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UNITED STATES PATENT OFFICE.

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CORROSION-RESISTING FERROUS ALLOY.

No Drawing. Application filed February 27, 1919. Serial No. 279,650.

To all whom it may concern:

Be it known that I, WILLIAM H. SMITH, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Corrosion-Resisting Ferrous Alloys, of which the following is a full, clear, and exact description.

This invention relates to a metal alloy which has inherent in it, certain qualities and characteristics that make it exceedingly useful and desirable for use under circumstances which require an article to be resistant to corrosive action of other metals, liquids, solids, fumes or gases, or where the metal object or part is repeatedly heated to high temperatures, and a non-warping, non-cracking structure is desirable, or where the object or part is subjected to heavy service which occasions wear and tear.

The alloy comprises a combination of chromium, iron, titanium and manganese, and silicon or aluminum, or both silicon and aluminum, present in small quantities.

In melting the alloy, ferro-chrome is preferably used, and in order to produce the alloy at low cost, the ferro-chrome produced by the electric furnace process may be used, but ferro-chrome produced by the thermite or other processes may be used if desired.

The alloy comprises substantially 15 to 40 per cent chromium, .04 of 1 per cent to 12 per cent (the titanium with manganese being .54 to 14 per cent) .5 per cent to 3 per cent of silicon, the balance consisting mainly of iron and carbon. Aluminum may be present in small amounts, for instance, .04 of 1 per cent to 3 per cent.

As an example of a typical analysis of an alloy found to have the desirable qualities, the following is given: 18 per cent chromium, 1.5 per cent manganese, 1 per cent silicon, .20 to .35 per cent titanium, .03 per cent aluminum, phosphorus and sulphur less than .05 per cent, balance iron and carbon.

The silicon and aluminum (if the latter be added) are added just before the metal is poured, these elements acting as de-oxidizers for the metal bath, and also imparting fluidity to the metal so that it may be poured readily. Furthermore these metals or metalloids, of either or both of which the alloy may contain about .54 per cent to 6 per cent, apparently form a skin coating or film of oxide which is non-flaking, and protects the metal from further oxidizing effects.

The titanium acts in part as a scavenger and de-oxidizer, and in part apparently combines with the nitrogen that may be occluded in the molten alloy, apparently forming a compound of nitrogen and titanium, which is taken up by the slag. Any additional titanium which is in excess of that removed with the slag, appears in the final alloy and imparts to the alloy the properties of toughness, resiliency and resistance to cracking. The quantity of titanium may be varied, in accordance with the degree in which it is desired to produce the characteristics just mentioned.

The alloy is preferably produced in the electric furnace by melting ferro-chrome together with the various other ingredients of the alloy which have been mentioned, and with a suitable flux such as is well known in the art. In making the alloy it is only necessary to bring the temperature of the furnace to the point necessary to produce a complete melting and then incorporating the various elements of the alloy. It has been found that when the alloy contains a low percentage of carbon it is fairly malleable, and where the carbon is kept as low as about .07 per cent to .08 per cent, the alloy is also easily machinable. In many circumstances this quality of malleability is important and desirable.

Having described my invention, I claim:

1. A substantially nickel free alloy containing at least 40% of iron, not less than 15% of chromium, .04% to 12% of titanium, and an appreciable quantity of manganese not in excess of 2%.

2. An alloy containing as its principal ingredients iron, chromium and titanium, and containing chromium 15% to 40%, an appreciable quantity of titanium not in excess of 12%, and an appreciable quantity of manganese not in excess of 2%.

3. An alloy containing as essential ingredients, substantially 15 to 40 per cent of chromium, substantially 4/100 of 1 per cent

to 12 per cent of titanium, an appreciable quantity of manganese not in excess of 2%, and the balance of iron and carbon.

4. A ferrous alloy consisting of substantially 15 to 40 per cent of chromium, 4/100 of 1 per cent to 12 per cent titanium, ½ of 1 per cent to 2 per cent manganese, ½ of 1 per cent to 3 per cent silicon, and 4/100 of 1 per cent to 3 per cent of aluminum.

5. An alloy containing substantially 18 per cent chromium, 3/10 per cent titanium, 1½ per cent manganese, ½ per cent silicon, balance iron and carbon.

6. Alloyed malleable soft steel resistant to corrosion and to oxidation at elevated temperatures and containing substantially chromium 15% to 40%, titanium with manganese .54% to 14%, and material having the protective film forming properties of silicon and aluminum .54% to 6%.

7. Alloyed malleable soft steel resistant to corrosion and to oxidation at elevated temperatures and containing chromium 15% to 40%, titanium with manganese .54% to 14%, and silicon .5% to 3%.

8. Alloyed malleable soft steel resistant to corrosion and to oxidation at elevated temperatures and containing chromium about 18%, manganese about 1.5%, silicon about .5% to 3%, titanium about .20% to .35%, and aluminum about .03%.

9. Alloyed malleable soft steel resistant to corrosion and to oxidation at elevated temperatures and containing chromium about 18%, manganese about 1.5%, material having the protective film forming properties of silicon and aluminum about .54% to 6%, and titanium about .20% to .35%.

10. Alloyed malleable soft steel resistant to corrosion and to oxidation at elevated temperatures and containing chromium about 18%, manganese with titanium about .54% to 14%, and material having the protective film forming properties of silicon and aluminum about .54% to 6%.

11. Alloy resistant to corrosion and to oxidation at elevated temperatures and containing chromium 15% to 40%, titanium with manganese .54% to 14%, material having the protective film forming properties of silicon and aluminum .54% to 6%, and the principal part of the remainder iron.

12. Alloy resistant to corrosion and to oxidation at elevated temperatures, containing substantially chromium 15% to 40%, manganese about .50% to 2%, titanium about .04% to 12%, material having the protective film forming properties of silicon and aluminum about .54% to 6%, and the principal part of the remainder iron.

13. Alloy resistant to corrosion and to oxidation at elevated temperatures and containing substantially chromium 15% to 40%, manganese about .50% to 2%, titanium about .04% to 12%, and silicon about .5% to 3%, and the principal part of the remainder iron.

In testimony whereof, I hereunto affix my signature.

WILLIAM H. SMITH.

Certificate of Correction.

It is hereby certified that in Letters Patent No. 1,508,032, granted September 9, 1924, upon the application of William H. Smith, of Cleveland, Ohio, for an improvement in "Corrosion-Resisting Ferrous Alloys," an error appears in the printed specification requiring correction as follows: Page 1, line 35, after the word "cent" insert the following words *titanium, .5 to 2 per cent manganese;* and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 14th day of October, A. D. 1924.

[SEAL.]

KARL FENNING,
Acting Commissioner of Patents.