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ALVAH W. CLEMENT, OF EAST CLEVELAND, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO LUDLUM STEEL CO., OF WATERVLIET, NEW YORK, A CORPORATION OF NEW JERSEY.

TITANIUM ALLOY.

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This invention relates to an alloy which may be used for the fabrication of articles and devices which in their use are subjected to the action of corroding gases and high temperatures, and the alloy is also useful as a metal for the making of dies for die castings, ball races for ball bearings, and other articles which require durability and great wearing qualities, and in the case of molds and dies, when used in connection with the molding and casting of metalliferous substances which are corroding in character. The alloy also finds usefulness as an electrical resistance element.

The alloy comprises a combination of iron, chromium, titanium and either aluminum or silicon, or both of these elements.

In making the alloy, the carbon content should be kept as low as possible by the use of oxidizing slags, because carbon in appreciable amounts renders the alloy hard and difficult to work.

A very effective alloy I have found to consist of chromium, 10 per cent, titanium, 6 per cent, aluminum, 10 per cent, the balance of iron, and possibly some silicon, the silicon present being less than 1 per cent. The presence of large quantities of silicon is undesirable as it tends to make the resultant alloy brittle and grainy in structure.

The percentage of aluminum and titanium may be varied, but the titanium should be present in amounts not less than 5 per cent, and may form as large a part as 10 to 12 per cent of the alloy. The chromium may vary from 10 per cent to 30 per cent, the iron always making up the balance of the alloy, and as before stated, silicon may be used in amounts equaling 1 per cent or less but usually silicon in less than $\frac{5}{10}$ of 1% does not give desired effects, in which event the combined iron and silicon make up the balance of the alloy.

The presence of aluminum or silicon, or both, is very effective in preventing any oxidation of the surfaces of an article made from the alloy, by providing a film or surface of oxide, which serves as a protecting coating. The alloy has a high melting point, is tough, and if care be taken to keep the carbon present to a low percentage, the alloy it not brittle.

The alloy may be prepared in a variety of ways. I prefer, however, to prepare the alloy in an electric furnace by melting together a ferro chrome, and adding to the molten bath a suitable amount of titanium either in its metallic form or in some combined form which is preferable. Of course, the usual fluxes will be used to purify the metal, preferably a calcium flux.

The aluminum and silicon may be added in their metallic form, or introduced in any other form which is preferred, by providing for the use of the necessary substances, such as carbon, to reduce them to their metallic form in the furnace for the purpose of alloying.

The alloy herein described is particularly useful in the making of annealing and carbonizing boxes or saggars which are used under conditions involving high temperatures, also for crucibles for melting brass, bronzes, etc., also as parts of furnaces, or, in fact, in any situation where it is desired to produce a structure which is resistant to heat, particularly to great heat.

Inasmuch as the alloy is non-warping, even at high temperatures, it is possible to construct articles of this alloy, which articles have thin walls, and generally the quantity of metal required in forming articles which are to have the desired characteristics, is much less than with many other metals because of the non-warping inherent property of the alloy. This therefore enables the use of light weight structures.

The alloy may be very advantageously used for the making of dies for die castings, or for dies and plungers in the handling of hot glass, or for molds in the handling of hot glass, under which circumstances the alloy not only is resistant to wear, but is resistant to the corroding effects of the molten glass. The alloy is very useful for forming ball bearings, and when so used, the article is fabricated of the alloy as described, and subsequently the surfaces which are to be exposed to the wear and abrasion are subjected to a suitable form of heat treatment, so that there is formed at the surfaces, a high proportion of carbides of titanium and chromium, the carbides mentioned being exceedingly hard and resistant to wear and abrasion.

In the claims I shall use the expression "a metal having the properties of aluminum and silicon" and by this phrase I wish it to

be understood as referring to aluminum or silicon or both.

Having described my invention, what I claim is:

1. An alloy containing chromium in proportion varying from 10 to 30 percent, titanium in proportion from 5 to 12 percent, silicon in excess of the proportion normally present as an ordinary impurity and not exceeding 1 percent, the balance being aluminum and iron with carbon sufficiently low to avoid making the alloy so hard as to be difficult to work, the aluminum being present in appreciable amount and up to 10%.

2. An alloy containing chromium in proportion varying from 10 to 30 percent, titanium in proportion from 5 to 12 percent, silicon in excess of the proportion normally present as an ordinary inpurity and not exceeding 1 percent, aluminum, the proportion of aluminum and silicon together not exceeding ten percent, the balance being substantially iron.

3. An alloy containing chromium in proportion varying from 10 to 30 percent, titanium in proportion from 5 to 12 percent, aluminum in appreciable amount up to 10 percent, silicon in excess of the proportion normally present as an ordinary impurity and not exceeding 1 percent, the balance being substantially iron.

4. An alloy containing chromium 10 percent, titanium 6 percent, aluminum 10 percent, silicon in excess of the proportion normally present as an ordinary impurity and not exceeding 1 percent, the balance being substantially iron.

5. An alloy containing chromium 10 percent, titanium 6 percent, aluminum 10 percent, silicon in excess of the proportion normally present as an ordinary impurity and not exceeding 1 percent, the balance being substantially iron with carbon present in amount less than that which will make the alloy so hard as to be difficult to work.

In testimony whereof, I hereunto affix my signature.

ALVAH W. CLEMENT.