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HARDENED NONFERROUS ALLOYS

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Our invention relates to an improved class of alloys, namely, alloys of copper-manganese-nickel-silver, said alloys having properties which render them highly suitable in environments where toughness and resistance to corrosion are required.

In our copending application, Serial No. 300,798, filed October 23, 1939, we have disclosed that certain alloys of manganese-copper-nickel may be hardened by a quenching and aging procedure. The hardening process which we disclosed for these alloys comprises, in one embodiment, heating them to a temperature of approximately 900 degrees C. quenching, preferably in water, and, with or without intermediate cold working, reheating to a temperature of approximately 425–450 degrees C. for several hours.

Our present invention is directed to the addition of small amounts of silver to copper-manganese-nickel alloys, falling within the percentage ranges hereinafter set forth, and including those disclosed in our aforementioned copending application, the addition of the silver to said alloys resulting in a considerable improvement in their physical properties, particularly with respect to their toughness. The alloys of our present invention, even where they have substantially the same degree of hardness as those of copper-manganese-nickel alone, nevertheless, are substantially tougher. In addition, they have materially increased corrosion resistance, especially with respect to salt water.

The alloys to which our present invention relates contain at least 10% each of manganese and nickel and, preferably, more than 12.5% each of manganese and nickel, the balance being copper and silver, the silver constituting from about 0.1% to not more than 2%, and the ratio of manganese to nickel being not less than 0.5 nor more than 2. The copper constitutes at least 18% and preferably from 30 to 60% of the alloy. Preferably, the alloys contain at least 20% each of manganese and nickel, from about 0.5% to about 1.5% silver, the balance copper, and the ratio of manganese to nickel being not greater than 1.5 to 1.0 nor less than 1.0 to 1.5. Especially satisfactory alloys are those of the character mentioned hereinabove where the ratio of manganese to nickel is of the order of unity.

The following table discloses representative examples of alloys falling within the scope of our present invention and their hardness on the Rockwell C scale, as cast, in the quenched, cold worked, and reheated condition:

Mn	Ni	Cu	Ag	Cast	Quenched	Cold worked	Reheated 18 hrs. 426°
20	20	60	1	−30	−29	13	41
35	35	30	1	−4	−15	18	52
30	30	40	1	−11	−17	17	52
25	25	50	0.5	−23	−24	18	50
25	25	50	1	−23	−24	17	50

In general, the amount of silver which is employed is not particularly critical although it should, in general, not exceed approximately 2%. As we have indicated hereinabove, as little as about 0.1% of silver produces advantageous results and 0.5% silver is sufficient, in most cases, to increase definitely the toughness and corrosion resistance of the alloys. These properties are further increased where the percentage of silver is around 1% and, therefore, this represents the preferred amount of silver for the practice of our invention.

We prefer to use highly pure copper, manganese, nickel and silver in the preparation of the alloys of our present invention. Commercial copper, nickel and silver, as regularly offered on the market, are exceedingly pure metals. The manganese which we employ is preferably of the electrolytic type, having a purity of at least 99.9%. While we do not exclude the use of grades of manganese or others of the metals which do not have this degree of purity, so far as the broader aspects of our invention are concerned, we do, nevertheless, as pointed out hereinabove, consider the use of metals of the purity indicated as representing a decidedly advantageous practice of our present invention.

It will be understood that various changes may be made in the light of our teachings without in any way departing from the spirit of the invention as pointed out in the claims.

This application is a continuation-in-part of our copending application Serial No. 300,798, filed October 23, 1939.

What we claim as new and desire to protect by Letters Patent of the United States is:

1. Alloys of copper-manganese-nickel-silver containing at least 10% of each of manganese and nickel, the ratio of manganese to nickel being not less than 0.5 nor more than 2, from 0.1 to 2.0% silver, and the balance copper, the copper constituting at least 18% of the alloy.

2. A hardened, corrosion resistant alloy of copper-manganese-nickel-silver containing at least

10% of each of manganese and nickel, the ratio of manganese to nickel being not less than 0.5 nor more than 2, from 0.1 to 2.0% silver, and the balance copper, the copper constituting at least 18% of the alloy, the hardening resulting from a treatment including quenching at a temperature not substantially less than 900 degrees C. and aging at a temperature not substantially in excess of 450 degrees C.

3. Alloys of copper-manganese-nickel-silver containing at least 20% of each of manganese and nickel, the ratio of manganese to nickel being not less than 1 to 1.5 nor more than 1.5 to 1, from about 0.5 to about 1.5% silver, and the balance copper, the copper constituting at least 18% of the alloy.

4. A hardened, corrosion resistant alloy of copper-manganese-nickel-silver containing at least 20% of each of manganese and nickel, the ratio of manganese to nickel being not less than 1 to 1.5 nor more than 1.5 to 1, from about 0.5 to about 1.5% silver, and the balance copper, the copper constituting at least 18% of the alloy, the hardening resulting from a treatment including quenching at a temperature not substantially less than 900 degrees C. and aging at a temperature not substantially in excess of 450 degrees C.

5. Alloys of copper-manganese-nickel-silver containing at least 20% of each of manganese and nickel, the ratio of manganese to nickel being approximately unity, from 0.1 to about 1.5% silver, and the balance copper, the copper constituting at least 18% of the alloy.

6. A hardened, corrosion resistant alloy of copper-manganese-nickel-silver containing at least 20% of each of manganese and nickel, the ratio of manganese to nickel being approximately unity, from 0.1 to about 1.5% silver, and the balance copper, the copper constituting at least 18% of the alloy, the hardening resulting from a treatment including quenching at a temperature not substantially less than 900 degrees C. and aging at a temperature not substantially in excess of 450 degrees C.

7. Alloys of copper-manganese-nickel-silver containing not substantially less than 10% of each of manganese and nickel, the ratio of manganese to nickel being approximately unity, from 0.1 to about 1.5% silver, and the balance copper, the copper constituting from about 30% to about 60% of the alloy.

8. A hardened, corrosion resistant alloy of copper-manganese-nickel-silver containing not substantially less than 10% of each of nickel and highly purified electrolytic manganese, the ratio of manganese to nickel being approximately unity, from 0.1 to about 1.5% silver, and the balance copper, the copper constituting from about 30% to about 60% of the alloy, the hardening resulting from a treatment including quenching at a temperature of about 900 degrees C. and aging at a temperature of about 425 degrees C.

9. Alloys of copper-manganese-nickel-silver consisting of about 60 parts of copper, about 20 parts each of manganese and nickel, and from 0.1 to about 2 parts of silver.

10. A hardened, corrosion resistant alloy of copper-manganese-nickel-silver consisting of about 60 parts of copper, about 20 parts each of manganese and nickel, and from 0.1 to about 2 parts of silver, the hardening resulting from a treatment including quenching at a temperature not substantially less than 900 degrees C. and aging at a temperature not substantially in excess of 450 degrees C.

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