

UNITED STATES PATENT OFFICE

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ACID RESISTING ALLOY

No Drawing.

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This invention relates to an acid-resistant copper alloy.

I am aware that several alloys have previously been made consisting of copper, nickel, and aluminum, without the inclusion of other metals in substantial proportions. One such disclosure of a copper, nickel, aluminum alloy is that contained in the patent to Ityro Iytaka, No. 1,496,269. I have, however, found the disclosure of that patent worthless for the purpose of obtaining a highly acid-resistant copper alloy, which may be rolled without checking at the normal rolling temperature, and may be straightened, after rolling, without breakage. This is for the reason that the disclosed range of the Iytaka patent as to each ingredient of the alloy is so wide that it fails to convey useful information.

I am also aware of a certain British patent to John Frederick Duke, No. 12,042, of 1908. In this patent there are disclosed three apparently useful formulæ for making up copper, aluminum, and nickel alloys. By test I have found that the alloys disclosed in the Duke patent have an acid resistance greater than that of pure copper; that they may be rolled and straightened; but that the alloys do not have a sufficiently high tensile strength for various purposes; and that they may not be, in commercial practice, drawn, welded, or pierced, and do not have a remarkably high resistance to corrosion by commercial acids.

The object of my invention is to provide a copper alloy possessing high acid resistance and high tensile strength, which may not only be rolled and straightened according to normal commercial practice, but may also be satisfactorily drawn, welded, and pierced according to normal commercial practice.

My alloy comprises in proportions by weight:

	Per cent. of the whole
Copper	90 to 94
Aluminum	3 to 5
Nickel	3 to 5

It should be noted that the ranges are relatively narrow, and I have, in fact, found it

impossible to obtain a highly ductile, pierceable, and weldable alloy if the proportion range given be departed from to the extent of one per cent. more or less for any ingredient. That is, the formula must be followed within a tolerance of less than one per cent.

It is further a fact that within the range of three to five per cent. prescribed for both the aluminum and nickel, these alloying metals must be present in substantially equal quantities, a very narrow tolerance being permissible in the relative variation of their proportions. Thus if aluminum be included in the alloy in a proportion of substantially four per cent. of the whole, nickel must also be included in a proportion of substantially four per cent. of the whole, giving a copper content of ninety-two per cent. of the whole. I have found that the tolerance as to equality between the aluminum and the nickel must be less than one-half of one per cent. of the total composition, and for best results should be no greater than one-fourth of one per cent. Any diversity greater than 0.5 per cent. in the relative quantity of nickel and aluminum results in a marked decrease from the exceptionally high workability of the alloy, and specifically causes a loss of the welding and piercing capabilities.

I consider my optimum formula to be as follows:

	Per cent. of the whole
Copper	92
Aluminum	4
Nickel	4

With this specific formula, also, the equality between the nickel and the aluminum must be maintained within the tolerances given above.

I have found by repeated tests that an increase in corrosion resistance of approximately twenty per cent. is obtained over a workable copper-aluminum bronze in which aluminum is incorporated with the copper in a proportion of ten per cent. or less of the whole. The percentage increase of corrosion resistance as compared with unalloyed copper is much greater than twenty per cent.

The yield point of my alloy is approximately fifty thousand pounds per square inch.

The tensile strength being adequate, the noteworthy features of my alloy are the unusually high resistance to corrosion, coupled with a workability not hitherto obtained in a copper, aluminum, and nickel alloy. Apparently this susceptibility to drawing, welding, and piercing is obtained by using equal proportions of aluminum and nickel within the ranges given, and I am not aware that any generally similar alloy has ever before been susceptible of welding and piercing in a commercial manner.

It should be noted that the copper used in the alloy must be of high commercial purity, as substantial inclusion of iron, or other impurities, in the copper detracts greatly from the value of the alloy as to substantially all its desirable characteristics.

The peculiar qualities of my bronze render it useful for various purposes, and in fact for any purpose in which a highly acid-resistant bronze must be worked into a particular shape for use. As examples of such use there may be noted tubes, rivets, rods, turnbuckles, bolts, nuts, cotters, and the like, which are subjected to the action of dilute commercial acids, such as sulphuric, hydrochloric, and acetic acids.

My alloy is entering use in the petroleum industry, for the reason that "sour oil" is encountered in various localities, and has an active tendency to corrode metal equipment with which it comes in contact. In a refinery handling "sour oil" my alloy, because of its resistance to corrosion, is advantageously used for all the tubing which is in contact with the oil, and also for rolled sheets and for screening wire. Its accompanying, and peculiar, workability permits it to be readily made up into such manufactured equipment.

It is also advantageously used for the pipe line transportation of petroleum, and in the production of petroleum. In the latter connection, well screens, well casings, pump rods, and polish rods made of my alloy are able to resist corrosive action of the petroleum.

It should be understood that in commercial practice it has not been possible previously to work an alloy of higher corrosion resistance into such various useful forms. By the "alloys of higher corrosion resistance" I mean that class of copper alloys, or bronzes, having a corrosion resistance notably higher than that of pure, or substantially pure, copper. The zinc alloys of copper, while more workable than the aluminum

bronzes, are not so acid-resistant, and are highly susceptible to disintegration by electrolytic action. Zinc is thus not a generally desirable ingredient of a copper alloy, which is to be worked into forms for use in the arts.

Tests have proven that my alloy is not subject to electrolytic action, a quality which, so far as I am informed, has not been previously obtained in an alloy having the property of facile commercial workability. It is thus generally useful for tubing, and other elements to be embedded underground, particularly in regions of active soil acidity, or in cinder beds.

As to the substantial equality of aluminum and nickel, it is possible that there are in existence metals of such equivalency to either of these alloying metals, that they may be used to partially replace either of them in maintaining the relative equality of aluminum and nickel, without rendering the alloy subject to electrolytic action, or otherwise detracting from its valuable properties.

I claim as my invention:

1. A drawable and weldable corrosion-resisting alloy consisting in substantial entirety of copper, aluminum, and nickel, the metals being included in the relative proportions by weight of ninety per cent. to ninety-four per cent. copper, three per cent. to five per cent. aluminum, and three per cent. to five per cent. nickel, the proportions of nickel and aluminum included in the alloy being substantially equal.

2. A drawable and weldable corrosion-resisting alloy consisting in substantial entirety of copper, aluminum, and nickel, the metals being included in the approximate relative proportions by weight of ninety-two per cent. copper, four per cent. aluminum, and four per cent. nickel, the equality in the included proportions of aluminum and nickel being maintained within a tolerance of less than one-half of one per cent. of the whole.

3. A drawable and weldable corrosion-resisting alloy consisting in substantial entirety of copper, aluminum, and nickel, the copper being included in a proportion by weight of ninety per cent. to ninety-four per cent. of the whole within a tolerance of less than one per cent., and the aluminum and nickel being included in approximate equality by weight, the equality in the included proportions of aluminum and nickel being maintained within a tolerance of less than one-half of one per cent. of the whole.

In testimony whereof I have hereunto set my hand.

WILLIAM J. BRADDOCK.