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METHOD OF ROLLING ALLOYS

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2 Claims. (Cl. 80-60)

The invention is a method of hot working alloys of the cobalt-chromium-tungsten type.

Cobalt-chromium-tungsten alloys are disclosed in Patent 1,057,423 issued April 1, 1913, to Elwood Haynes, and several modifications of the original alloys are known. The use of these alloys for wear-resistant articles has been extensive, the extent being limited chiefly by difficulties in fabricating large articles. The alloys can be machined only with considerable difficulty and forged only to a very limited extent. It has heretofore been believed that this material could not be hot-rolled into large sheets and plates, and it has been necessary to shape the metal by casting, welding, and grinding.

I have now found that by adjusting the composition, choosing the correct working temperature, and limiting the amount of draft or rate of reduction, all within relatively narrow limits, it is possible to hot-work cobalt-chromium-tungsten alloys into relatively large sheets, plates, and the like. Such hot-worked products are not only better adapted for further fabrication into certain articles than cast metal, but the properties of the new wrought material are unique and valuable.

The preferred composition comprises approximately 30% chromium, 5% tungsten, 1% carbon, and the remainder cobalt. The composition may be varied within the approximate limits of 15% to 35% chromium, 2% to 6% metal of the group consisting of tungsten and molybdenum, from very small but appreciable amounts to 1.25% carbon, the remainder chiefly cobalt with which there may be associated small amounts of materials such as iron, nickel, manganese, and silicon. If any one of the ingredients chromium, tungsten, or carbon is near the upper limit of its respective range as given above, it is preferred that the other two of these ingredients be well below the upper limits of their specified ranges.

The best rolling temperature for the preferred composition is about 2000° F. to 2050° F. If the composition is varied within the described limits, the best rolling temperature will likewise vary; but it will be within the limits of about 1900° F. and about 2150° F. If the rolling temperature is too low the billet cracks along its edges; if the temperature is too high the metal is mushy and tends to check or pull apart.

Herein and in the appended claims, the term "temperature" wherever used means the apparent temperature as determined by measurement with an optical pyrometer of the disappearing

filament type on an object in the open, no correction being made for black body radiation.

It is usually necessary to heat the billet to a temperature somewhat above the rolling temperature to compensate for the heat lost between the furnace and the rolls, but this superheat should be kept to a minimum.

The amount of reduction which can safely be made in each pass through the rolls is usually not more than about 0.015 inch for each of the first few passes, until the billet has been reduced by about 0.125 inch, and not more than about 0.03 inch for each subsequent pass, although sometimes a reduction of as much as 0.03 inch per pass may be made even in the initial passes. The billet ordinarily must be reheated to rolling temperature after each pass, although it is sometimes possible to secure a further reduction by repassing the billet once through the rolls without reheating and without changing the clearance between the rolls.

In the practice of the method of the invention I have successfully rolled billets measuring 3 inches by 8 inches by ½ inch, and 18 inches by 18 inches by 1.25 inches down to relatively thin plates and sheets. For example, the last mentioned billets have been rolled down to ¼ inch plates having excellent surfaces and valuable mechanical properties.

The rolled material of the invention is characterized by high strength and great resistance to corrosion, erosion, and abrasion. Comparative tests of rolled material within the invention and of cast material having substantially the same chemical composition indicated an average tensile strength of about 132,400 pounds per square inch for the former material as compared with about 95,590 pounds per square inch for the latter material. A break test which comprised securely clamping a ½ inch square bar, leaving a 1 inch overhang, applying a load at the end of the overhang, and increasing the load until the bar broke, indicated an average transverse strength of 4866 pounds for the rolled material as compared with 3050 pounds for the cast material.

I claim:

1. Method of forming stainless and wear resistant metal sheets and plates which comprises hot rolling at a temperature between 1900° F. and 2150° F. a billet of an alloy having substantially the composition: 15% to 35% chromium, 2% to 6% metal of the group tungsten and molybdenum, carbon in amounts up to about 1.25%, and the remainder principally cobalt; the billet being reheated to rolling temperature after each

reduction in thickness of not over 0.015 inch until a total reduction of about 0.125 inch has been effected, and the billet thereafter being reheated to rolling temperature after each reduction in thickness of not over 0.03 inch.

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2. Method of forming stainless and wear resistant metal sheets and plates which comprises hot rolling at a temperature of approximately 2000° F. to 2050° F. a billet of an alloy having approximately the composition: 30% chromium,

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5% tungsten, 1% carbon, the remainder substantially cobalt; the billet being reheated to rolling temperature after each reduction in thickness of not over about 0.015 inch until a total reduction of about 0.125 inch has been effected, and the billet thereafter being reheated to rolling temperature after each reduction in thickness of not over about 0.03 inch.

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