Patented May 28, 1940 2,202,012

UNITED STATES PATENT OFFICE

2,202,012

MANGANESE ALLOY

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No Drawing. Application May 5, 1937, Serial No. 140,817. Renewed October 20, 1939

6 Claims. (Cl. 75—134)

My invention relates to an improved alloy of manganese having for many purposes the most advantageous properties of some white metal alloys heretofore produced, and in addition properties or combination of properties not possessed by any alloys heretofore produced with which I am familiar.

Manganese has long been known as a metal of a generally white color when recovered in a substantially pure condition, and because of its white color, it has been suggested as a substitute for other types of white metal in the preparation of certain types of alloys. As a constituent of non-ferrous alloys, however, manganese has heretofore been of little or no commercial or practical value because invariably it was found to impart undesirable properties to the alloy when used in appreciable proportions. The most objectionable property imparted to the alloy by the use of manganese was brittleness, but still other undesirable results were obtained.

The principal object of my invention is to utilize manganese in an improved type of alloy.

Another object is the production of an alloy having a new and unusual combination of properties.

I have found that commercially pure manganese as produced heretofore contained significant proportions of impurities, principally iron, carbon, aluminum and silicon, with at times traces of other elements such as, for example, sulphur. While I found none of these substances in commercially pure manganese in numerically large proportions, I found that the sum of the various impurities ran as high as 3 to 5% of the total manganese product. I moreover discovered that if manganese be prepared in a chemically pure condition, so that the total amount of iron, carbon, aluminum and silicon is less than 1% but preferably less than .3%, the alloy produced with such manganese has entirely different properties than alloys produced with the commercially pure manganese heretofore employed. I have found that for the best results the sum of the iron, carbon, silicon and aluminum should comprise less than .3% of the manganese metal and that not one of these impurities should be present in an amount greater than .1% of the manganese metal as a whole.

I have found that not only can manganese, in a pure condition, be substituted for all or a large proportion of the nickel in some types of alloys without loss of corrosion resistance, strength or silver color, but that, in addition, the working qualities of the new alloy are greatly modified, so that for most purposes the properties are greatly improved in a product in which the manganese is substituted for nickel. Indeed, the product of my invention has many of the advantages of alloys of nickel heretofore produced, but it has still additional advantages and combinations of properties which make my new alloy adaptable for use in ways for which no alloy heretofore produced was suited. The difference between the alloys of my invention and those produced with commercial manganese as known and utilized heretofore is so marked as to indicate that an entirely different kind of alloy is produced.

An example of an improved alloy made in accordance with my invention and having many unusual and desirable properties is as follows:

	Per cent
Nickel (commercial)	20
Manganese (highly purified)	50
Copper (commercial)	30

This alloy has many properties which are found in some types of nickel alloys, and still other properties not found in nickel alloys. It has an average hardness of 56 on the Rockwell B scale in a hot worked or annealed condition. The alloy can be cold rolled and, when cold rolled, the hardness of the same sample is increased to above 100 on the Rockwell B scale. In addition, this alloy possesses unusual plastic properties at low red heat, being very easily pressed into shape at that temperature. It can accordingly be hot pressed into any suitable or desired form very economically and simply. The resulting product is ductile and strong and, from a large number of tests which I have made, seems to suffer no injury whatever to its mechanical properties by reason of its having been deformed while in the plastic range. Because of the unusual working properties of this alloy, coupled with its hardness, tensile strength, corrosion resistance and appearance, it is a very suitable alloy for making small parts of the type heretofore made to a great extent by die casting. Large numbers of parts, such as door handles and other parts having a decorative and/or useful function in the automobile industries, may be produced simply and economically.

For the further guidance of those skilled in the art, I shall refer more in detail now to the source of manganese employed in my improved alloys. From a relatively large number of analyses of commercial samples of manganese, I give below two which may be in general considered representative:

Commercial sample No. 1

	Per cent
Manganese	96.74
Silicon	0.76
Carbon	0.03
Sulphur	0.09
Aluminum	0.88

Commercial sample No. 2

	Per cent
Manganese	94.71
Silicon	1.56
Carbon	0.18
Aluminum	trace

It will be noted that the sample No. 1 contained somewhat over 1.5% total impurities present as silicon, carbon and aluminum, and that sample No. 2 contained close to 2% of these three metals. Obviously, the analysis of the two samples is not given in detail for the reason that impurities other than those shown in these two particular samples do not appear to be significant. The impurities shown, but principally the silicon, carbon and aluminum (with iron which was not found in these particular samples) have very marked detrimental effect on alloys in which manganese is employed in relatively large proportions. If either of the two samples of commercial manganese be employed in the specific alloy example described hereinabove, the resulting product will be found to have very poor working properties in that it will be substantially impossible to cold work it to any extent whatsoever and when formed to shape by any method it will be extremely brittle. When, however, either of the samples of manganese is purified by distillation in vacuum so that the purified product contains less than .3% of the sum of the three elements as impurities, then all of the desirable properties resulting from the use of manganese in significant proportions are again obtainable.

Manganese, suitable for carrying out my invention, may be produced in several ways. The distillation of commercial manganese in vacuum in general is too costly a process for commercial adaptation. A satisfactory grade of manganese can be produced by electrolysis of pure manganese sulphate solutions. Since the development of my invention, some methods for carrying out these operations have been published in the literature and so I deem it unnecessary to describe in detail the manner of producing a suitable pure grade of manganese for use in my invention.

I have given hereinabove a specific example of a nickel manganese copper alloy having extremely valuable properties, particularly resistance to corrosion, pleasing color, adequate hardness, a relatively great tensile strength, and of remarkable significance, extremely valuable working properties. It should not be assumed that substantially the identical results cannot be obtained by modifying somewhat the proportions of the alloy constituents. I have found that a very satisfactory range is nickel 15 to 25%, manganese 45 to 50% and copper 25 to 35%. As in the specific examples given, the nickel and copper may be the usual commercial grades, but the manganese is a highly purified product such as described hereinabove wherein the total proportion of iron, carbon, silicon and aluminum should be not more than .3% of the manganese metal, and none of these impurities is present in proportions greater than .1%. Within these proportions substantially the identical properties found in the specific examples given are obtainable, with very little modification with the range shown.

I find also that I am able to produce a very satisfactory alloy for my purposes by utilizing only manganese and copper. Moreover, the proportions of copper may be modified considerably and for the most part alloys are obtained which, in general, have working properties much superior to any alloys similar in general characteristics with which I am familiar. I have found that the following range of proportions is a fair guide for the metallurgist in the selection of alloy constituents in order to produce, in general, easily worked alloys of fair to excellent tensile strength, hardness, color, resistance to corrosion and the like:

	Per cent
Nickel	0 to 70
Manganese	30 to 70
Copper	10 to 40

While I prefer to operate generally within the range given in the more limited range of the second example given, I consider my invention to extend to the somewhat broader range wherein the proportion of nickel may be cut substantially to the point where a binary system results.

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

1. An alloy of nickel, manganese and copper, said alloy being ductile when cold, containing from 10% to 40% copper, from 5% to 30% nickel, and substantially all of the remainder being a highly purified manganese, said manganese containing not more than 0.1% by weight of any of the elements iron, carbon, silicon, and aluminum.

2. An alloy of nickel, manganese and copper, said alloy being ductile when cold, containing from 25% to 35% copper, from 15% to 25% nickel, and the balance comprising from 45% to 55% of a highly purified manganese, said manganese containing not more than 0.1% by weight of any of the elements iron, carbon, silicon, and aluminum.

3. An alloy in accordance with claim 2, wherein the total proportion of iron, carbon, silicon and aluminum present in the manganese does not exceed 0.3%.

4. An alloy of nickel, manganese and copper, said alloy being ductile when cold, containing approximately 30% copper, 20% nickel, and 50% of a highly purified manganese, said manganese containing less than 1.0% by weight of the total of the elements iron, carbon, silicon, and aluminum.

5. An alloy of nickel, manganese and copper, said alloy being ductile when cold and containing 30% to 70% manganese, said manganese containing less than 1.0% of a total of iron, carbon, silicon and aluminum, the balance of the alloy being nickel and copper, the nickel being present in amounts of 5% to 30% and the copper being present in amounts of 10% to 40% based on the weight of the entire alloy.

6. An alloy of nickel, manganese and copper, said alloy being ductile when cold and containing 45% to 70% electrolytic manganese, said electrolytic manganese containing less than 0.3% of a total of iron, carbon, silicon, and aluminum, the balance of the alloy being nickel and copper, the nickel being present in amounts of 5% to 30% and the copper being present in amounts of 10% to 40%, based on the weight of the entire alloy.

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