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METHOD OF INHIBITING BLISTERING IN
HEAT-TREATING ALUMINUM ALLOYSCharles Beneke, Louisville, Ky., assignor to
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tion of DelawareNo Drawing. Application October 30, 1943,
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1 Claim. (Cl. 148-6)

The object of the present invention is to provide a method for inhibiting blistering of heat-treated aluminum alloys, which blistering occurs in the heat treatment operation on strong aluminum products.

Strong alloy aluminum products, particularly aluminum forgings from stocks made by rolling and extrusion, are subjected to heat treating operation, as for example in a gas-fired furnace at temperatures from 910°-970° F. for suitable periods of time followed by a quenching operation. In this heat treatment the said aluminum products are subject to blistering, through a phenomenon which is termed high temperature oxidation and which has in the past been considered as due to emanations from the fuel in the furnace, if it is a combustion furnace, from atmospheric conditions of the air itself, or from other causes as yet undetermined.

An aluminum alloy which is particularly subject to blistering under heat treatment is known as 14-S, a second alloy being known as 17-S; both of these alloys being of relatively high copper content.

The blistering is of several types, and in a considerable proportion of cases the blistering extends internally for a substantial distance. In still other cases the blistering extends only a fraction of an inch inwardly of the surface.

The problem of blistering has been particularly felt in aluminum alloy forgings used in the aircraft industry, wherein the result of defective parts may be very serious. In fact, inspection of forgings does not always bring to light internal defects due to blistering and from which forgings superficially appearing blisters have been removed by grinding or machining.

Due to the blistering problem, in the heat treatment of bar stock and other aluminum stocks, and in the heat treatment of forged aluminum alloys, considerable loss has occurred in manufacturing operations, because even where the product can be used by removing surface blisters, and bar stock, for example, may partially be utilized by cutting out blistered sections, the loss nevertheless is substantial.

It has been proposed to coat the said aluminum alloys, prior to heat treatment, with a coating of sodium fluoborate in order to reduce blistering, but there are objections thereto and such coatings are not effective in oil-fired furnaces.

I have discovered a method of treating such hard aluminum alloys prior to heat treatment so that blistering is inhibited during the heat treat-

ing operations, and my method may be employed with gas-fired furnaces and all other types of heat treating apparatus.

The principle of my blister inhibiting treatment is that it minimizes high temperature oxidation of the alloy, particularly near the surface, and provides the alloy with a higher heat absorbing characteristic in a given length of time. My treatment is particularly advantageous in furnaces where products of combustion come in contact with the aluminum products being treated, i. e., oil-fired and gas-fired furnaces of the recirculating type.

After a heat treating operation the coating provided by my treatment may be quickly removed and in such manner that the aluminum product is in an ideal surface condition for thorough inspection.

As an example of my method, the aluminum alloy product to be heat treated is given the following treatment prior to the heat treating process:

A bath consisting of a caustic soda solution, i. e., a sodium hydroxide solution, is prepared, the concentration of caustic being preferably in the ratio of 8%-15%. The aluminum alloy products are immersed in the caustic solution for sufficient time to form thereon an oxide coating. When the aluminum alloys contain a substantial proportion of copper, as in the case of 14-S aluminum alloy, for example, the oxide coating will consist of aluminum oxide and cupric oxide. The surface of the product so treated will approach the color of a black body, and generally the time of immersion is a matter of minutes, it only being required that the coating be homogeneously formed throughout the surfaces of the aluminum alloy products.

When the coating has been formed the products are withdrawn from the bath (which bath may be operated at a temperature of about 150° F.), the products then being washed, preferably by a hot water rinse.

When the coated surfaces of the product are dried the products may be heat-treated in all types of furnaces and under the customary heat-treating temperatures for these specific aluminum alloys, the furnaces including oil-fired furnaces. The products when thus treated inhibit blistering.

Throughout the heating-treating operation the dark coated surfaces remain on the said aluminum alloy products. After the heat-treating operations the said aluminum alloy products are removed from the heat treating furnaces and are

quenched in accordance with customary practice. Thereupon, the coatings may be removed by immersing the said products in an etching bath of nitric acid solution, say of 15-20% concentration, then removed from the etching bath and subjected to a cold water rinse.

By means of my method the said aluminum alloy products are protected against blistering under all conditions of heat treatment and the great loss heretofore occurring is prevented.

Having described my invention, what I claim and desire to secure by Letters Patent is as follows:

5 A method of inhibiting blistering in heat treatment an alloy predominately of aluminum and containing minor proportion alloying metals exclusively of iron except as an impurity, which comprises immersing said product in a bath of caustic soda of 8 to 15% concentration whereby a homogeneous dark coating is formed thereon, and subsequently washing said coating with hot water to remove the excess alkali.

10 CHARLES BENEKE.