

## UNITED STATES PATENT OFFICE

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DENTURE

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4 Claims. (Cl. 32—2)

This invention relates to metallurgy, particularly to a metallic alloy, and more especially to a metal alloy particularly adapted for the making of prosthetic articles.

Heretofore, it has been proposed to cast prosthetic articles, such as dentures, from an alloy composed of cobalt and chromium, perhaps with the addition of improving metals, or from an alloy composed largely of cobalt and chromium combined with tungsten and titanium as disclosed in my prior Patent #1,961,626, granted June 5, 1934.

Continued investigation has shown that the alloy dealt with in Patent #1,961,626 may have its properties substantially improved by proper modifications. It is with these modifications that the present application deals.

It has been found that the ratio of the cobalt to the chromium in this alloy is a critical one, and that deviation from an optimum ratio, on either side, results in an impairment of the desirable properties. This optimum ratio applicant has established to be 1 part of chromium to 2.3 parts of cobalt.

Up to about 30% of chromium the chromium additions to the cobalt result in a structure which is homogeneous or single phase. When more than 30% of chromium is added, a heterogeneous or two phase system results. This two phase system is made up of a hard and a soft constituent. As a result, any attempt to polish the two phase alloy causes relief etching, the harder constituent not wearing down to the same degree as the soft one. The metal, therefore, will not take the bright, lustrous polish desired. Further, as a result of this hard constituent the alloy is very brittle, a feature definitely not desired. In fact, the brittleness renders the use of the alloy as a denture undesirable because of the great possibility of breakage with consequent inconvenience to the user and necessity for replacement. On the other hand, the alloys containing less than 30% of chromium while homogeneous single phase alloys, are decidedly inferior to the alloy containing the optimum proportions in mechanical and physical properties and also in corrosion resistance.

The most desirable alloy, therefore, is as applicant has found, one containing the maximum amount of chromium possible without exceeding the limit of the single phase solid solution type alloy. When such an alloy is formed, its characteristics are what might be called remarkable, from the mechanical, physical and chemical standpoints.

Although a superior alloy may be made for the purposes stated by alloying cobalt and chromium solely, I prefer to make use of improving metals.

As stated in the patent previously referred to, the melting point of the alloy is at best very high. Applicant has discovered that by substituting molybdenum for tungsten a substantial lowering of the melting point takes place. The molybdenum appears to be in optimum amount when present at 6%, but from 1%—8% can well be used, thus securing either more or less of the effect desired without seriously affecting the basic properties.

The lowering of the melting point of the alloy by the addition of molybdenum is especially desirable when using the alloy for the purpose of making dentures because both chromium and cobalt seem to have a marked affinity for refractories at high temperatures and to have a tendency to react with the investment material of the mold. This undesirable action and affinity is minimized by keeping the melting point of the alloy as low as possible, which is done by the addition of molybdenum.

Further, by the use of the cobalt and chromium in a ratio of 2.3 to 1, the amount of titanium used may be substantially lowered. Applicant finds that with this ratio a superior alloy may be made using titanium at approximately from .2%—2%.

In adding the titanium, manganese titanium, titanium carbide, copper titanium, or ferro titanium may be used. Experience has shown the manganese titanium to be preferable because of its action in deoxidizing and denitrifying the alloy. It generally contains one part of titanium to two parts of manganese. This method of introducing the titanium is also an improvement over the method previously disclosed and is of very considerable advantage as it allows the alloy to be manipulated without exercising such extreme precautions as would otherwise be necessary on account of the extreme susceptibility to atmospheric conditions of the alloy of chromium and cobalt solely with the formation of oxides and nitrides therein which have a deleterious influence upon the alloy.

As stated in my prior patent hereinbefore referred to, I prefer to add a small amount of silicon to the alloy as this increases the fluidity and causes it to flow so much more readily, especially when used for casting dentures. I find that I can well use the silicon from about 0.2 to 1%.

The alloy specified by applicant, made of cobalt and chromium, molybdenum and titanium, and in which the proportions of cobalt to chro-

mium is 2.3 to 1, and in which the proportion does not vary more than from 2.4-1 to 2.2-1 is remarkably resistant to corrosion; is easily polished, and takes an exceptional finish; the color is somewhat akin to but not as white as platinum; it is entirely suitable for casting; has a hardness appropriate for a denture; has a high tensile strength; is free from objectionable brittleness; has a low coefficient of expansion; and may be soldered and welded by the use of the ordinary methods, in which hard solder is used by mechanical dentists.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A denture formed of an alloy of cobalt and chromium containing 1 part of chromium to 2.2 to 2.4 parts of cobalt.
2. A denture formed of an alloy of chromium

and cobalt in which the proportions are substantially 1 to 2.33 and in which there is from 1 to 8% molybdenum; and titanium from 0.2 to 2%.

3. A denture formed of an alloy of chromium and cobalt in which the proportions are substantially 1 to 2.33 and in which there is from 1 to 8% molybdenum; titanium from 0.2 to 2%; and silicon from 0.2 to 1%.

4. A cast denture formed from an alloy in which cobalt and chromium in the proportion of about 1 part of chromium to from 2.2 to 2.4 parts of cobalt are the principal alloying ingredients; and which also contains molybdenum from more than 3% to about 8% whereby the melting point of the composition for casting purposes is substantially lowered and the shrinkage in solidifying thereby reduced.

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