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Gobble et al.

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[54] **SEALING RING OF STAINLESS IRON BASE ALLOY**

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[58] **Field of Search** ..... 75/126 A, 128 D, 126 R; 29/183, 190

[56] **References Cited**

UNITED STATES PATENTS

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2,038,639	4/1936	Burgess	75/126 A
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[57] **ABSTRACT**

A highly corrosion and abrasion resistant stainless iron base alloy for metal-to-metal high speed seals consisting essentially of 3.1 to 3.65 percent carbon, 24 to 27 percent chromium, up to 0.9 percent manganese, up to 1.50 percent silicon and the balance iron.

1 Claim, No Drawings

SEALING RING OF STAINLESS IRON BASE ALLOY

BACKGROUND OF THE INVENTION

This invention relates to a stainless alloy. More particularly, it relates to a particularly wear and corrosion-resistant stainless alloy based upon iron and chromium and having a relatively high proportion of carbon.

Stainless alloys have found extensive application throughout industry because of their outstanding corrosion resistance under severe conditions. This property, coupled with wear resistance and other favorable metallurgical properties, has accounted for their increasing utilization. However, where such alloys have been subjected to extremely severe service conditions, e.g., the presence of mud and dirt, and wherein such alloys are used to form seals to protect vital machinery parts, it has been found necessary to resort to stainless steels having even more pronounced wear and corrosion resistance.

In order to achieve such wear and corrosion resistance, the industry has had to resort to alloy stainless steels including costly alloying elements such as columbium, cobalt, molybdenum and vanadium. Such alloys have been found to be highly suitable for such severe service use. However, it has been found desirable from both an economic standpoint and from a "strategic availability" standpoint to develop alloys suitable for such severe service use, but wherein such elements as vanadium, molybdenum, cobalt, and columbium are unnecessary.

A stainless iron base alloy has now been developed which is totally free from such "exotic" elements, but which exhibits comparable properties of wear and corrosion resistance. At the same time, the brittleness characteristics of the alloy are sufficiently low to obviate the necessity of careful handling during casting and subsequent operations. Such alloy comprises relatively high amounts of chromium and carbon which are alloyed in an iron base together with small percentages of manganese and silicon. Such stainless alloy differs from known stainless steel alloys possessing similar corrosion and wear resistant characteristics in that the more exotic materials such as molybdenum, cobalt, vanadium and columbium are eliminated, yet the alloy possesses conveniently low brittleness characteristics. This resultant alloy is an economical metallurgical composition which still exhibits the required characteristics for severe service use.

BRIEF SUMMARY AND OBJECTS OF THE INVENTION

The present invention is a stainless alloy, suitable for metal-to-metal face seals and like structures, wherein said alloy comprises a relatively large percentage of chromium, a lesser amount of carbon, and even smaller amounts of manganese and silicon, all alloyed with a major percentage of iron.

It is, therefore, an object of the present invention to provide a stainless alloy having outstanding wear and corrosion resistant characteristics.

It is another object of the invention to provide a stainless alloy from which all exotic elements such as molybdenum, vanadium, columbium, and cobalt are eliminated.

It is still another object of the invention to provide a stainless alloy composition comprising iron, chromium, carbon, silicon and manganese having excellent wear and corrosion resistant characteristics, and comparatively low brittleness characteristics.

It is a further object of this invention to provide an alloy suitable for severe service conditions but comprising readily available and inexpensive alloying elements.

It is still a further object of the invention to provide a stainless alloy having excellent wear and corrosion resistance when utilized in metal-to-metal constructions involving both high and low speed relative motion between parts.

DETAILED DESCRIPTION OF THE INVENTION

The alloy of the present invention comprises a material exhibiting the properties of a wear-resistant, stainless steel wherein said properties are derived from a combination of the elements iron, chromium, carbon, manganese, and silicon. In accordance with this invention, a stainless iron base alloy is provided having the following percentages (by weight) of these elements:

Carbon	3.10 - 3.65
Chromium	24 - 27
Manganese	0.90 (maximum)
Silicon	1.50 (maximum)
Iron	Balance

The presence of chromium in the above stainless alloy imparts excellent corrosion resistance thereto. Preferably, the chromium percentage in the alloy is about 25 percent to impart optimum abrasion and corrosion resistance.

The carbon in the alloy forms intermetallic carbides which are dispersed throughout the solid solution of chromiumiron; these carbides impart excellent wear resistant properties to the alloy. It is preferable that carbon be present in the alloy in an amount of about 3.5 percent to obtain optimum wear resistance with minimal brittleness characteristics. This property of carbon which imparts brittleness to the stainless alloy of the invention requires that the percentage of carbon in the composition not exceed that indicated above, i.e., 3.65 percent, lest the alloy be too brittle for usefulness. Within the ranges specified, the high carbon alloy exhibits greatly superior wear characteristics over conventional stainless alloys, especially in high-speed applications. Further, such alloys have conveniently low brittleness characteristics which do not require special handling during casting or subsequent operations. These alloys are excellent for use in high-speed metal-to-metal seal construction.

Manganese and silicon are added to control depth of chill and hardness, inter alia. The ranges specified above contribute to an excellent wear and corrosion resistant alloy in conjunction with the specified amounts of carbon, chromium and iron. Preferably, manganese is present in amounts of about 0.5 percent by weight in the alloy of the invention.

Iron is of course the predominant element in the alloy, and in the presence of the amounts of chromium indicated above, forms a solid solution therewith having excellent corrosion and stain resistant properties.

The alloys of the invention can be produced by metallurgical alloying techniques commonly practiced in the art. The alloy furnishes an excellent material for the

production of cast products wherein extreme hardness and outstanding stain resistance are desirable, in particular cast seals such as those described in U.S. Pat. No. 3,180,648 to Kupfert, et al., filed Dec. 14, 1959, and having common assignee herewith. The above-designated patent includes a sealing ring having a generally axially extending portion and a generally radially extending flange.

For example, cast seals having an alloy composition of this invention were produced by conventional shell molding techniques. After the castings were cleaned, they were heated to 1,850° to 1,900° F for 1 hour, followed by air-quenching to room temperature, and then tempered by reheating to 375° F for 1 hour. The castings had a through hardness of Rockwell C63 and displayed an unexpectedly high transverse rupture strength.

Equally good results were obtained by forming castings of seals of the alloy of this invention by the flexible pattern techniques disclosed in U.S. Pat. No. 3,552,480 (Harris) and 3,570,585 (Harris), for example, followed by heating, quenching, and tempering as noted above. In addition, such ring seal castings exhibited Rockwell C hardness comparable to stainless steel alloys containing large amounts of "exotic" materials such as molybdenum, cobalt, and vanadium.

What is claimed is:

1. A sealing ring having a generally axially extending portion and a generally radially extending flange having high corrosion and abrasion resistance made of a stainless iron base alloy consisting essentially of 3.1 to 3.65 percent carbon, 24 to 27 percent chromium, up to 0.9 percent manganese, up to 1.50 percent silicon and the balance iron.

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