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UNITED STATES PATENT OFFICE.

LEROY S. KUEHN, OF CLEVELAND, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO LUDLUM STEEL CO., OF WATERVLIET, NEW YORK, A CORPORATION OF NEW JERSEY.

ALLOY.

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To all whom it may concern:

Be it known that I, LEROY S. KUEHN, 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 Alloys, of which the following is a full, clear, and exact description.

The present invention relates to a metal alloy which has properties adapting it for the manufacture of various articles or parts of structures which in use are subjected to repeated heatings to high temperatures, or where the article or structure is subject to the action of corrosive liquids, solids, fumes or gases.

The alloy is exceedingly resistant to wear, also to warping, cracking and breaking, and is quite resistant to corrosion by contact with corroding substances, fumes or gases, and is not subject to surface deterioration by flaking, when exposed to corroding or oxidizing agents.

A further desirable quality of the alloy lies in the fact that its melting point is very high and it does not warp and is not materially changed in shape by repeated heatings.

Among the important uses to which the alloy may be put, we may mention as typical cast and forged applications, although in no way limiting, containers or heat treating boxes, saggers, furnace pots, crucibles, glass molds, metal molds for foundry use, retorts, dies, die rings, and many other uses where the properties of the metal give the results desired.

The alloy also forms a good material from which may be manufactured electrical resistance elements, the non-warping and non-oxidizing characteristics of the alloy being particularly important in this case.

Due to the fact that the alloy is non-warping, the walls or parts of structures from which the alloy is made may be comparatively thin.

The alloy may contain from 10 to 15 per cent of chromium, 4 to 10 per cent of nickel, 2/10 of 1 per cent to 4 per cent of titanium, 1/10 of 1 per cent to 2½ per cent of silicon, and 4/10 of 1 per cent to 1½ per cent of manganese. If aluminum be present, it should not be used in greater percentage than 2 per cent, the balance consisting mainly of iron and carbon.

Sulphur and phosphorus are not desirable in the alloy but may occur as impurities, and should be kept as low as possible, preferably less than 5/100 of 1 per cent.

As an example of a typical analysis of an alloy of the character described, the following is given:

Chromium	10 per cent
Nickel	5 per cent
Titanium	3/10 of 1 per cent
Silicon	3/10 of 1 per cent
Manganese	1 per cent
Balance	Iron and carbon

The chromium imparts to the alloy the qualities of resistance to wear, and to corrosion, and to warping.

The nickel renders the alloy more homogeneous and less likely to crack when subjected to repeated heatings.

The manganese gives good grain to the alloy.

The silicon acts as a de-oxidizer and also imparts fluidity to the metal so that it may more readily be poured.

The titanium also acts in part as a deoxidizer, part of the titanium combining with the occluded gases, particularly nitrogen, and this combination with titanium is removed in the slag. Additionally the titanium which is in excess of that required as a deoxidizer, appears in the final alloy and imparts properties of toughness, resiliency and resistance to cracking.

The alloy may be produced in the electric furnace, as by melting commercial electric furnace ferro-chrome, or ferro-chrome produced by the thermite process.

To reduce the amount of carbon present, the ferro-chrome may be refined in a manner which is well-known in the art. In many cases it is desirable to refine the alloy so as to have the carbon present in as small quantity as possible which may be under 1 per cent. When the carbon is low—say 11/100 per cent to 12/100 per cent, the alloy is malleable, and where the alloy contains about 8/100 per cent carbon, the alloy is also easily machinable.

Where the source of ferro-chrome is that made by the thermite process, the amount

of carbon present, if any at all is present, is so low as to be negligible. In the case of using the thermite ferro-chrome, it is more than likely that some aluminum will be found in the final alloy.

The alloy has a high tensile strength, and the fracture of the metal shows a fine compact grain. The alloy is tough and resistant to breakage, and the melting point is high, over 2500° Fahrenheit.

The above noted physical qualities may be varied by varying the amounts of the elements present.

Having described my invention, I claim:

1. A malleable alloyed soft steel resistant to corrosion and to oxidation containing as its principal constituents iron, nickel, chromium and titanium, having at least 10% but less than 15% of chromium, nickel not in excess of 10% nor less than 1% and an appreciable quantity of titanium not in excess of 5%, the balance consisting principally of iron.

2. A malleable alloyed soft steel resistant to corrosion and to oxidation containing as essential ingredients, substantially over 10 per cent and not more than 15 per cent of chromium, substantially 4 to 10 per cent of nickel, substantially 2/10 of 1 per cent to 4 per cent of titanium, substantially 1/10 of 1 per cent to 2½ per cent of silicon, substantially 4/10 per cent to 1½ per cent of manganese.

3. A malleable alloyed soft steel resistant to corrosion and to oxidation containing substantially 10 per cent of chromium, 4 per cent of nickel, 2/10 of 1 per cent of titanium, 5/10 of 1 per cent of silicon, and 1 per cent of manganese.

4. A malleable alloyed soft steel resistant to corrosion and to oxidation containing as its principal constituents iron, nickel, chromium and titanium, having at least 10% but not more than 15% of chromium, nickel about 10%, and an appreciable quantity of titanium not in excess of 5%, the balance consisting principally of iron.

5. A malleable alloyed soft steel resistant to corrosion and to oxidation containing substantially 10% of chromium, 4% of nickel, 2/10 of 1% of titanium, .5% to 2.5% of silicon, and 1% of manganese.

6. A malleable alloyed soft steel resistant to corrosion and to oxidation containing chromium over 10% and not more than 15%, an appreciable quantity of nickel under 10%, titanium substantially 2/10 of 1%, silicon .5% to 2.5%, and manganese .4% to 1.5%.

7. A malleable alloyed soft steel resistant to corrosion and to oxidation containing chromium over 10% and not more than 15%, nickel over 1% and under 10%, silicon .10% to 2.5%, an appreciable quantity of titanium under 5% and manganese .4% to 1.5%.

In testimony whereof, I hereunto affix my signature.

LEROY S. KUEHN.