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METHOD FOR CASTING INGOTS

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The present invention has reference generally to improvements in metal casting and more particularly relates to a method of pouring steel so as to provide ingots having efficient welding qualities throughout for rolling and mechanical working.

Heretofore in casting ingots it has been the purpose when pouring for instance into a series of molds to continuously use covers especially during back pouring, the covers being of either insulated or refractory material for the purpose of retaining the heat at the top of the metal in the mold, the covers being retained during the several stages of back pouring and even after the final pouring for the purpose of obliterating piping, one of such methods being described in my previous Patent 1,761,494 granted June 3, 1929.

The present invention has for its primary aim and object the provision of a novel method of pouring steel in which although use is made of a cover of either refractory or insulating material, the cover is removed at the final pouring, either actually before or immediately after thereby exposing the top of the metal in the mold and causing this part of the metal to freeze immediately, such action sealing the ingot and preventing any chance of air or other foreign elements reaching the shrinkage cavity or the walls thereof for the purpose of preventing oxidation in the cavity or vicinity thereof thereby ensuring the production of an ingot having efficient welding qualities throughout for rolling and like operations.

Other objects as well as the nature, characteristics and scope of the invention will be more readily apparent from the following description pointed out in the claims.

The invention is clearly illustrated in the accompanying drawings, in which:

Fig. 1 is a vertical sectional view showing the ingot some time after the pouring but before the back pouring showing approximately the depth of the cavity, and Fig. 2 is a similar view showing the ingot after back pouring.

In carrying out my invention it has been found expedient to pour molten metal into a series of molds preferably to a height close to the top of the mold, then applying a cover either of insulating or refractory material or of any other desired material the purpose being to retain the heat in the metal near the top of the mold, then after pouring the metal into the whole series or to any desired number of molds, back pouring is effected preferably in sufficient quantity to completely seal the ingot in the mold, in the meantime the cover being removed so that the metal at the top of the mold is exposed thereby causing the top part of the metal to freeze immediately.

This quick freezing of the material takes place because of the small volume of the metal added and prevents action of air or other foreign elements on the shrinkage cavity and walls thereof and prevents the shrinkage cavity and metal in the vicinity thereof from becoming oxidized thereby ensuring of an ingot having efficient welding qualities throughout for rolling and like operations.

Broadly this invention involves the novel step of removing the cover practically simultaneously with the final back pouring action.

Specifically when a cover is employed made of insulating material, of a porous and organic nature, it is necessary especially when the metal in the first pouring is several inches short of the top of the mold to blow the residue in the form of enbers etc. off before back pouring. If however the metal from the first pouring is near the top of the mold back pouring may be effected before removing such embers which rise to the top of the mold and are scraped off from the top of the mold immediately after the back pouring has been effected.

In another example when using a cover of refractory material such as disclosed in my prior Patent 1,761,494 it is desirable to first remove the cover before the final back pouring. It is important to note that the invention does not reside in the type of cover used nor whether the cover is removed immediately before or immediately after the final back pouring but that the cover is removed practically simultaneously with the final back pouring, the purpose being to expose the top part of the metal in the mold so that it will freeze immediately. In contradistinction to the previous pouring methods the final back pouring of metal seals off the top part of the ingots preventing air or other foreign elements from reaching the shrinkage cavity and walls thereof to prevent oxidation in the cavity and vicinity thereof thus ensuring of the production of an ingot having efficient welding qualities throughout for rolling and like operations. This action is the result of allowing the metal in the top of the mold to immediately freeze on removal of a refractory cover and simultaneous back pouring in contradistinction to the previous practice of maintaining an insulating cover on the top part of the metal when in the mold or maintaining a hot top of the side wall type on a mold.
The covering of the metal in the mold after the first pouring maintains the center of the metal in a liquid condition while the final substantially simultaneous removal of the covering and the back pouring of an additional quantity of metal into the molds while the center of the metal of the first poured metal is in a liquid state at the top respectively effects freezing of the surface of the additionally poured metal and a dilution of the first poured metal whereby to seal the ingots and prevent air causing oxidation in the cavity or vicinity thereof.

It is to be understood that when effecting the final back pouring the metal thereof forces air and other foreign substances from the cavity in the ingot and immediately hermetically seals the top of the cavity resulting in a solid ingot or an ingot having a vacuum cavity which will yield in rolling.

This action is illustrated in the figures in which Fig. 1 shows an ingot 1 some time after the initial pouring but prior to the back pouring and shows the upper central portion 2, in a liquid condition. Before this portion 2 becomes solidified, additional metal is poured into the mold to substantially cover the entire exposed surface of the ingot as shown at 3 and 4. Fig. 2 illustrates the condition of the ingot shortly after this additional metal has been added to and mixed with the liquid portion 2 of Fig. 1. On removal of the cover previously described this metal freezes over on top at the portion 4 this sealing the top of the ingot. As further cooling progresses, a shrinkage cavity 5 forms under the frozen surface which, being hermetically sealed against the outside air, remains oxidized, the cavity 5 being surrounded by oxidized solidified portions 6. The cavity 5 is thus a substantial vacuum. On subsequent rolling or working, the oxidized surfaces 6 of the cavity readily weld together to form solid metal in the portions of the ingot which would have remained defective and imperfectly welded without the protection and sealing effect of the frozen surface. The heavy lines designated 7 in Fig. 2 represent the initial shrinkage cavity.

It is believed in view of the foregoing that a further detailed description of the operation of the invention is unnecessary. Likewise it is believed that the advantages thereof will be readily apparent.

Having thus fully described the invention what is claimed as new and desired to be secured by Letters Patent is:

1. A process for casting ingots comprising pouring molten metal into molds until the metal has reached a predetermined height therein, immediately covering the metal as soon as it has been poured into each mold, then after completing the first pouring into a group of the molds back pouring into the molds to hermetically seal the ingots, and immediately removing the covering to ensure a quick freezing of the top of the ingot.

2. A process for casting ingots comprising pouring molten metal into molds until the metal has reached a predetermined height therein, immediately covering the metal as soon as it has been poured into each mold with an organic cover to maintain the center of the metal in a liquid condition, then pouring an additional quantity of metal into the molds after the first pouring has been completed in a group of molds to dilute the first metal and to force air and other foreign substances from the cavity in the ingot to immediately hermetically seal the top of the cavity, and immediately after each last mentioned pouring removing the residue constituting the organic cover from the top of the ingots to insure of the quick freezing of the surface of the last poured metal.

3. A method for casting ingots comprising pouring molten metal into a series of molds until the metal has reached a predetermined height therein, immediately covering the metal as soon as it has been poured into each mold to maintain the center of the metal in a liquid condition, and finally substantially simultaneously removing the cover and pouring an additional quantity of metal into the molds while the center of the metal first poured is in liquid state at the top, to respectively freeze the surface of the additional metal and dilute the first poured metal whereby to seal the ingot and prevent any chance of air causing oxidation in the cavity or vicinity thereof and ensure of the production of an ingot having efficient welding properties for rolling purposes.

4. A process for casting ingots comprising pouring molten metal into molds until the metal has reached a predetermined height therein, immediately covering the metal as soon as it has been poured into each mold, and then after completing the first pouring into a group of molds removing the covering and back pouring into the molds to quickly freeze the surface of the additional metal to insure a quick freezing at the top of the ingots, and to hermetically seal the ingots.

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