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3,134,670

STAINLESS ALLOYS CONTAINING GALLIUM
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No Drawing. Filed May 13, 1961, Ser. No. 110,857
2 Claims. (Cl. 75-171)

The present invention relates to stainless base metal alloys and aims to provide certain improvements therein. By stainless base metal alloy is meant, an alloy containing a substantial percentage of chromium and a substantial percentage of at least one of the metals selected from the group consisting of iron, nickel, and cobalt and which is corrosion resistant and will retain a high luster or polish imparted thereto. Such alloys usually contain in their formulations one or more of the elements: manganese, molybdenum, tungsten, vanadium, silicon, titanium, aluminum, copper, carbon, phosphorous, sulphur, and possibly others in small amounts for imparting some special property or characteristic to the alloy. Stainless steels and non-ferrous alloys for use in the manufacture of cast dentures are alloys of the character to which the present invention relates.

For about twenty years the better known cobalt-chromium dental alloys have been pretty much on a par. Chemical analysis and microstructures have varied in minor respects, and these differences have yielded alloys which varied to some degree in properties—there were small differences, for example, in surface hardness, in resistance to bending, in tensile strength, in corrosion resistance, etc. Considering the field of the “top alloys,” not one of them was so outstanding as to be instantly and universally recognized as “the best.”

The primary object of the present invention is to modify the formulation of known stainless base metal alloys and to provide special formulations of such alloys which will possess a silvery luster, gleam, and reflectivity greater than has been heretofore obtainable by the stainless base metal alloys.

A further object of the invention is to improve the workability of stainless base metal alloys so that machining, grinding, and polishing thereof is rendered more facile.

A further and more specific of the invention, not to provide dental casting alloys which will possess ease of flow in the casting of dentures, a bright silvery luster when polished, and a resiliency essential in cast dentures.

The foregoing and other objects of the invention, not specifically enumerated, I accomplish by incorporating from 0.01 to 10% of gallium in formulations of stainless base metal alloys of the character specified.

The addition of gallium in amounts from 0.01 to 10% to conventional stainless steels and to stainless base metal alloys such for example as are disclosed in my prior U.S. Patent No. 2,128,847 primarily adapted for use in the manufacture of cast dentures imparts to such alloys a bright silvery luster when polished, renders the machining, grinding and polishing of the resulting alloy more facile without materially adversely affecting the tensile strength or the hardness of the alloy. Although the addition of gallium lowers the melting point slightly, it is primarily added to promote a fine grain structure in the alloy and ease of flow at casting temperatures.

In all alloys to which the present invention relates, chromium is the element which imparts the stainless and corrosion resistant properties. In stainless steels, chromium must be present in amounts not below 8.5% nor appreciably above 26%. In such alloys part of the iron may be replaced by nickel, cobalt, molybdenum, tungsten or vanadium. In denture casting alloys chromium may be present in amounts up to 35% and such alloys usually

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contain at least one of the elements selected from the group consisting of nickel, cobalt, iron, molybdenum, tungsten, and vanadium, and wherein the combined elements of said group may vary between 65-70%.

Since the composition of stainless steels and of corrosion resistance denture casting alloys vary within relatively wide limits I have determined that the addition of 0.01-10% gallium will produce in the resulting alloy the desired bright silvery luster when polished, and ease of working, grinding, and polishing. I have also found that in dental casting alloys the presence of gallium in an amount as low as 0.01% will impart the characteristic of a bright silvery luster when polished and as the percentage of gallium is increased, the workability and fineness of grain of the alloy are increased and its hardness is reduced. Accordingly, since the present cost of gallium is about \$25 per gram, the amount used in the formulation of an alloy should be governed by the use of the minimum quantity which will produce the desired characteristics of a bright silvery luster when polished and ease of workability.

Where stainless steel is fabricated for use as tableware, cutlery, watch cases and other articles of manufacture requiring a high luster resembling polished silver, I have found that from 0.01-2% of gallium when added to a stainless steel composition normally intended for such uses will impart to such stainless steels a bright silvery luster when polished.

Where non-ferrous corrosion resistant alloys, are intended for use in the manufacture of denture castings I have found that from 0.01-1% of gallium when added to alloys now conventionally used for such purposes will impart to such alloys a bright silvery luster when polished. I have determined that all of the desirable characteristics in an alloy intended for use in denture castings are realized by the following formulation in approximate percentages by weight:

	Percent
Chromium -----	32
Cobalt -----	62
Molybdenum -----	5
Silicon -----	0.35
Carbon -----	0.35
Copper -----	0.04
Gallium -----	0.02

In the above designated specific composition, tungsten may be substituted in whole or in part for molybdenum and the presence of copper is optional.

In preparing the alloy of the present invention it is preferable to add the gallium together with the copper in the liquid state to the molten stainless steel or to the molten denture casting alloy. Just how the gallium reacts or mixes with the molten compositions to which it is added is not known, but presumably it so combines with the constituents of the alloys to which it is added as to eliminate discontinuities in the surface of the alloy when highly polished.

As the percentage of gallium in denture casting alloys is increased, the melting point of the alloy progressively decreases. The presence of 10% gallium in a denture casting alloy as disclosed in my prior U.S. Patent No. 2,128,847 would reduce the melting point of the alloy so that it could be cast in plasterbound refractory material and thereby reduce the cost of material handling and would make for simplicity of the casting operation.

Although I have described the concept underlying the invention by reference to the applicability of the concept to stainless ferrous alloys containing from 12-32% chromium and to non-ferrous corrosion resistant alloys intended for use in the manufacture of cast dentures and have given but a single example of a specific alloy com-

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position, it is to be understood that the invention is to be construed within the scope of the appended claims.

What I claim is:

1. A stainless corrosion resistant alloy comprising the following constituents in approximately the following percentages by weight:

	Percent
Chromium -----	32
Cobalt -----	62
Molybdenum -----	5
Silicon -----	0.35
Carbon -----	0.35
Gallium -----	0.02

said alloy possessing ease of flow at casting temperatures, a bright silvery luster when polished and a resiliency essential in cast dentures.

2. A stainless corrosion resistant alloy comprising the following constituents in approximately the following percentages by weight:

	Percent
Chromium -----	32
Cobalt -----	62

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Molybdenum -----	5
Silicon -----	0.35
Carbon -----	0.35
Copper -----	0.04
Gallium -----	0.02

said alloy possessing ease of flow at casting temperatures, a bright silvery luster when polished and a resiliency essential in cast dentures.

References Cited in the file of this patent

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,134,670

May 26, 1964

Emil M. Prosen

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 45, after "specific" insert -- object --;
same line, for "invention, not" read -- invention is --;
column 4, line 15, list of references cited, for "Mar. 25,
1937" read -- May 25, 1937 --.

Signed and sealed this 13th day of October 1964.

(SEAL)

Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents