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ROLL FOR FABRICATING HOT METAL

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This invention relates to rolls for fabricating hot metal, and to alloys for making the same.

The rolls for hot rolling steel and other metal ingots, bars, billets, sheets, and the like are subjected to very high temperatures. Metals such as steel are hot rolled at a temperature which is commonly known as a white heat, and this rapidly heats up the rolls. In order to prevent the rolls from heating to such an extent that they do not have the required strength, they are cooled by bringing cold water in contact with their outer surfaces immediately after contact of the metal being rolled with the rolls. The rolls are thus subjected to thermal shocks due to the alternate heating to high temperature and the rapid cooling thereof. Thermal shock often results in checking or cracking the surfaces of the rolls after a relatively short period of use. The blemishes thus produced in the rolls mar the hot metal which is being rolled, and accordingly it is necessary from time to time to change the rolls in order to provide the proper smooth surface for rolling the hot metal.

I have found that the addition of cobalt in relatively small amounts, say, from .25 to 1.75%, to ferrous alloys, such as cast iron or steel, produces an alloy adapted for forming rolls to be used in fabricating hot metal. The alloy containing cobalt within these percentages has a high resistance to thermal shock, by which is meant a high resistance to checking and cracking when subjected to alternate high temperatures and quick cooling.

This invention relates to the use of cobalt for the purpose of preventing injurious results of thermal shock. Hitherto cobalt has been used extensively in ferrous alloys, with other metals, chiefly for one or other of two purposes,—first, to obtain certain magnetic properties of the alloy, and second, to produce hard cutting tools that may be used at very high temperatures without softening. Its effects in both of these alloys are well known, and are attained by the use of materially larger percentages of cobalt than I have found necessary or desirable to prevent thermal shock.

It is generally recognized that cobalt and nickel have many properties in common and that they are equivalent for many purposes when used as alloying additions to steel and other alloys. I have found, however, that whereas cobalt, when added to steel or cast iron, produces a marked decrease in checking or cracking as a result of the alloy being subjected to thermal shock, nickel does not have this desirable property. On the contrary, nickel may in some instances cause an increase in the tendency of the alloy surface to check or crack when subjected to thermal shock. It is, however, in many instances, desirable to use nickel to impart specific properties which cobalt does not give; and in case nickel is so used, the amount of cobalt required to prevent thermal shock may be increased.

In all iron and steel rolls used in rolling metals, carbon is a necessary element. However, the effect of cobalt in preventing thermal shock is the same in ferrous alloys, whether much or little carbon is present. Usually rolls containing less than about 1.75% of carbon are classed as steel and those containing more than this percent up to 4% or more of carbon are classed as cast iron. In cast iron a part of the carbon is in the form of graphite, and not of iron carbide. The invention, however, relates to the effect of the cobalt on the iron alloy, however it be named, and not to the effect of the carbon, and therefore, broadly speaking, is independent of the proportion of carbon.

Manganese is ordinarily present to some extent in both cast iron and steel, being added for specific purposes known to the metallurgist. Its presence in the proportions usually employed has no pronounced influence upon the effect of cobalt in resisting thermal shock. Addition of manganese in quantities between .5 and 1.25% to cast iron or steel used in a roll increases the soundness possible to secure in casting.

Silicon is ordinarily present in both iron and steel. In cast iron rolls it is present in larger proportion, from .80 up to 2%. Its effect is to lower the melting point and to induce a larger percentage of the carbon to crystallize as graphite. In steel rolls the percentage ranges from .15 to .60%, being kept as low as commercially practicable. The presence of silicon within the ranges specified has little or no effect upon the effectiveness of cobalt in resisting thermal shock.

Molybdenum and chromium are frequently, though not necessarily, present in cast iron and steel. Where steel castings are made by melting scrap (with the addition of other metal as desired), one or both of these metals will be present. They are used to regulate the depth of chill or the form and dispersion of carbides. In cast iron rolls molybdenum may be present from .10 to 3%, and in cast steel from .10 to 4%. Chromium may be used in cast iron rolls from .25 to 2% and about the same range in steel. The effect of the presence of either molybdenum or chromium in the percentages stated, upon the effect of cobalt in resisting thermal shock is too little to be of importance in roll manufacture.

This invention consists in adding cobalt, in quantities between .25 and 1.75%, preferably between .40 and 1.25%, to the alloys used in making cast iron or steel rolls, for the purpose of imparting the property of resistance to thermal shock.

The following is the actual analysis of a suc-

cessful steel roll embodying the invention, and used for elongating tubes in a tube mill:

	Percent
Carbon	.44
Silicon	.48
Cobalt	1.51
Manganese	1
Molybdenum	1.40
Chromium	1.25
Impurities	.03
Balance iron	93.89

The same combination, without the cobalt, was tried and was not successful. This particular roll contains comparatively high percentages of molybdenum and chromium, because its peculiar form and service require it to be made unusually strong. For rolling sheets and ordinary shapes the following represents a preferred range and specific example for steel rolls:

	Range	Example
	Percent	*Percent*
Total carbon	.6 to 1.0	.8
Silicon	.15 to .5	.3
Cobalt	.75 to 1.25	1
Manganse	.7 to 1.0	.8
Impurities		1
Balance iron		96.1

A wider range for each ingredient may be tolerated.

As examples of preferred analyses of cast iron rolls possessing all of the desired properties, the following are given:

	Range	Example
	Percent	*Percent*
Total carbon	2.75 to 3.25	3
Silicon	.80 to 1.25	1
Cobalt	.40 to .60	.5
Manganese	.70 to 1	.8
Impurities		1
Balance iron		93.7

A wider range of each ingredient may be tolerated.

My ferrous alloy containing cobalt within the ranges that have been specified is useful in the production of articles in general which are subjected to thermal shock by alternate heating to high temperature followed by quick cooling. The alloy is particularly adapted for the formation of rolls used in fabricating hot metal where it is necessary to cool the rolls such as by the application of cold water thereto during or immediately after the rolling step.

I have given specific illustrations of my present preferred composition, but it is to be understood that the invention is not so limited, but may be otherwise embodied within the scope of the following claims.

I claim:

1. A cast roll adapted for fabricating hot metal and having high resistance to thermal shock, said roll being composed of a ferrous alloy containing up to about 4% carbon, about .25 to 1.75% cobalt, and about .25 to 2% chromium, the balance being substantially all iron with the exception of impurities within the ranges usually found in cast iron and steel.

2. A roll adapted for fabricating hot metal and having high resistance to thermal shock, said roll being composed of a ferrous alloy containing up to about 4% carbon, about .40 to 1.25% cobalt, about .7 to 1.0% manganese, about .15 to 1.25% silicon, about .25 to 2% chromium, the balance being substantially all iron.

3. A roll adapted for fabricating hot metal and having high resistance to thermal shock, said roll being composed of a ferrous alloy containing up to about 4% carbon, about .40 to 1.25% cobalt, about .7 to 1.0% manganese, about .15 to 1.25% silicon, and about .25 to 2% chromium, the balance being substantially all iron with the exception of impurities within the ranges usually found in cast iron and steel.

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