UNITED STATES PATENT OFFICE.

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ACID-RESISTING ARTICLE AND METHOD OF MAKING SAME.

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To all whom it may concern:

Be it known that I, ALVAH W. CLEMENT, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Acid-Resisting Articles and Methods of Making Same, of which the following is a full, clear, and exact description.

This invention has to do with a method by which a metal alloy fabricated into suitable forms, may be prepared so as to effectively resist the action of sulfuric acid in all its forms, particularly hot dilute sulfuric acid.

Experience reveals the fact that an alloy of iron and chromium in which alloy carbon is present, as carbids of iron and chromium, is in certain proportions highly resistant to the action of sulfuric acid in its various forms.

However, the presence of any considerable quantity of carbon existing as carbids of iron and chromium in the alloy renders the metallic alloy hard to fabricate and difficult to machine. Furthermore, such an alloy tends toward brittleness, which, of course, is objectionable particularly where the alloy is made up into pumps, pipes and cocks and similar articles which enter into the making of a piping system through which the sulfuric acid may be caused to flow.

This invention therefore proposes a method for obtaining in the ultimate article the presence of iron and chromium carbid at those parts or surfaces of the article which encounter the acid, and which therefore should exhibit the properties of resistance to the acid.

In proceeding with this method I form an alloy of iron and chromium of the desired proportions which generally may be stated to be substantially in the neighborhood of 60 per cent. chromium and 40 per cent. iron, and practically free of oxids although so far as this method is concerned, I do not wish to be limited to the particular proportion stated.

The iron chromium alloy is formed under conditions which make the alloy substantially carbonless, or as near that condition as may be commercially possible.

In this condition the alloy is easily workable and machinable, and is fabricated by any desired process into the article which it is desired to make, as for instance, a pipe, a cock, or other article.

The article thus formed, is machined as may be required, and then the article is subjected to a heat treatment that is to say, the article is heated in a heat treating furnace with a suitable carbonizing compound in such a manner that the surface or surfaces of the article which are to come in contact with the acid, in the ultimate use of the article are highly impregnated with carbon.

After thus heat treating, the articles may be directly quenched in oil, water or other suitable quenching medium, or otherwise quickly cooled, which induces in the body at the surface thus treated, an impregnation or coating which contains a high amount of carbon in the form of carbids of iron and chromium.

The surface thus treated will, therefore, be very highly resistant to sulfuric or hydrochloric acid in concentrated or dilute form, and whether the acid is in hot or cooled condition.

The entire body of the article itself need not necessarily be impregnated with carbon, as the only necessary thing, is to treat the surface which is to be exposed. However, it will, of course, be apparent that if the body of the article itself absorbs more or less carbon during the heat treating process, it will not be objectionable, so long as the surface which will be contacted by the acid, is made sufficiently resistant by the method before disclosed.

Having described my invention, what I claim is:

1. The method of forming articles of an iron chromium alloy to have an acid resisting surface which consists in making an iron chromium alloy of the desired proportions which alloy is substantially carbonless, then fabricating the alloy into the article it is desired to make, treating the said article in suitable fashion to impregnate the surface, which should be acid resisting, with carbon, and quickly cooling the surface which is to be acid resisting in any suitable manner, thereby to induce the formation of iron and chromium carbid in the body of the article at the surface which is to be acid resisting.

2. As an article of manufacture having an acid resisting surface, said article comprising a body portion of an alloy of de-

sired ingredients, some or all of which are capable of forming carbids which are acid resisting, the said article at substantially only the surface which is to be acid resisting containing a large proportion of carbids of the metals making up the alloy.

3. As an article of manufacture having an acid resisting surface which consists of a body formed of an alloy of metals of desired ingredients, some or all of which are capable of forming carbids which are acid resisting, that portion of the article which is to be exposed to contact with the acid being made resistant by the presence of carbids of the metals forming the alloy as substantially only the surface exposed.

4. As an article of manufacture having an acid resisting surface, a body composed of an alloy of iron and chromium, the acid resisting surface of which is made resistant by the presence of iron and chromium carbid in the body at substantially only the said surface.

In testimony whereof, I hereunto affix my signature.

ALVAH W. CLEMENT.