

UNITED STATES PATENT OFFICE.

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MANUFACTURE OF CRUCIBLE-STEEL.

SPECIFICATION forming part of Letters Patent No. 703,543, dated July 1, 1902.

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To all whom it may concern:

Be it known that I, EBEN B. CLARKE, of No. 4629 Bayard street, in the city of Pittsburg, State of Pennsylvania, have invented certain new and useful Improvements in the Manufacture of Crucible-Steel, of which the following is a specification.

The objects of the invention are to reduce the cost of manufacture and also to improve the composition of the steel by enabling it to be made more uniformly.

The invention accomplishes a great saving in the time required for treatment of the materials in the crucible, a great increase in the life of the crucibles, an increased capacity by reason of a greater quantity of steel being made in each crucible at each charge, and the production of a more uniform composition of crucible-steel at a decreased cost.

One of the usual processes of making crucible-steel is to introduce into the crucible pieces of bar-iron or bar-steel and scrap-iron or scrap-steel of the same or various degrees of carbonization with carbon either combined with some metal, as iron, or in a non-metallic shape, such as charcoal, together with such other modifying substances as may be desired. The crucible filled with these materials in a cold state is then covered with the usual cover and placed in the crucible-furnace, where it remains for several hours until the contents are melted and time is given for the completion of the reactions which take place in the formation of crucible-steel, the time depending on the size and character of the crucible, the fusibility of the material contained, and other well-known conditions. Another method is to use blister-bar or other iron or steel of high carbon and introduce this with quantities of iron, steel, or scrap of carbonization requisite to finally give the desired degree of carbonization within the crucible at the end of the process. I believe it has been proposed to make a so-called "crucible-steel" by subjecting the raw materials to a preliminary treatment in a Martin furnace or converter, whereby its carbon is reduced to the necessary quantity and it is freed from manganese, sulfur, and phosphorous or other impurities. This process is es-

entially different from a true crucible process, because it contemplates metallurgical treatment prior to the introduction of the steel into the crucible.

The improvement which forms the subject-matter of the present invention consists in introducing the usual ingredients of crucible-steel into the crucible while they or most of them are in a heated state. Preferably the raw material in the form of iron or steel bars and scrap of various degrees of carbonization is first melted in quantities sufficient to charge a number of crucibles and is then introduced into crucibles, preferably already heated, into which the necessary amount of carbon, with or without other modifying substances—such as manganese, &c.—is also introduced, if such addition of carbon or other modifying substances are necessary to perfect the composition of the finished crucible-steel. The cover is then placed on the crucible, and the crucible is subjected to continuous heating in the crucible-furnace for such a time as is necessary to complete the formation of the crucible-steel. In this way a much more uniform composition of material can be obtained with much less care than where the materials are charged in a cold state into each separate crucible. The addition of carbon or carbonizing substance or other modifying substances if introduced into the crucible form at most but a small part of the crucible-steel and may therefore be introduced in a cold state as more convenient. If desired, the heating or fusing of the raw material can take place on a much larger scale by a continuous process analogous to the Talbot process of manufacturing open-hearth steel.

By this improved process the time and heat required to raise the raw materials to the melting temperature and to supply the latent heat required to melt them are entirely saved so far as the crucible-furnace is concerned. The life of the crucible is thereby prolonged. Furthermore, no waste of heat occurs in the preliminary heating of the crucible, because as soon as one lot of finished steel has been poured out from a crucible that same crucible in its highly-heated state is ready to receive the new charge. The time necessary to heat

the crucible is therefore saved and the utility or life of the crucible thereby further augmented.

There is obviously a great saving in labor and increased capacity of the plant.

I am aware that it has been proposed to make crucible-steel from pig-iron and other materials by first making either Bessemer or open-hearth steel and immediately upon the steel reaching the supposedly proper conditions tapping it off into crucibles for its final treatment. Such processes are dependent upon the estimation of the right moment at which to tap off, because the metal is undergoing a continuing metallurgical treatment or reaction and its proportions are changing as long as it remains in the converter or in the open hearth. My process furnishes a means of producing crucible-steel of uniform and predetermined composition in a more economical manner than heretofore, and yet with all the exactness of proportions necessary to high-grade crucible-steel. The materials are brought together in known and accurately-determined proportions, and instead of undergoing changes in proportion during the melting process they may and always should be carefully protected as far as possible from any oxidation or change by covering, as is well understood in the art, with a neutral or inactive slag. Therefore my process is practically independent of the precise moment chosen for pouring the molten metal into the crucible, and it is also independent of the uncertainty and lack of uniformity characterizing successive heats of open-hearth steel even when made in the same hearth and by the same maker.

I claim as my improvement and desire to secure by Letters Patent the following:

1. The improved process of making crucible-steel, which consists in first introducing the materials for making crucible-steel in the

required predetermined proportions into a receptacle and melting them, in contradistinction to treating the materials with oxidizing or metallurgical agents, whereby change in the proportions may be avoided, and then introducing the melted mass into a previously-heated crucible with carbon or other modifying substance and covering the crucible, and subjecting it to further heating for a limited time, substantially for the purposes described.

2. The improved process of making crucible-steel, which consists in first introducing the raw materials of steel or iron, or the like, in the cold state and in predetermined proportions into a suitable heating-receptacle and melting them without Bessemer or open-hearth reactions, and then immediately without other metallurgical treatment and before the formation of the finished crucible-steel takes place, introducing the melted mass into a crucible and closing the same, and subjecting the crucible and its contents to a continued heating while the crucible-steel is being produced therein, substantially for the purposes described.

3. The improvement in crucible-steel processes which consists in melting together the greater portions, at least, of the crucible-steel ingredients in predetermined proportions and without causing substantial change of proportions by chemical or metallurgical treatment, and thereafter introducing said ingredients into a crucible, covering them to protect them from oxidation, and thereafter subjecting them to heat during a limited time, substantially for the purposes described.

Signed this 25th day of March, 1901, at Pittsburgh, Pennsylvania.

EBEN B. CLARKE.

Witnesses:

T. DAVID McCLOSKEY,
BERTHA TROTH.