UNITED STATES PATENT OFFICE.

DANIEL ELLIS CONNER AND ORVILLE BAGBY, OF COVINGTON, KENTUCKY; SAID BAGBY ASSIGNOR OF HIS RIGHT TO LOUIS FRITZ, OF SAME PLACE, AND SAID CONNER ASSIGNOR OF ONE-HALF OF HIS RIGHT TO GEORGE M. PEARCE, OF WASHINGTON, DISTRICT OF COLUMBIA.

ART OF HARDENING AND TEMPERING COPPER, GOLD, OR SILVER.

SPECIFICATION forming part of Letters Patent No. 660,983, dated October 30, 1900.

Application filed May 24, 1899. Serial No. 718,096. (No specimens.)

To all whom it may concern:

Be it known that we, DANIEL ELLIS CONNER and ORVILLE BAGBY, citizens of the United States, residing at Covington, in the county of Kenton and State of Kentucky, have invented and discovered certain new and useful Improvements in the Art of Hardening and Tempering Copper, Gold, or Silver; and we do hereby declare the following to be a full, clear, and exact description of the discovery and process, such as will enable others skilled in the art to which it appertains to understand and use the same.

Our invention relates to a process for hardening non-ferrous metals, such as copper, gold, and silver. This object is attained in the process herein described.

In the following description we will describe the method of hardening copper by our process. Gold and silver may be hardened in a similar manner.

In hardening copper we first clean and anneal it by heating it to a red heat and plunging it into cold acidulated water or brine. After such treatment the copper should be laid aside, preferably for at least twenty-four hours. If then necessary, this process of cleaning and annealing it may be repeated. We then subject the metal to as low a temperature as possible, at least as low as 50° below zero Fahrenheit. To this end it may be placed in a mixture of salt, ice, and liquid ammonia or cooled in any other familiar way; but preferably we cool it by immersing it in liquid air, as thereby a lower temperature may be obtained than can be obtained in any other convenient manner. This cooling is continued until the metal has been cooled as much as possible and until it has been given full opportunity to contract. The metal is then withdrawn from the cooling-bath and is heated immediately and as rapidly as possible. We have found that it may be heated most rapidly and conveniently by passing an electric current through it by means of an electric forge, furnace, or any other well-known electrical heating apparatus suitable for the purpose. The heating is continued until the metal acquires a temperature of at least 1,000° Fahrenheit and preferably until it acquires a bluish cast, but not until the metal becomes red-hot. When thus heated, it is laid aside and allowed to cool gradually, after which it may be finished as desired.

The success of this process depends largely upon first cooling the metal to a very low temperature and then raising its temperature very quickly to the point desired. If the heating be too slow, the desired hardening may not be produced at all, and if produced may not be as complete as if the heat were applied more rapidly. We have found that this treatment increases very materially the tensile strength and hardness of copper and also its stiffness.

We prefer to heat the metal by passing an electric current through it, as above described, not only because by that means its temperature may be raised very quickly, but also because the heating is uniform and not from the surface inward.

Having thus completely described our invention, what we claim, and desire to secure by Letters Patent, is—

1. The herein-described process of hardening non-ferrous metals, which consists in first cooling the same to a temperature at least 50° below zero, Fahrenheit, and then rapidly heating them to a temperature of at least 1,000°, Fahrenheit.

2. The herein-described process of hardening non-ferrous metals, which consists in placing them in liquid air, and then rapidly heating them to a temperature of at least 1,000°, Fahrenheit.

3. The herein-described process of hardening non-ferrous metals, which consists in first cleaning and annealing the metal treated by heating and immersing it in cold brine, then cooling the metal to at least 50° below zero, Fahrenheit and then rapidly heating the same to a temperature of at least 1,000°, Fahrenheit.

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Witnesses:
JOS. A. DREXELIUS,
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