

UNITED STATES PATENT OFFICE.

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GOLD ALLOY AND METHOD OF MAKING THE SAME.

No Drawing.

Application filed September 4, 1925. Serial No. 54,499.

To all whom it may concern:

Be it known that I, VICTOR D. DAVIGNON, a citizen of the United States, and a resident of Attleboro, in the county of Bristol and State of Massachusetts, have invented an Improvement in Gold Alloys and Methods of Making the Same, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This application is a continuation in part of my pending application, Serial Number 47,367, filed July 31, 1925.

My invention relates to alloys of precious metals, and particularly to alloys of gold containing aluminum, and to the process of making the same.

The gold alloy now commonly used in the arts has as its characteristic constituents gold and copper with appropriate base metals other than copper to give it the requisite hardness, color and other desired physical characteristics. This gold-copper alloy, while otherwise satisfactory, has the disadvantage of possessing a relatively high specific gravity; and it is among the objects of my invention to produce a gold alloy of much lower specific gravity but with the same gold ratio, thereby enabling me to fabricate articles of given size or volume with a smaller gold content than with alloys heretofore known to me.

In the arts "gold" is rated according to its "carat," that is to say, 14 carat gold, for example, contains 14 parts by weight of gold and 10 parts by weight of base metal, a total of 24 parts, and any gold alloy which contains 14 parts by weight of gold for each 24 parts by weight of alloy will be rated as 14 carat gold regardless of the specific gravity of the alloy. Accordingly, by reducing the specific gravity of the alloy by my improved method, I obtain an alloy which for a given carat and volume will have less weight, enabling articles of given volume made from it to be rated at this given carat although in fact containing a smaller amount of gold than if made of prior known alloys. For these reasons, as the cost of producing an alloy is largely determined by its gold content, articles of given volume made of "gold" of a given carat can be made at less expense with my improved alloy.

I have found that it is impossible to alloy gold with aluminum by prior methods of

producing gold alloys and obtain homogeneous product which is malleable and ductile enough to meet the requirements of the goldsmith and which possesses the requisite characteristics for enabling articles to be fabricated therefrom by usual goldsmith's processes, as, for example, the forming of shapes from the ingot by the mill process of alternate rolling and annealing. This lack of desirable properties in the attempted aluminum alloy I believe is largely due to the presence of oxidized aluminum in the alloy.

As distinguished from the prior gold-copper alloys, my improved alloy has as its distinguishing characteristics the presence of aluminum in amount sufficient materially to reduce the specific gravity of the alloy; the alloy being malleable and ductile to a degree sufficient to meet the usual requirements of the goldsmith; and the ingot when made by my improved method being workable by usual goldsmith's processes, and being a substantially homogeneous structure free from checks and blisters, thus permitting efficient utilization of the alloy.

The desired degree of hardness and color or other physical characteristics are obtained by the introduction of other base metals as will hereinafter appear.

As showing the effect of the aluminum on the specific gravity of my improved alloy I may make a 14 carat gold alloy in the proportions of 14 parts by weight of gold, 6 parts by weight of copper, 3 parts by weight of zinc, and 1 part by weight of aluminum. The effect of the aluminum on the specific gravity of the alloy can be appreciated when it is observed that in this example the volume of the aluminum employed is slightly greater than 50% of the volume of the gold due to the relatively low specific gravity of the aluminum compared to that of gold.

As an example of the practice of my improved method but without limitation thereto, the metals entering into the alloy are placed in the crucible or other container in which they are melted, preferably in inverse order of their specific gravities, which is to say that the aluminum, for example, will be placed at the bottom of the crucible and the gold and other metals above it. The crucible is then heated in a furnace to a temperature at which the metals become liquid, the mixture conveniently being stirred to mix the constituents which is facilitated by the fact that the metals of low specific grav-

ity tend to rise through the metals of higher specific gravity, and after the mixture is effected the crucible is removed from the furnace and the liquid alloy preferably is poured into a mold and allowed to solidify.

During the pouring operation, and preferably during a period immediately preceding the pouring operation, I effect prevention of the action of the air on the molten metals, for example, by adding to the contents of the crucible a suitable flux which, when added, will melt and form a liquid layer at the top of the molten metal and pass out of the crucible simultaneously with the stream of molten metal entering the mold, this example being particularly applicable in cases where the melting and pouring are effected by use of the conventional types of crucible and mold. Preferably the flux employed in this example consists of or contains a substance which will effectively eliminate from the alloy substantially all aluminum oxide as well as the oxides of copper and of other base metals such as zinc, nickel and silver, commonly entering into gold alloys.

I have found as suitable for flux, potassium bifluoride or calcium chloride, or a mixture of the two in the proportion of 1 part calcium chloride to 2 parts potassium bifluoride. These substances I have found at the temperature of the molten metal will not substantially volatilize at the temperature maintained, and consequently will effectively maintain a seal on the molten metal in the crucible and about the stream of molten metal being poured into the mold.

In the above example of the practice of my method I preferably add the flux to the crucible in the form of crystals or powder and pour the metal into the molds after the flux has remained on the metal in a molten state for a short period, say about five minutes. Preferably the amount of flux will be sufficient to form on the metal in the crucible a layer of about one-quarter of an inch in thickness. When the metal is poured the flux which leaves the crucible with the stream of metal, owing to its low specific gravity, will form a layer or film about the stream of metal and will enter the mold with the metal, thus preventing action of the air on the metal. At the same time the flux effects elimination of aluminum oxide which I explain it does by dissolving from the metal while the latter is liquid, any oxide which may be formed or present, and thus confining the oxide to the layer of slag which forms in the crucible and about the surface of the ingot.

In addition to calcium chloride and potassium bifluoride I have also found as suitable for flux, cryolite, potassium chloride, sodium chloride and sodium fluoride.

Although in the example of fluxes given all are halogen salts of alkaline earths, it is

to be understood that I am not necessarily limited to fluxes so characterized, but that other fluxes which will eliminate aluminum oxide and form a liquid seal preventing access of air to the molten metal may be used.

In the above example of the practice of my method I have found that satisfactory results will be secured by employing substantially pure "virgin" aluminum, as for example, the grade characterized by the trade as "commercially pure," if substantially free from substances such as lead, phosphorus, bismuth and arsenic, deleteriously affecting the malleability or other desired physical characteristics of the alloy.

It will be understood that in the above example other base metals than those already mentioned may be added for imparting special properties to the alloy, and that the content of aluminum may be varied relatively to the gold content to produce alloys of different carat and different specific gravity. In practice, the gold may run from 25% to 85% and the aluminum content from 1% to 10% by weight of the alloy, the remaining base metal in the usual case being wholly or largely copper except where "green gold" (commonly an 18 carat product) is desired, in which case the remaining base metal will be wholly or largely silver. As an example of a desirable 14 carat commercial alloy, the alloy may consist of about 58% gold, 5% aluminum and 37% copper, in which example if desired, a portion of the copper may be replaced by other base metal or metals such as zinc, nickel, silver, etc. In the claims by "base metal rendering the alloy malleable and ductile" I refer to such metals as copper, silver, etc., commonly employed as constituents of gold alloys.

As an example of the practice of my method but without limitation thereto I may take a graphite crucible of the generally frusto-conical shape commonly employed in the art, say the one known to the trade as a "#8—black lead" crucible, which is about four inches in diameter at the top and about seven and one-half inches high, and place in the bottom of the crucible scraps of sheet aluminum about the size of a dime in amount equal to 5 troy ounces. Upon the aluminum I now place a mixture of 58.33 troy ounces of gold in bar form and 36.27 troy ounces of copper in the form of small shot. The crucible is now placed in a common type of gas fired open melting furnace and the temperature of the furnace is raised to about 1900 degrees Fahrenheit and maintained at this temperature for about fifteen or twenty minutes. During this time the metals liquefy, and when liquid are stirred by the operator manually from time to time with a carbon rod thoroughly to mix them. After the mixture is complete flux consisting of a mixture of potassium bifluoride and

calcium chloride crystals, heretofore described, is slowly added to the crucible until a liquid layer of molten flux about one-quarter of an inch in thickness is formed on the molten metal. About five minutes after the flux has melted the crucible is removed from the furnace and the contents of the crucible are poured into the mold in a steady stream of about the thickness of a lead pencil say five-sixteenths of an inch.

The mold for this purpose conveniently may be of iron with a mold chamber, in cross-section a rectangle of about $\frac{1}{2}$ by $2\frac{1}{2}$ inches, and about 10 inches long. The mold preferably is positioned to place the long axis of the mold chamber at about 45 degrees to the horizontal and with the sides of the mold chamber of greatest width in vertical planes.

The metal is now allowed to solidify, after which the mold is opened and the ingot removed. After the ingot has cooled it is placed in a "pickle" consisting of dilute sulphuric acid in the proportion of 1 part acid to 20 parts water and allowed to remain in the pickle until the slag or scale covering its exterior is removed or softened sufficiently to permit removal by subsequent washing, after which the ingot is removed and washed and then may be subjected to the rolling or other operations desired.

Although I have described for purposes of illustration several specific compositions of my improved alloy and one particular way of practicing my method, it is to be understood that I am not limited thereby to the particular method, constituents or proportions thereof, or to the particular apparatus described, but that within the scope of my invention wide deviations may be made therefrom without departing from the spirit of my invention.

I claim:

1. A substantially homogeneous malleable and ductile gold-copper alloy having not less than about 25% by weight of gold and a material proportion of copper and containing at least 1% by weight of aluminum.

2. A gold-copper alloy having not less than about 25% by weight of gold and a material proportion of copper and containing at least 1% of aluminum, and being substantially free from oxidized aluminum.

3. A substantially homogeneous malleable and ductile gold-copper alloy having not less than about 25% by weight of gold and a material proportion of copper and containing from 1 to 10% by weight of aluminum.

4. Maleable and ductile gold-copper alloys having a material proportion of copper and containing from about 25% to 85% by weight of gold and from 1 to 10% by weight of aluminum.

5. Substantially homogeneous gold alloys

having from about 25% to 85% by weight of gold and from 1% to 10% by weight of aluminum, and containing base metal rendering the alloy malleable and ductile.

6. A malleable and ductile alloy containing by weight about 58% of gold, 5% of aluminum and 37% of copper.

7. A malleable and ductile alloy containing by weight about 58% of gold, 5% of aluminum and 37% of base metal including a material amount of copper.

8. That process of making a gold alloy containing a material proportion of aluminum which comprises melting the metals in a container, and effecting sealing of the molten metal from the action of the atmosphere while pouring the metal into a mold.

9. That process of making a gold alloy containing a material proportion of aluminum which comprises melting the metals in a container, and effecting sealing of the molten metal from the action of the atmosphere while pouring the metal into a mold by effecting on the stream of molten metal being poured from the container into the mold a coating of flux capable of eliminating aluminum oxide.

10. That process of making a gold alloy containing a material proportion of aluminum, which comprises melting the metals in a container and adding to the molten metals a flux having a halogen salt of an alkaline earth.

11. That process of making a gold alloy containing a material proportion of aluminum, which comprises melting the metals in a container and adding to the molten metals a flux which will eliminate aluminum oxide.

12. That process of making a gold alloy containing a material proportion of aluminum, which comprises melting the metals in a container and adding to the molten metals a flux comprising potassium bifluoride.

13. That process of making a gold alloy containing a material proportion of aluminum, which comprises melting the metals in a container and adding to the molten metals a flux containing calcium chloride and potassium bifluoride.

14. That process of making a gold alloy containing a material proportion of aluminum, which comprises melting the metals in a container, adding to the metals a fusible flux capable of eliminating aluminum oxide in amount sufficient to form a liquid layer on the molten metal effective to seal said metal from the atmosphere, and pouring the molten metal and flux simultaneously from said container into a mold.

15. That process of making a gold alloy containing a material proportion of aluminum, which comprises melting the metals in a container, adding to the metals a flux containing a fusible halogen salt of an alkaline earth in amount sufficient to form a liquid

layer on the molten metal effective to seal said metal from the atmosphere, and pouring the molten metal and flux simultaneously from said container into a mold.

- 5 16. That process of making a gold alloy containing a material proportion of aluminum, utilizing a crucible, a furnace and a mold, which comprises placing the metals in solid state in said crucible with the
10 aluminum below the heavier metals, heating the crucible to render said metals liquid,

adding to said crucible after liquefaction of the metals a fusible flux containing metallic salts capable of eliminating aluminum oxide, said flux being in amount sufficient to form
15 a layer over the molten metal for sealing the same from the atmosphere, and then pouring the metal and flux simultaneously in a stream into the mold.

In testimony whereof, I have signed my
20 name to this specification.

VICTOR D. DAVIGNON.