

UNITED STATES PATENT OFFICE

ROBERT JOHN OWENS AND HUGH JOHN FRASER, OF HUNTINGTON, WEST VIRGINIA,
ASSIGNORS TO THE INTERNATIONAL NICKEL COMPANY, INC., OF NEW YORK, N. Y.,
A CORPORATION OF DELAWARE

PROCESS OF BRIGHT ANNEALING STEELS AND ALLOYS

No Drawing.

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The present invention relates to a process of bright annealing steels and alloys and particularly to a process of bright annealing stainless steels and nickel-chromium alloys.

It is an object of the present invention to provide a procedure whereby steels and alloys of nickel-iron, nickel-chromium and other nickel containing alloys may be annealed in such a manner that the bright surface of the steel or alloy is not spoiled.

It is another object of the present invention to provide a process of bright annealing metals and alloys having passive surfaces.

It is also within the contemplation of the present invention to provide an improved process of annealing metals and alloys without detrimentally affecting by oxidation the surface of the metal or alloys undergoing treatment.

It is a further object of the invention to provide a process of annealing metals and alloys which includes producing surface passivity on the metals and alloys for preventing detrimental discoloration by oxidation or the like.

Another object of the invention is the provision of controlling the relation between the character of the passive surface produced on the metal or alloy undergoing treatment and the nature of the gaseous atmosphere for effecting bright annealing.

Other objects and advantages of the invention become apparent from the following description of a preferred procedure for carrying the invention into practice.

A metal or alloy such as a stainless steel containing about 18% chromium and about 14% nickel or a nickel-chromium alloy containing about 88% nickel and about 12% chromium is fabricated in the customary manner and has a bright surface imparted thereto by the usual operations. Although the metals or alloys may be in any desired condition, they are described herein as being in the form of cold rolled sheets. These sheets are first made passive by a suitable process such as immersing them in a nitric acid solution having about 5% to about 30% concentration. In practice, it has been found satisfactory to utilize a temperature of about

160° F. to about 200° F. from about 15 minutes to about 60 minutes. By heating the sheets in the foregoing manner, the surfaces thereof were rendered passive.

The passive sheets are then washed and dried in an appropriate manner. After washing and drying, the passive sheets are placed in a suitable chamber such as a nickel lined muffle furnace, which is provided with a gaseous reducing atmosphere, which is not necessarily completely free of water vapor. Various reducing gases may be employed but it is preferred to use completely dried hydrogen. By heating the sheets in the nickel lined electric furnace with a dry hydrogen atmosphere to a temperature of about 1650° F. to about 1800° F. or about 2000° F. for a period of about 2 hours to about 2½ hours, the sheets were completely annealed without any detrimental discoloration occurring.

A specific example of carrying the invention into practice will now be given for a better understanding of the invention by those skilled in the art.

Sheets of a nickel-chromium alloy containing about 88% nickel and about 12% chromium are immersed in about 10% nitric acid bath having a temperature of about 180° F. By keeping the sheets immersed for a period of about 45 minutes to about 1 hour, passivity is created on the surface of the sheets. The thus passified sheets are cleaned and dried.

By subjecting the dry passive sheets to heat treatment in a nickel lined electric muffle furnace having a reducing atmosphere such as hydrogen, or carbon monoxide and hydrogen, or carbon monoxide, hydrogen and nitrogen, or carbon monoxide, carbon dioxide, hydrogen and nitrogen, either completely dried or containing relatively high concentrations of water vapor, and having a temperature of about 1650° F. to 1800° F. it is possible to bright anneal sheets without any detrimental discoloration or oxidation. Time cycles up to 1 hour produce satisfactory results.

In drying the gas used for the atmosphere in the nickel lined electric furnace, calcium chloride driers were used in producing the

gas which was not completely dried, and anhydrous magnesium perchlorate driers were used in producing the gas which was completely dried. Any equivalent driers can be employed.

It will be observed that by the use of the present invention alloys, such as the stainless steels and nickel-chromium alloys, can be bright annealed in the form of sheets, strip, etc. which is not commercially possible with the present facilities.

It will also be noted that in carrying the present invention into practice, hydrogen of exceptionally high purity is not necessarily a requisite. For the nickel-chromium alloys, either hydrogen or any of the gases derived by the burning or cracking of natural gas, other fuel gases, or fuel oils, providing free oxygen and sulphur compounds are not present, are adaptable to the process; it is not necessary to completely dry the gas, or gases. For the stainless steels, satisfactory results can be obtained with hydrogen containing water vapor as high as 1 grain per cubic foot. This has not been possible heretofore.

Furthermore, the present invention provides a process in which the capital expenditure and operating costs involved would be less than would be required to install and operate production units whose design would be based upon data heretofore available, if such units could be made commercially practical.

Moreover, the present invention provides a process which offers a wide range of adaptability insofar as handling alloys in various shapes and sizes is concerned.

It is also within the contemplation of the invention to provide a method which provides greater ease of control of the operations than would be the case with prior art units and, consequently, the method can be handled by the ordinary run of mill labor.

Although the present invention has been described in connection with certain specific temperatures, reagents, gases, etc., it will be observed that variations may be resorted to as those skilled in the art will understand and are to be considered within the scope of the appended claims. For instance, not only nickel and nickel alloys may be treated but also other metallic products such as stainless alloys, chromium steels, stellite, etc. Then again, in place of the nitric acid treatment, chromic acid treatment or electrolytic treatment can be used to make the surfaces passive. In the same way, various reducing atmospheres, such as, hydrogen-carbon monoxide or hydrogen, with or without nitrogen or other diluents and/or with or without carbon dioxide and water vapor. Furthermore, a nickel or nickel alloy or other suitable metallic heating chamber may be used instead of a nickel lined heating chamber.

What is claimed is:

1. The process of annealing the sheet of stainless steel containing chromium and nickel which comprises rolling a sheet of said stainless steel, imparting a bright surface to said sheet, immersing said sheet in a nitric acid solution having about 5% to about 30% concentration, heating said sheet in said solution to a temperature of about 160° F. to about 200° F. from a period of about 15 minutes to about 60 minutes to make the said sheet passive, and then heating the said sheet to a temperature of about 1650° F. to about 1800° F. for several hours in the presence of a hydrogen containing gas to anneal said sheet without producing any substantial detrimental discoloration to the surface thereof.

2. The process of annealing the sheet of nickel-chromium alloy containing about 88% nickel and about 12% chromium which comprises rolling a sheet of said nickel-chromium alloy, imparting a bright surface to said sheet, immersing said sheet in a nitric acid solution having about 5% to about 30% concentration, heating said sheet in said solution to a temperature of about 160° F. to about 200° F. from a period of about 15 minutes to about 60 minutes to make the said sheet passive, and then heating the said sheet to a temperature of about 1650° F. to about 1800° F. for several hours in the presence of a hydrogen containing gas to anneal said sheet without producing any substantial detrimental discoloration to the surface thereof.

3. The process of annealing a product from the group consisting of nickel stainless steel and nickel-chromium alloys with a bright surface which comprises forming the afore-said product, imparting a bright surface to said product, treating said product with nitric acid to render the bright surface passive and then heating said product to a temperature of about 1650° F. to about 2000° F. for several hours in the presence of a reducing atmosphere to anneal said product without producing any substantial discoloration of the bright surface.

4. The process of annealing a product from the group consisting of nickel stainless steel and nickel-chromium alloys with a bright surface which comprises forming a product of nickel alloy, imparting a bright surface to said product, treating said product with a nitric acid solution capable of rendering the bright surface passive and then heating said product to a temperature of about 1650° F. to about 2000° F. for a period of time up to about 2½ hours in the presence of a reducing atmosphere to anneal said sheet without producing any substantial discoloration of the bright surface.

5. The process of annealing a sheet from the group consisting of nickel stainless steel and nickel-chromium alloys with a bright surface which comprises rolling a sheet of nickel alloy, imparting a bright surface to

said sheet, treating said sheet with a hot nitric acid solution to render said bright surface passive, and then heating the said sheet with a passive surface to a temperature of about 1650° F. to about 2000° F. for several hours in the presence of a reducing atmosphere without producing any substantial detrimental discoloration to the bright surface.

In testimony whereof, we have hereunto set our hands.

ROBERT JOHN OWENS.
HUGH JOHN FRASER.