

UNITED STATES PATENT OFFICE.

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ALLOY.

No Drawing.

Application filed December 22, 1924. Serial No. 757,401.

To all whom it may concern:

Be it known that I, SAMUEL W. PARR, a citizen of the United States, residing at Urbana, in the county of Champaign, State of Illinois, have invented certain new and useful Improvements in Alloys; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The present invention relates to alloys consisting for the most part of nickel, copper and aluminum wherein the aluminum is present to the extent of about 2% to 8% by weight of the total. Such alloys are resistant to corrosion, and it is the object of the present invention to so modify the proportions of the major constituents, and to so provide for additional minor constituents, and to so modify the process of compounding, that there will be produced a non-corrosive alloy of improved crystalline texture, of greater workability, and with greater freedom from the blow holes and faults than have been common with alloys of this general type. All proportions hereinafter given are by weight.

I have found, as the result of extended experimentation, that to produce an easily workable alloy consisting for the most part of nickel, copper and aluminum, the aluminum should be present to the extent of 2% to 8% of the total. Using 2% to 4% gives greatest ductility and softness, and 6% aluminum is about the upper limit for workability by usual methods of rolling and of wire drawing.

Also I have found that best results are to be had when the ratio of nickel to copper in the alloy is about that of 64 to 31. Stating this idea with more exactitude, the nickel present should amount to 1.85 to 2.20 times the amount of copper present. I have discovered the further principle that as the percentage of aluminum in the alloy goes up to the upper limit of 8, the ratio of nickel to copper should be as 1.85 is to 1, and when the percentage of aluminum present goes down to 2 the ratio of nickel to copper should be as 2.20 is to 1.

I have found that for the production of an alloy of the best crystalline texture, and with freedom from such segregation of the crystals as will yield a spongy center, metals other than nickel, copper and aluminum

must be used in compounding the alloy. According to my practice manganese to the extent of $\frac{1}{10}$ % to 1% is added to the molten nickel copper and aluminum with highly beneficial effects. $\frac{1}{10}$ th of 1% will help somewhat, but the best percentage is between $\frac{1}{2}$ % and 1%.

I am not prepared to state just what rôle the manganese plays when thus added to the molten alloy just previous to pouring, but without its use I have found that an alloy of nickel, copper and aluminum, as above described, will, on cooling crystallize out in such a way as to have a spongy center. On rolling and wire drawing this spongy center develops into a distinct fault preventing entirely the production of uniform sheets or wires. In this respect the addition of manganese to the extent of 1% or less is essential. I am aware of the established practice of using manganese as a deoxidizer or scavenger, and in my practice advantage is taken of that principle. I believe, however, that under the special circumstances above described it has another and more important rôle, though what that rôle is I cannot now state with certainty. The beneficial effects seem to have been imparted to the alloy even though the manganese may have been consumed in large part in freeing the fused mass of oxygen, nitrogen and similar elements.

Also I have discovered that to secure the best results another element must be added to the fusion, namely, tantalum. Tantalum can be used between the limits of $\frac{1}{10}$ th of a percent to 8%, but so far as my results show there is no need to use more than 1%. The tantalum undoubtedly reacts with the oxygen and nitrogen constituents in the fusion and acts as a scavenger, perhaps being entirely consumed by that action. Except for the use of tantalum the alloy of nickel, copper and aluminum, even when manganese has been used as above described, will not have the high malleability and workability desired by me and attainable when tantalum is used, though it will have high resistance to corrosion and good strength and a hardness easily regulated by the extent to which aluminum has been used. In this sense, and to this extent, scavenging with tantalum is essential.

Scavenging with tantalum may be followed with scavenging with magnesium or zinc to the extent of $\frac{1}{10}$ th of a percent to

1%, but that use of magnesium or zinc is not vital to success. When magnesium is used, there appears to be none of it left in the finished alloy. The best percentages

known to me for producing a corrosion resistant alloy consisting mainly of nickel, copper and aluminum, of good crystalline texture, and of easy workability, and with freedom from spongy centers, blow holes and faults is as follows:

Nickel 64 parts, copper 31 parts, aluminum 2 to 6 parts, depending on whether a soft or hard metal is desired, manganese 1 part or less, tantalum in the neighborhood of 1 part or less, together with fractional percentages of impurities common to the foregoing elements.

The method of compounding consists in forming a fusion of the nickel, copper and aluminum, then adding the manganese, and just before pouring, scavenging with the tantalum, and if desired, with an additional fractional percentage of magnesium or zinc.

The alloy casts well, and in addition to having good strength, high resistance to corrosion, and a hardness easily controllable between wide limits, through control of the quantity of aluminum present, has the additional and highly desirable characteristics not heretofore found in alloys of this type, that when cast, there is no troublesome segregation of crystals and no formation of a spongy center, and the texture is of excellent grain, uniform throughout the casting, and free from blow holes or faults. The net result is a metal that can easily be rolled into sheets or rods or drawn into wire without blemishes or imperfections. The product so made fulfills a substantial need in the industrial arts.

I claim:

1. An alloy comprising nickel, copper and aluminum, substantially as described, to which has been added manganese not less than $\frac{1}{10}$ percent nor more than 1% and tantalum in an effective amount not exceeding 8%.

2. An alloy comprising nickel, copper and aluminum, substantially as described, to which has been added manganese not less than $\frac{1}{2}$ % nor more than 1% and tantalum not less than $\frac{1}{10}$ th per cent nor more than 2%.

3. An alloy comprising nickel, copper, aluminum and manganese, substantially as described, said alloy having been scavenged with less than 8% tantalum and being characterized by high malleability and workability.

4. An alloy comprising nickel, copper and aluminum with the nickel content in excess of 50%, the aluminum content not less than 2% nor more than 8%, and the copper con-

tent in excess of 22%, together with manganese, substantially as described.

5. An alloy comprising nickel, copper and aluminum with the nickel content in excess of 50%, the aluminum content not less than 2% nor more than 8%, and the copper content in excess of 22%, together with manganese and tantalum, substantially as described.

6. An alloy comprising nickel, copper and aluminum with the nickel content in excess of 60%, the aluminum content not less than 2% nor more than 8%, and the copper content in excess of 27%, together with manganese not exceeding 1% and tantalum not exceeding 8%.

7. An alloy consisting essentially of nickel about 64 parts, copper about 31 parts, manganese about 1 part, aluminum about 2 to 8 parts and tantalum to the extent needed to give high malleability, substantially as described.

8. An alloy of nickel, copper, aluminum and manganese wherein the ratio of the nickel content to the copper content is about as 64 is to 31, the nickel constituting more than 50% of said alloy, substantially as described.

9. An alloy comprising aluminum 2 to 8%, manganese about 1%, the remainder, after scavenging with 8% or less of tantalum, consisting mainly of nickel and copper in about the relative proportions of 1.85 to 2.20 parts nickel to 1 part copper said alloy being characterized by a good crystalline texture and freedom from spongy centers, blow holes and faults and by easy workability and resistance to corrosion.

10. In the process of fusing and casting an alloy consisting for the most part of nickel, copper and aluminum substantially as described, the step which consists in scavenging the fused alloy with tantalum so that the cast metal will have a higher malleability.

11. In the process of fusing and casting an alloy of nickel, copper, aluminum and manganese substantially as described, the step which consists in scavenging with an effective amount of tantalum not exceeding 8% to thereby increase the malleability of the finished alloy.

12. In the process of fusing and casting an alloy comprising more than 50% nickel, not less than 2% nor more than 8% of aluminum, more than 22% copper, and manganese in an effective amount not exceeding 1%, the step which consists in scavenging the molten alloy with tantalum to give to it a higher malleability than it otherwise would have.

In testimony whereof I affix my signature
SAMUEL W. PARR.