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MANGANESE ALLOYS

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This invention relates to alloys of manganese, copper and zinc. It relates, in particular, to heat treatable alloys of manganese, copper and zinc. I have found that as long as the copper content is at least about 60% or more, the alloys of manganese, copper and zinc are substantially unaffected by heat treatment. These latter alloys may be hardened by cold work to give tensile strengths of more than 100,000 lbs. per sq. in., and they are relatively corrosion resistant and suitable for many uses in the art where brasses and nickel silvers are now used. When the manganese content is greater than 20%, they are of a silver color. The electrical resistance of these alloys varies from that of pure copper to about 110×10^{-6} ohms/cm^3. Their temperature coefficient of electrical resistance is approximately 10×10^{-4} ohms/ohm/deg. C.

I have also found that when the alloys contain not substantially more and preferably less than 60% and more than about 5% copper, and the ratio of zinc to copper is not more and is preferably less than about 2 to 3, alloys are obtained which are susceptible to improvements of mechanical properties by heat treatment. A suitable heat treatment comprises quenching from about 700 degrees C. and reheating to 400 degrees C. for several hours. It is to this class of alloys that the claims of the present application are specifically directed.

The following examples will illustrate the practice of my invention in this respect:

(1) An alloy of 30% manganese, 20% zinc, balance copper is heated to 700 degrees C., quenched and cold worked. The alloy is ductile and has excellent working properties. The Rockwell hardness after moderate cold working is Rc-4. After heating for three hours at 400 degrees C., the hardness is increased to Rc-10.

(2) Another example of my invention consists of an alloy containing 50% manganese, 10% zinc and the balance copper. This alloy, when treated as in the above example, has a hardness of Rc-5 in the cold worked condition and, after the hardening treatment, a hardness of Rc-11.

The electrical resistance of the quenched and cold worked alloys passes through a maximum at approximately 65% manganese. At this maximum, the resistance is approximately 200×10^{-6} ohm/cm^3. With more or less manganese the resistance falls off.

The resistance of the aged alloys is considerably less for the alloys containing less than about 75% manganese. The resistance of alloys containing more than about 75% manganese is somewhat increased by the heat treatment described above. I have found that by the use of higher aging temperatures, such as 600 degrees C. to 700 degrees C., the resistance of these alloys is greatly increased.

I have found that the alloys of my invention containing at least and preferably more than 40% manganese have high vibration damping capacity. This vibration damping capacity is greatly improved by heat treatment, suitably from 700 degrees C. and reheating to temperatures between about 300 degrees C. and about 500 degrees C. Alloys containing a ratio of zinc to copper slightly greater than 2 to 3 may be obtained in the ductile state by quenching, and may be hardened by the above described heat treatments. There is a tendency, however, for these hardened alloys to become brittle. When the ratio of zinc to copper becomes greater than 9 to 11, the alloys are not readily workable even in the quenched condition.

In the preparation of the alloys of my invention, I prefer particularly to use pure manganese, that is, manganese having a purity of at least 99.5%, and particularly electrolytic manganese of 99.9% purity. In general, it appears that the impurities usually present in commercial aluminothermic or silico-thermic manganese tend to affect adversely some of the mechanical and other properties of the alloys in the quenched state, and also appear to have some effect on their hardening properties. It should be understood, therefore, that the use of a highly pure manganese represents an important preferred aspect of my invention, although I do not exclude from the scope thereof other suitable sources of manganese.

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

1. A heat treatable alloy of manganese, zinc and copper, said alloy being ductile in the quenched state, containing from about 5% to about 60% copper, from about 3% to about 40% zinc, the ratio of the zinc to the copper being not more than 2 to 3, the balance being substantially all manganese, the manganese being present in proportions of at least 30%.

2. A hardened alloy of manganese, zinc and copper, containing from about 5% to about 60% copper, from about 3% to about 40% zinc, the ratio of the zinc to copper being not more than 2 to 3, the balance being substantially all manganese, the manganese being present in proportions of at least 30%.

3. An alloy containing from 10% to 20% zinc, from 40% to 50% copper, and the balance being substantially all electrolytic manganese.

4. An alloy of manganese, zinc and copper, containing from about 5% to about 60% copper, from about 3% to about 40% zinc, the ratio of the zinc to the copper being not more than 2 to 3, the manganese having a purity of at least 99.5% and being present in the alloy in proportions of at least 30%.

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