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ROLL AND METHOD OF MAKING THE SAME

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This invention relates to metal rolls and methods of making the same.

Chilled rolls made from cast iron alloys are now largely used in place of forged steel rolls in the rolling of certain products such as sheet and strip material.

The chill of course is extremely hard but the alloys generally used in casting these rolls are in and of themselves extremely hard and difficult to machine.

Most of the alloys used in casting chill rolls such as are here contemplated have a relatively high content of alloying elements chosen for the purpose of adding hardness and toughness to the rolls as well as for controlling the body chill.

Among the many alloys used for making such rolls are those disclosed in the following United States Patents: No. 1,948,243, 1,948,245, 1,948,246 issued on February 20, 1934.

In the alloys of these patents, the total carbon may run as high as from 3.25% to 3.35% and in some special instances as in the alloy of Patent No. 1,948,245 if more chill and somewhat greater hardness is required the total carbon may run as high as 3.85%. The alloys of each of these patents have a relatively high nickel content; in some instances up to 5% and, in addition to the carbon and nickel, the alloys of each of these patents have other modifying constituents which increase their hardness and toughness.

With the present methods of casting rolls in which the roll necks and body are cast as a unit, the roll necks are necessarily formed from the same material as the body, and when alloys such as those referred to are utilized, the work necessary to properly machine the roll necks greatly increases the cost of the rolls over what the cost would be if the necks were made from softer readily machinable material.

An object of this invention is to provide a method of casting metal rolls in which the roll body and the roll necks are cast as a unit but in which the body may be formed from an alloy of one analysis and the necks from an alloy of another analysis which is more readily machinable.

Another object is to provide a method of casting metal rolls in which the roll body and the roll necks are cast as a unit, and in which the body may be provided with a chill and formed from a relatively hard iron alloy and the necks of a relatively soft readily machinable iron alloy.

A further object is to provide a method of casting metal rolls in which the roll body and the roll necks are cast as a unit, but in which the body has a relatively high content of alloying elements, while the necks have a relatively low content of alloying elements.

A further object is to produce a cast iron roll in which the body of the roll is of one analysis while the necks are of another analysis.

Another object is to produce a unitary cast roll structure in which the body has a relatively high content of alloying elements while the necks have a much lower content of alloying elements.

A still further object is to produce a cast iron roll having a chilled body formed from an alloy which in and of itself is relatively hard and necks which are relatively soft and readily machinable.

These, as well as other objects which will be apparent to those skilled in the art to which this invention relates, I attain by means of the method and roll described in the specification.

In the drawing accompanying and forming part of this application, I have illustrated a roll embodying this invention and a more or less diagrammatic illustration of a mold set up by means of which my novel method may be carried out.

Figure 1 of the drawing is the more or less diagrammatic illustration referred to; and

Fig. 2 is a view of the roll referred to.

The mold which I utilize in carrying out my method comprises a body cavity and neck cavities axially aligned therewith and which join the ends of the body cavity.

The roll casting comprising the roll body portion and the neck portions is bottom poured and in order to accomplish this, the mold consisting of the drag, the chill mold and the cope is placed in a vertical position; the chill mold being supported on the drag and in turn supporting the cope.

The neck portions of the casting are formed within the drag and cope respectively; that within the drag I term the lower neck portion and that within the cope, the upper neck portion. The body portion is formed within the chill mold. Both the drag and cope are lined with sand as is customary so that the neck portions of the casting will be free from chill.

In the mold setup, one runner which I term the main runner is arranged to conduct molten metal to the neck mold cavity within the drag while another runner, which I term the supplemental or secondary runner is arranged to conduct molten metal to the lower part of the neck mold cavity within the cope. An overflow outlet for molten metal positioned adjacent the lower part of the neck mold cavity within the cope is arranged not only to limit the upward travel of metal introduced through the main runner but

to serve as means for running off the dross and other impurities which float to the top of the molten metal within the body cavity of the mold, in other words to the top of the chill mold.

The cope is extended a sufficient distance above the neck mold cavity therein to provide the casting with an adequate sink head to insure a sound upper neck portion.

Before the casting procedure is started, it is necessary to have a sufficient supply of the molten alloy desired in the body portion of the roll casting as well as a sufficient supply of molten substantially pure iron or some readily machinable iron alloy for use in forming the neck portions of the roll casting.

Gates at the outlet ends of the runners are so positioned with relation to the neck mold cavities with which they connect that the molten metal conducted by the runners enters said cavities tangentially thereby setting up a swirling action within the molten metal as it rises within the mold.

Molten body alloy, that is, alloy from which the body is to be formed is first introduced through the main runner and pouring of this metal continues until metal starts to run out through the overflow. As soon as this happens, molten pure iron or a readily machinable iron alloy is introduced through the same runner and this second pouring is continued until not only all the dross and other impurities are carried off through the overflow but until clean metal makes its appearance in the overflow outlet.

By ascertaining the amount of molten metal necessary to fill the main runner and the lower neck cavity, I am enabled to arrive at the amount of molten pure iron or other neck alloy necessary to displace the body alloy within the runner and the lower neck cavity and as soon as pouring of the body alloy has ceased, I immediately pour pure iron or other neck alloy and this pouring continues until the body alloy within the runner and the lower neck cavity is replaced by this metal. This displacement of the body alloy within the lower neck cavity by molten neck metal of course causes a displacement of molten body alloy within the chill mold. This displacement occurs through the central portion of the body cavity since setting or freezing of the metal adjacent the chill mold walls begins to take place as soon as the molten metal contacts with said walls.

When sufficient metal has passed of through the overflow outlet to insure that the lower neck cavity contains sufficient neck metal, the joint between the cope and the offtake runner is broken and the overflow outlet or gate is plugged. As soon as this is done, the upper neck cavity and riser is filled with molten neck metal through the supplemental runner. The molten metal is also introduced into the upper neck cavity upon a tangent. It will be apparent that the molten neck metal introduced into both of the neck cavities will pick up some of the body metal and for this reason, will show some content of alloying elements. I find, however, that if care is taken the amount is not enough to impair the machinability of the neck portions of the casting. This is especially so if the molten neck metal is substantially free from any elements which impair its machinability.

I find that there is a perfect union between the neck metal and the body metal and that the casting as a whole is as perfect as though bottom poured from one alloy.

In the setup more or less diagrammatically disclosed in Figure 1 of the drawing the mold is made up of drag **5** with its sand lining **6**, the chill mold **7** and cope **8** with its sand lining **9**.

The lower neck cavity is numbered **10**, the body cavity **11**, the upper neck cavity **12** and the riser **13**.

The primary runner **14** joins the drag in such a manner that molten metal flows from the runner into the lower neck cavity tangentially through gate **15**. Runner **14** which is the main runner is provided with a basin **16**, as is the usual practice, and also with a rammed sand lining **17**, as is usual.

The supplemental or secondary runner **18** connects with the upper neck cavity **12** in such a manner that molten metal from it enters through gate **19** adjacent the bottom of the upper neck cavity and in a tangential manner. The secondary runner is also provided with a basin **20** and of course with a rammed sand lining **21**.

The off-take orifice **22** connects with the upper neck cavity adjacent the top of body cavity **11** and a down-take runner **23** conducts the dross and excess metal to a suitable pot or ladle **24**. A finished roll embodying this invention is illustrated in Fig. 2 of the drawing and comprises the body **25** formed of relatively hard alloy as above set forth and with a chilled outer portion. The roll necks **26** are formed of relatively soft iron or alloy such as is readily machinable. The outer ends of the necks terminate in wobblers **27**.

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

1. In a method of making a metal roll having a relatively hard body and relatively soft machinable necks, the steps which consist in bottom pouring the roll body through an underlying neck mold cavity (utilizing molten metal containing in addition to iron, a relatively high content of alloying elements) in then displacing upwardly a substantial part of the molten metal in said neck mold cavity by molten metal having a smaller content of alloying elements and in running off the dross and excess metal above the body mold cavity and in then bottom pouring the other roll neck with molten metal of substantially the same analysis as that utilized to displace molten metal from the neck mold cavity below the body mold cavity.

2. In a method of casting a unitary roll structure having a hard alloy body and softer machinable necks, the steps which consist in bottom pouring with molten hard alloy one neck portion and the body portion superposed with relation thereto, in then bottom pouring with molten relatively soft iron said neck portion thereby displacing upwardly into the body cavity of the mold previously poured hard metal alloy within said neck cavity and in running off at a point adjacent the upper end of said body cavity the dross and excess hard alloy and in then bottom pouring with relatively soft iron the other roll neck portion within the upper neck cavity located above the body cavity.

3. In a method of casting a unitary roll structure having a chilled hard alloy body and softer machinable necks, the steps which consist in bottom pouring with molten hard alloy one neck portion and the body portion in superposed position with relation to said neck portion, in again bottom pouring but with molten relatively soft iron said neck portion thereby displacing upwardly into the body cavity defined by a chill

mold previously poured hard metal alloy within the neck cavity below the chill mold and in running off at a point adjacent the upper end of said chill mold the dross and excess hard alloy and then, by means of a second riser, in bottom pouring with relatively soft iron the other roll neck portion.

4. In a method of casting a unitary roll structure comprising a body of one analysis and necks of a different analysis, the steps which consist in bottom pouring with molten roll body material one neck portion and the body portion positioned above the neck portion, in again bottom pouring the same neck portion with molten metal of a different analysis thereby displacing body metal within the mold cavity for said neck and part of the molten body metal within the body cavity of the mold, in running off through an overflow outlet located at a point adjacent the upper end of the body cavity of the mold such displaced metal, in plugging the overflow outlet and then in bottom pouring with molten metal of a different analysis than that of the body portion of the roll the upper neck portion of the roll within the mold cavity above and connecting with the body cavity of the mold.

5. In a method of casting a unitary roll structure having a relatively hard iron alloy body and relatively soft machinable iron alloy necks, the steps which consist in bottom pouring with molten hard iron alloy the roll body portion through an underlying neck portion cavity, in displacing upwardly a substantial part of such molten metal from said neck portion cavity by molten relatively soft iron and in running off the dross at a point adjacent the top of the body portion cavity and in then bottom pouring the other roll neck portion with molten relatively soft iron; the molten metal being introduced tangentially into both neck portion cavities whereby body alloy is picked by and blended with the relatively soft iron.

6. A method of casting a unitary roll structure having a hard alloy body portion and softer machinable neck portions in a vertically positioned mold having upper and lower neck portion cavities and an intermediate body portion cavity, which consists in bottom pouring with molten hard alloy the lower neck portion and the body portion, in then displacing upwardly into the body portion cavity previously poured hard metal alloy from the lower neck portion cavity and in running off the dross at a point adjacent the upper end of the body portion cavity and in then bottom pouring with relatively soft iron the other neck portion; the molten metal being introduced tangentially into both neck portion cavities.

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