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CHROME-NICKEL HARDENABLE STAINLESS STEEL

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This invention relates to a new and improved stainless steel alloy of a martensitic type basically having a superior corrosion resistance and also having highly improved mechanical properties at elevated temperatures.

One characteristic of our alloy is its hardness, creep strength and stability under high temperatures and high temperature utilizations. Its superior corrosion resistance makes it important in the cutlery field. Its high temperature mechanical properties are important from the standpoint of the conditioning and shaping of cutlery and particularly, from the standpoint of high temperature utilizations of a product made from the alloy. In the latter connection, it is suitable for use in connection with engine valves, steam turbines, etc.

Although ferrous chromium stainless steels have been before used in the manufacture of blades for cutlery, they have had a limited acceptance by reason of their tendency to pit and corrode after a period of use due to contact with contaminating agents, such as mineral acids, copper and ferric chlorides, etc. The present alloy not only provides a requisite mirror finish for such a utilization, but has a much superior life-time resistance to pitting and corroding, such that it is suitable for highest quality cutlery.

It has been an object of our invention to provide a new and improved alloy of the described type that has essentially a highly superior room temperature corrosion resistance from a long-term standpoint;

Another object has been to provide a chromium-nickel alloy of the described type which will also have highly improved mechanical properties at elevated temperatures.

In carrying out our invention, we have determined that the carbon content is highly critical and should be below a maximum of about .10% (optimum of .08% or lower). We have determined that hardness can be obtained with this low carbon content, provided the essential elements chromium, nickel, molybdenum, silicon and manganese are within the certain specified ranges or maximums as the case may be. Prior to the present invention, a higher carbon content was necessary to provide requisite harden-ability. We have found that carbon above the maximum specified is deleterious from the standpoint of a lowering of corrosion resistance and additionally, that the desired hardenability can be obtained by properly proportioning the other essential elements and particularly, by proportioning them with respect to the nickel content. A characteristic of our alloy is that it will harden to a minimum of 35 Rockwell C.

The alloy of our invention fills a definite need in the art for a superior cutlery steel of a stainless type and it can be provided with a life-time bright finish that is highly resistant to corrosion. In addition, it is highly suitable for valve and turbine utilizations where stability and creep strength as well as hardness and corrosion resistance are needed.

The alloy of our invention contains the following elements in the proportions stated:

(*a*)

C=below .10% max. (optimum about .08% max.)
Cr=10 to 17% (optimum 10 to 15%)
Ni=1 to 4%
Mo=1 to 4%
Si=.50% max.
Mn=.50% max.
Remainder substantially all iron with incidental impurities.

In this alloy, the ranges of chromium and nickel are critical based on the molybdenum content, the nickel content is critical from the standpoint of the carbon content, and the maximum carbon content is highly critical. An optimum alloy, especially from the standpoint of corrosion resistance has the following content:

(*b*)

C=.08% max.
Cr=12 to 15%
Ni=2 to 3.5%
Mo=2.5 to 3.5%
Si=.50% max.
Mn=.50% max.
Remainder substantially all iron with incidental impurities.

The following table shows comparative tests of a 431 steel alloy containing 16 to 18% chromium, 1.5 to 2.5% nickel and no molybdenum with respect to an alloy of our invention containing about .05% carbon, 14% chromium, 4% nickel, up to .50% maximum, each of silicon and manganese, and about 3.5% molybdenum:

Alloy Type	1% H_2SO_4 at 100° F.	2% H_2SO_4 at 100° F.	Ferric Chloride
431	.2	.3	Pits badly.
Ours	.001	.025	Little or no pitting.

The alloy of (*b*) is highly suitable for cutlery usage, while the alloy (*a*) is suitable for both cutlery and high temperature utilizations.

What we claim is:

1. A highly superior stainless steel alloy of a martensitic type that is characterized by its exceptionally high room temperature resistance to corrosion and pitting on a long-term basis from both the standpoint of acid and copper chloride and ferric chloride attack, by its ability to be hardened to a minimum of about 35 Rockwell C, and by its improved mechanical properties at elevated temperatures and which, with iron and incidental impurities, contains as its essential elements carbon, chromium, nickel and molybdenum in a critically proportioned and balanced relationship; the alloying elements consisting of a highly critical maximum carbon content of below .10%, about 10 to 17% chromium, about 1 to 4% nickel, about 1 to 4% molybdenum, and up to a maximum of about .50%, each of silicon and manganese.

2. A highly superior stainless steel alloy of a martensitic type for high temperature and essentially for high quality cutlery usage that is characterized by its high room temperature resistance to corrosion and pitting on a long-term basis from both the standpoint of acid and copper chloride and ferric chloride attack, by its ability to be hardened to a minimum of about 35 Rockwell C, and by its improved mechanical properties at elevated temperatures and which, with iron and incidental impurities, contains as its essential elements carbon, chromium, nickel and molybdenum in a critically proportioned and balanced relationship; the alloying elements consisting of below .08% carbon, about 12 to 15% chromium, about 2 to 3.5% nickel, about 2.5 to 3.5% molybdenum, and up to a maximum of .50%, each of silicon and manganese.

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