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PROCESS FOR THE MANUFACTURE OF ARTICLES WHICH ARE MADE OF IRON OR STEEL AND ARE THREADED OR POSSESS SURFACES WHICH MAKE TIGHT JOINTS

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1 Claim. (Cl. 148—14)

For vessels in which operations are carried out at a high temperature with or without the application of high pressure, bolts, screws, nuts and the like made of heat-resistant and corrosion-resistant steel alloys having a low carbon content have hitherto been employed. As is well known the heat-resistant and corrosion-resistant alloy steels are very likely to seize so that screw connections or parts used in making a tight closure cannot be released later or can be released only with considerable difficulty. This tendency of alloy steels to seize is particularly troublesome in the case of connecting elements and tightening parts used in high pressure apparatus which must fit with a clearance of only a few hundredths of a millimeter. In such cases it frequently happens that a nut seizes on being screwed upon the bolt or the screw connections of the cover can not be released after the vessel has been in use for only a short time. In the case of connecting bolts provided with screw threads and also of packing parts which are exposed to high temperatures, for example, 400° C. and higher, the difficulties are still more pronounced owing to the occurrence of superficial oxidation.

It has now been found that the troublesome seizing of threaded parts made of iron or steel alloys, such as nuts, screws and the like, and of surfaces by which tight contact is made, especially those which are subjected to high pressure and high temperature, can be entirely eliminated by treating the parts or surfaces in a chromium-containing gas, preferably chromium chloride gas (CrCl_2), and thereby enriching their surface with chromium. The enrichment with chromium is effected, in accordance with the invention, at temperatures of approximately 850° C. and higher, either by packing the articles in a medium, for example a chromium chloride salt which evolves a chromium-containing gas or, as has provided particularly suitable, by conducting a current of chromium chloride gas over the parts or articles which have been heated to the stated temperature.

The surface of articles which have been treated in this manner is converted into an extremely dense and smooth iron-chromium alloy owing to the fact that by the diffusion of chromium in the form of gas, especially chromium chloride gas at a temperature above 850° C., the chromium contained in the gas is exchanged for an equivalent proportion of the iron in the objects treated which, at the same time, maintain substantially their original dimensions.

The aforesaid surface treatment has particu-

larly favorable results in the case of screws, nuts, closure plugs and other closing and tightening or connecting elements which are made of low and medium alloy steels, for example of chromium-molybdenum steels, which may also contain additions of nickel, vanadium, tungsten and so forth; whereas all such articles are likely to seize to the parts to which they are connected after remaining for even only a short time at a temperature of 500° C. if they are not treated with a gaseous chromium-containing medium in accordance with the invention. If threaded parts, closure surfaces and the like are treated in the manner described then they can be released from the parts to which they are connected without any difficulty even when the vessel to which they are attached or in which they are inserted has been in continuous use at temperatures of 600° C. and higher. The highly alloyed ferritic and martensitic heat-resistant and corrosion resistant steels, which are otherwise also inclined to seize even at a low pressure, lose this property when they are treated in chromium chloride gas at a temperature above 850° C.

The parts provided with screw threads and tightening or closure surfaces which have been treated in accordance with the invention at temperatures of about 850° C. or higher for example in a current of chromium chloride gas, acquire an extremely firmly adherent surface layer, which consists of an iron-chromium alloy, and is such that there is a gradual transition to the substance of the object. By this gradual transition this layer is clearly distinguishable from chromium-containing superficial coatings which are produced electrolytically. This result is of decisive importance in the present case, because a superficial layer which flakes or cracks off on the slightest deformation owing to cold or heat is more harmful than useful on threads and surfaces, which make a tight joint.

Since the surface layer which is formed in accordance with the invention by treatment of articles in chromium chloride gas at a temperature of about 850° C. or higher adheres extremely firmly to the articles and is actually combined with the remaining material, it can be applied to articles or parts made of iron or steel alloys even before they have been finally finished. Thus, for example, a bolt made of iron or a steel alloy which is to be provided with a screw thread can be first roughly shaped and then enriched with chromium on its surface by treatment at a temperature above 850° C., and it can then be finished by bringing it to the exact dimensions

required and providing it with the thread. The parts which have been superficially enriched with chromium in accordance with the invention can be subjected to considerable deformation by cold or hot treatment because the gaseous diffusion of chromium which takes place at an elevated temperature produces a surface layer which is so combined with the remainder of the material that cracking or flaking off of the surface layer by later hot or cold working need not be feared. It is therefore also possible subsequently to machine the parts which are made of iron or steel alloys and have been treated in gaseous chromium carriers at temperatures of above 850° C. and to work them subsequently by a hot or cold deformation treatment in any desired manner. Even when the objects are exposed to varying temperatures, as frequently occurs with connecting parts, the surface layer is not impaired in any way.

We claim:

The process of preventing seizing of closely interfitting parts made of iron alloy, when they are stationary relative to one another and maintained tightly held together, while being subjected to high temperature and corroding influence, said process consisting in modifying the outermost portion of at least one of said parts by chemically replacing some of the iron therein by chromium, by subjecting said part to the action of a gaseous chromium chloride at a temperature above 850° C., thus producing an article of substantially unaltered dimensions, which superficially consists of a chromium-iron alloy intimately united with the iron alloy beneath it.

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