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STEEL ROLL

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4 Claims. (Cl. 80—58)

The invention pertains to an improvement in steel rolls for use particularly in a hot mill and in the process of forming various types of metallic plates or shapes.

The subject matter of this application is related to the subject matter of my co-pending application, filed under even date and bearing Serial No. 422,010.

One of the objects of the invention is to provide a roll of alloy steel having great strength and shock resisting qualities capable of withstanding the heavy loads and stresses to which it is subjected in service.

Another object of the invention is to provide a roll formed of alloy steel for use in a hot mill and being particularly suitable for such use in that its construction is such as to avoid having fire checks or cracks formed on its outer metal engaging surface.

A further object of the invention is the provision of a steel roll having a surface hardness and hardness of the metal adjacent the center of the roll differ only in a minute degree so that, by reason of this substantially constant hardness throughout the entire mass of the roll, the latter may, due to wear which takes place in service, be machined to present a roll of slightly less diameter than its original configuration but, at the same time, sacrifice none of its original characteristics.

Heretofore rolls for use in a hot mill have been made of cast steel or steel alloys in attempts to provide a dense, ductile, hard and tough roll of sufficient strength and toughness to withstand the shocks and blows to which the same are subjected and, at the same time, to limit the magnitude of the fire checks or cracks formed in the roll surface by reason of the particular use to which it is placed. These attempts have generally not proved successful because if the roll surface is formed extremely hard, it has also generally been brittle and it is found where the surface of the roll is softer and more ductile to prevent fire checks, the wearing quality of the roll has suffered.

I have found that by combining said hereinafter named elements into a charge, a steel roll may be formed which not only presents a hard surface to impart wear resistant qualities in the roll, but that the entire roll is substantially of the same hardness throughout. The distinct advantage thus gained is that during service the roll, as will be understood, will wear due to the great amount of stresses to which it is subjected and, after a continued use, to for instance the stage at which ordinarily a cast roll would be rendered useless, the roll of the present invention may be further machined or dressed to extend materially the life of the roll. Further, it has been found that in cast rolls where the roll surface is hard, it is consequently brittle and develops fire cracks or checks therein. These fire cracks or checks produce in the formation or fabrication of metal, marks, embossments, or raised portions corresponding to the fire cracks which persist throughout all the rolling and working stages of the metal acted upon by the rolls. The fire checks, as will be understood during the process of rolling hot metal, are accentuated or magnified due to the portion of the roll contacting the hot metal being extremely heated and then advanced away from the hot metal to be subjected to a cooling medium or agent which consequently sets up great internal stresses in the roll structure and increases the size of the fire checks.

The roll of the present invention is capable of rapid change of heat without rupturing the surface by the formation of fire cracks or checks and, while it will be understood that the absolute elimination of fire cracks is not thought possible, the checks formed in the surface of the roll embodying the present invention are of such minute dimensions as to be microscopic and, therefore, of no consequence since, in practice, it has been found that they leave no counterpart impression upon the metal being worked, and do not grow or enlarge as a result of the wide range of temperature to which the roll is subjected in service.

I find in practice that these undesired effects in the roll can be substantially eliminated and the production of a tough, durable and exceptionally strong roll may be produced by first employing an amount of carbon considerably less than that required to form cast iron and introducing a sufficient amount of copper with a related proportion of molybdenum. A hardening agent in the form of manganese is also present with a slight percentage of sulphur and phosphorus to reduce the brittleness of the finished product.

It is to be noted that copper does not oxidize and, upon using in the charge, scrap rolls made previously from the herein contained combination of elements and which have, due to the usage and continued machining, been rendered unfit for further service, a slight amount of copper need be added to the charge to bring it within the hereinafter set forth proportion of this element.

In carrying out the invention, I preferably employ the hereinafter set forth proportions or ranges of the above-mentioned elements,

	Per cent
Carbon	.30 to .60
Manganese	.60 to 1.25
Silicon	.30 to .60
Sulphur and phosphorus, a maximum of	.06
Copper	.50 to 2.00
Molybdenum	.20 to .60

It has been found in practice that the most desired results are obtained in the rolls by the following method of treatment or processing of a roll after it has been formed to enhance greatly the physical properties of the steel roll. Being processed by the following method, the roll formed by the above-mentioned elements has Shore hardness of from 35 to 40 as well as having a high elastic ratio and great strength while, at the same time, easily machined. The preferred method of treating the roll is first to normalize the metal thereof by subjecting the roll to a heat treatment of between 1600° to 1700° F., and then allowing it to cool. The roll is again reheated with the best results attained by maintaining the second reheating temperature at 1,000° F., and allowing the roll to remain subjected to this constant temperature for approximately one hour for each one inch diameter of the roll so as to permit the heat to penetrate or reach the entire mass.

Other changes in the percentages than the one hereinabove set forth may, of course, be made without departing from within the spirit of the invention and the scope of the appended claims.

I claim:

1. A steel roll for hot metal rolling mills, said roll comprising approximately .60% carbon, 1.25% manganese, .60% silicon, .06% sulphur and phosphorus, 2.00% copper, and .60% molybdenum.

2. A steel roll for hot metal rolling mills, said roll comprising not more than .60% carbon, .06% sulphur and phosphorus together with approximately .60% to 1.25% manganese, .30% to .60% silicon, approximately 2.00% copper and .20% to .60% molybdenum.

3. A steel roll for hot metal rolling mills comprising an alloy containing .30% to .60% carbon, .60% to 1.25% manganese, .30% to .60% silicon, .06% maximum of sulphur and phosphorus, approximately 2.00% copper, and .20% to .60% molybdenum.

4. A steel roll adapted to hot metal rolling mill, said roll comprising an alloy containing a maximum of .60% carbon, .06% of equal portions of sulphur and phosphorus, about .60% to 1.25% manganese, about .30% to .60% silicon, about approximately 2.00% copper, and about .20% to .60% molybdenum.

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