

UNITED STATES PATENT OFFICE.

EPHRAIM SMITH, OF BOSTON, MASSACHUSETTS.

CASTING CRUCIBLE-STEEL INGOTS.

SPECIFICATION forming part of Letters Patent No. 517,197, dated March 27, 1894.

Application filed May 2, 1893. Serial No. 472,776. (No specimens.)

To all whom it may concern:

Be it known that I, EPHRAIM SMITH, of Boston, county of Suffolk, State of Massachusetts, have invented an Improvement in Casting Crucible-Steel Ingots, of which the following description is a specification.

In the production of articles from crucible steel it is now usual to cast small ingots directly from the crucibles, the slag being carefully removed from the top of the molten metal in the crucible just prior to pouring the metal into the mold. Necessarily, small ingots are thus obtained, the crucibles holding from eighty-five to ninety pounds of metal, and in order to ascertain the composition of the various ingots forming the daily output of even a comparatively small plant, a large number of tests must be made, one for each individual ingot. This is expensive and time consuming, and greatly hampers the use of crucible steel for many purposes to which it is especially adapted. To overcome this and to produce larger ingots, the experiment has been tried of pouring the contents of several crucibles into one ingot, with the result that practically no two tests of the ingot so made would approach agreement, the metal of the different crucibles, each with its own percentage of carbon, appearing to form separate layers or masses, giving a heterogeneous mass of steel which, on account of lack of uniformity throughout the ingot often caused serious loss to subsequent users of such steel. Furthermore, the removal of the slag from the metal in the crucibles so exposed it to the air that it deteriorated considerably.

In my efforts to cast crucible steel into large ingots, homogeneous in character and having the proper per cent. of carbon, I have discovered that if the contents of a number of crucibles be transferred bodily to a common receptacle, without removing any portion of the slag from said individual crucibles, the different charges will be commingled in the common receptacle, and the slag will rise rapidly through the molten mass and will form a covering over the top of it, completely and effectually preventing access of air to and consequent decarburization of the molten metal underneath, the covering maintaining

the metal fluid for a considerable time. The metal is then run directly into the ingot or other mold from beneath the cover so formed. When the mold is full, slag is placed upon its top, and all piping from cooling and consequent contraction is obviated.

My invention accordingly resides in the method of casting crucible steel ingots, which consists in transferring the molten steel and its slag from each of a series of crucibles direct to a common receptacle, permitting the slag to rise through and form thereby a protecting cover over the molten steel therein, to prevent decarburization thereof, and thereafter drawing off said molten steel from below the cover into a mold, substantially as will be described.

Other features of my invention will be hereinafter described and particularly pointed out in the claims.

In carrying out my invention, the charges of a sufficient number of crucibles to fill one or more large ingot molds are melted in usual manner, and any convenient arrangement of crucible furnaces may be adopted, the same forming no part of my invention. When the various charges are ready to be cast, the entire contents of each crucible, slag and metal, are poured into a common open receptacle, and I have found that a ladle of sufficient size, and of well known construction, provided with a nozzle in the bottom thereof and normally closed by a plug or stopper, may be used with great success, said ladle being supported by usual trunnions, that it may be turned thereon, for a purpose to be described. As the contents of the various crucibles are poured into the ladle the metal from each one is stirred up and mixed, as it were, with that from the others, and as the ladle is charged the slag rises through and forms a protecting layer upon the top of the molten metal. The covering so formed is impervious to air, and thus prevents decarburization of the metal underneath, at the same time retaining its heat so that it loses very little of its fluidity. This cover forms so rapidly and completely that the air has but little opportunity to act upon the metal. By means of the nozzle and its operating means the metal is then drawn off from be-

low the covering directly into the mold beneath the ladle.

The ladle may be movable with relation to the mold, or vice-versa, whichever be most convenient.

In casting large ingots, they chill from the sides of the mold, and as the metal cools and shrinks toward the sides the ingot will frequently "pipe," so that a considerable portion of deeply fissured steel must be cut from the upper end of the ingot as commercially worthless. With the hereinbefore described method of casting, this "piping" is greatly lessened, and I have found that if the slag forming the covering be dumped out immediately upon the top of the ingot after the casting, a very slight "pipe" will be formed. The hot slag seems to so protect the casting at its upper end that the metal remains sufficiently fluid to settle gradually down in the mold during cooling, so that it will not shrink apart in the center.

When the ladle is provided with trunnions or other means for turning it over, the slag is very conveniently emptied onto the top of the mold, or the nozzle may be formed in a plug of considerably larger diameter, detachably secured in the bottom of the ladle, so that when the slag comes down the plug can be removed bodily and the slag emptied through the opening so left, practically no time elapsing between the casting of the steel and the placing of the slag thereupon.

Ingots or castings produced as herein described are homogeneous in texture and other physical as well as chemical characteristics, free from holes or "pipes," and much supe-

rior in every way to the ingots cast in the ordinary manner.

I have herein used the term ingot in a generic sense as other forms may be cast by the same methods, with the described results.

I claim—

1. The herein described method of casting crucible steel ingots, which consists in transferring the molten steel and its slag from each of a series of crucibles direct to a common open receptacle, permitting the slag to rise through and form thereby a protecting covering over the molten steel therein, to prevent decarburization thereof, and thereafter drawing off said molten steel from below the covering directly into a mold, substantially as described.

2. The herein described method of casting crucible steel ingots, which consists in transferring the molten steel and its slag from each of a series of crucibles to a common open receptacle, permitting the slag to rise through and form thereby a protecting covering over the molten steel therein, to prevent decarburization thereof, drawing off said molten steel from below the covering into a mold, and immediately thereafter drawing off the hot slag, and covering the top of the ingot therewith, substantially as described.

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

EPHRAIM SMITH.

Witnesses:

FREDERICK L. EMERY,
JOHN C. EDWARDS.