introducing into said mass, a body consisting of unreduced alloying material, a silicon-bearing reducing agent, and flux, said body so introduced having such specific gravity as will cause the same to sink through the layer of molten slag.

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

BYRAMJI D. SAKLATWALLA.

Witnesses:

H. P. MECKLEY,

K. K. MCMAHON.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."