United States Patent Office

3,372,026
Patented Mar. 5, 1968

3,372,026

HOT ROLLING NICKEL SILVER ALLOY

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No Drawing. Filed Sept. 8, 1965, Ser. No. 485,954
4 Claims. (Cl. 75—157.5)

ABSTRACT OF THE DISCLOSURE

A nickel silver alloy possessing improved hot working properties consisting essentially of 7–30% Ni, 5–43% Zn, 0.003–0.3% Ti and the balance Cu present in the range of 45–75%.

This invention relates to a nickel silver alloy which has improved hot working properties, and more particularly, it relates to the addition of fractional amounts of titanium to a nickel silver alloy to form a nickel silver alloy that can be hot rolled.

It is widely accepted that the most economical way to reduce metal is by hot rolling because no strain-hardening results and greater reductions in thickness can be obtained. In the case of nickel silvers, they generally have poor hot working properties and cannot be reduced by hot rolling without severe cracking of the rolled metal. Nickel silvers have essentially two phases, a single-phase alpha nickel silver and a two-phase alpha-beta nickel silver. The alpha-beta nickel silver can be hot-worked but not with the results ordinarily achieved with brasses; the alpha nickel silvers have never been successfully hot-worked without the cracking problem mentioned above, and therefore they are used in applications requiring ductility in the cold condition as they have good cold working properties. Notwithstanding its cold working properties, the reduction of alpha nickels by cold rolling is an expensive process because they work-harden rapidly and require frequent anneals, and they are prone to fire cracking during annealing which causes considerable metal loss.

A similar problem with the single-phase alpha brasses was solved by keeping the lead impurity below 0.015%. In nickel silvers, however, the presence of zinc causes it to behave like the alpha brasses, rather than like cupronickel and controlling the lead content has not solved the problem of cracking.

I have found that the addition of fractional amounts of titanium to nickel silvers greatly improves the hot working properties of the nickel silver to the extent that a nickel silver alloy can be hot rolled without the appearance of cracks and it is possible to reduce the rolling temperature to that at which brass is rolled, with an added appreciable saving in heat requirements. Furthermore, although the structural refinement which occurs has not fully been determined, the properties of this new alloy are improved, particularly with respect to stress-corrosion cracking as indicated by the mercuric nitrate test; thus, the tendency to fire-crack during the one or two anneals required at the finishing stages is eliminated.

The nickel silver alloy of the invention is comprised of 45 to 75 percent by weight Cu, 7 to 30 percent by

weight Ni, 5 to 43 percent by weight Zn and 0.003 to 0.3 percent Ti. With alpha nickel silvers which are comprised of 45 to 75 percent by weight Cu, 7 to 25 percent by weight Ni, 5 to 32 percent by weight Zn, it is preferred to include from about 0.003 to 0.1 percent by weight Ti.

It is to be noted that although the alpha-beta nickel silvers can be hot-worked somewhat without the addition of titanium, whereas hot working was heretofore impossible with the alpha nickel silvers, the titanium addition to the alpha-beta nickel silvers is also beneficial. By "alpha nickel silvers" is meant a copper-nickel-zinc alloy containing 45 to 75 percent by weight Cu, 7 to not more than about 25 percent by weight Ni, and 5 to not more than about 32 percent by weight Zn, which, under conditions of structural equilibrium comprise a single solid solution, isomorphous with copper; above about 32 percent Zn, the "alpha-beta nickel silver" phase appears.

In one example four heats of nominal 18 percent alpha nickel silver (72 percent by weight Cu, 18 percent by weight Ni, 9.74 percent by weight Zn, 0.25 percent by weight Mn and 0.01 percent by weight Mg) were semi-continuously cast into 3" x 17" x 46" cakes. To the last two heats a small titanium addition was made prior to pouring, specifically 0.036 percent by weight Ti and 0.020 percent by weight respectively. All four cakes were given a four hour soak at 900° C. Hot rolling temperatures as measured by a Land Radiation Pyrometer were 870° C. and 880° C. The cakes without the titanium addition cracked in hot rolling after two hot rolling passes of approximately 0.500" reduction per pass and were scrapped. The two cakes with the titanium addition were hot rolled to 0.450" gauge without any cracking. Subsequent milling and cold rolling confirmed the high quality of the nickel silver strip.

In another example, production semi-continuous castings 6¼" x 26" x 72" of alpha nickel silvers were cast using titanium additions. Typical analyses in percent by weight are set out in the table below:

	Heat A	Heat B	Heat C	Heat D
Cu	71.02	71.29	71.15	71.47
Zn	10.30	10.28	10.42	10.32
Fe	0.08	0.08	0.18	0.05
Ni	17.97	17.97	17.85	17.96
Mn	0.61	0.37	0.37	0.19
Pb	<0.02	<0.02	<0.02	<0.02
Ti	0.02	0.01	0.03	0.01

The cakes were soaked at 900° C. for four hours prior to hot rolling. Hot rolling temperatures ranged from 860° C. to 900° C. All cakes were hot rolled to 0.500" gauge in 15 passes without evidence of cracking or other hot rolling defects.

Advantages have been realized by titanium addition to all commercial important nickel silvers and it has been determined that generally these advantages are achieved by addition of titanium within a range of 0.003 to 0.3 percent by weight, and with alpha nickel silvers a narrower range of .003 to 0.1 percent by weight Ti is preferred.

I claim:

1. A nickel silver alloy with improved hot working properties consisting essentially of 7–30% Ni, 5–43%

Zn, 0.003–0.3% Ti and the balance essentially Cu, said Cu being present in the range of 45–75%.

2. A nickel silver alloy with improved hot working properties consisting essentially of 7–30% Ni, 5–43% Zn, .003–0.1% Ti and the balance essentially Cu, said Cu being present in the range of 45–75%.

3. An alpha nickel silver alloy with improved hot working properties consisting essentially of 7–25% Ni, 5–32% Zn, 0.003–0.3% Ti and the balance essentially Cu, said Cu being present in the range of 45–75%.

4. An alpha nickel silver alloy with improved hot working properties consisting essentially of 7–25% Ni, 5–32% Zn, 0.003–0.1% Ti and the balance essentially Cu, said Cu being present in the range of 45–75%.

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