Patented Jan. 9, 1940

2,186,710

UNITED STATES PATENT OFFICE

2,186,710

STEEL ALLOY

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No Drawing. Application September 19, 1929, Serial No. 393,835. In Germany June 26, 1929

4 Claims. (Cl. 75—128)

The invention relates to corrosion-proof articles composed of chromium-nickel steel alloys which have a stable surface.

As experience has shown, the austenitic chromium-nickel steel alloys that hitherto have been employed as chemically neutral, become brittle, and, are no longer resistant, e. g. to the attack of acid or salt solutions, when they have experienced a heating up to about 500 to 800 degrees C. which can be compared to a drawing treatment, as occurs for instance in welding constructional parts. It has already been proposed, with satisfying results to employ for the manufacture of objects of austenitic chromium-nickel steel alloys which either in their manufacture or during service are exposed to a heating equivalent to a drawing treatment and cannot subsequently be given a high heat treatment to restore the pure austenitic condition, austenitic chromium nickel-steel alloys the carbon content of which is less than 0.07%. The invention has for its object to afford another solution of this problem by which the technical difficulty of lowering the carbon content to very slight values is avoided. This object is obtained according to the invention by adding to the austenitic chromium-nickel steel alloys, for instance to those containing 18 to 25% of chromium and 7 to 12% of nickel, to prevent them from becoming brittle when heated up to the chromium carbide precipitation range of about 500 to 800 degrees C., an alloy constituent, e. g. titanium or vanadium, which forms a stable chemical compound with a portion of the carbon dissolved in the austenitic base structure. The proportion of this alloy constituent to the carbon is so determined that practically all the carbon is bound to this alloy constituent which means, of course, that in the case of titanium, for example, the alloy will be made to contain sufficient titanium to afford an opportunity for practically all of the carbon to combine with the titanium to form titanium carbide.

Tests made with two chromium-nickel steel alloys that contained about 18% of chromium, 9% of nickel, 0.12% of carbon, and, respectively, 0.5 and 2% of titanium, have shown that steel alloys of this type are fully resistant to active chemical attacks even when in a condition resulting from exposure to a heating up to about 500 to 800 degrees C. without a subsequent high heat treatment. Measurements of the magnetic saturation made to investigate the structure have shown that the values of the magnetic saturation of the material when quenched and drawn, are not substantially higher than those of the magnetic saturation of the same material when merely quenched. For comparison purposes it may be noted that the corresponding values of a titaniumless austenitic chromium-nickel steel alloy are far higher in the temperature range of 500 to 800 degrees C. than in cooled state. The fact that the values of saturation are practically equal in the reheated and in the quenched state, in contradistinction to titaniumless chromium-nickel steels, proves that in the titanium-chromium-nickel steel alloys the drawing operation is much less capable of altering the nature of the base structure than in the corresponding titaniumless chromium-nickel-steel alloys. In the inventors' opinion the reason for this phenomenon resides in the following:

The presence of titanium or vanadium or of a mixture of both these substances has the effect that nearly the entire carbon is bound to the titanium or vanadium in a manner not jeopardising the chemical stability of the alloy, so that the base structure which as to the rest is austenitic, practically is free of dissolved carbon, which therefore cannot assume another form causing the alloy to become brittle when the alloy is heated to about 500 to 800 degrees C.

Potential tests made with the above two titanium-chromium-nickel steel alloys have shown that these alloys even after having been drawn to about 500 to 800 degrees C. and tested in a solution of sulphuric acid of 5% at room temperature and practically freed of oxygen by evacuation, possess a potential that is above the potential of hydrogen, whilst corresponding chromium-nickel-steel alloys that do not contain titanium, after reheating and under equal other conditions, show a potential which is below that of hydrogen. The addition of titanium therefore causes an increase of the potential beyond that of hydrogen and thus an increase of the chemical stability, whereby these alloys are made resistant to very severe attacks by chemical agents and more particularly are protected from becoming brittle under the action of a drawing treatment.

In a corresponding manner two chromium-nickel steel alloys have been tested which contain about 18% of chromium, 9% of nickel, 0.12% of carbon and, respectively, 0.5 and 2% of vanadium. The results of these tests corresponded in all substantial points to those obtained in testing the above chromium-nickel titanium steel alloy.

It is to be understood that the temperature range of 500° to 800° C. referred to in the foregoing specification is not intended to represent any specific outside limits of the range, but rather to indicate the approximate nature of heat treatment which is employed; for example, a temperature range such as is imparted as the result of a welding operation to that section of welded plates or the like where the destructive effect would manifest itself with ordinary austenitic chromium nickel steel alloys.

Any other elements, or mixtures of elements which have the property possessed by titanium of being able to combine with carbon to form stable carbides in austenitic chromium nickel steel alloys in the manner hereinabove described would constitute equivalents of the titanium for the purpose of our invention insofar as the same relates to welded articles.

Our invention is of particular value in connection with articles of welded construction, for use in the chemical and metallurgical fields, which, without being annealed after welding, stubbornly resist intergranular corrosion within the zone tempered by the welding operation, (that is to say, maintained by such operation for an appreciable period of time within the deleterious temperature range referred to) when subjected to corroding media, because substantially the whole of the carbon in the alloy is in stable combination with the additional alloy constituent. The proportion of carbon in such articles of welded construction is a small one, being less than 1%.

In the broader form of our invention which we have given by way of instance, the proportion of chromium is from 18–25% and the proportion of nickel from 7–12%, but it should be understood that a departure from one or the other of such ranges, to an extent which leaves the proportion of the ingredient approximate to the range specified, would be within the spirit of our invention and embody the advantages thereof.

The invention with reference to the species embodying vanadium is claimed in our application Ser. No. 276,230, filed May 26, 1939.

What we claim is:

1. An article of welded construction for use in the chemical and metallurgical fields which, without being annealed after welding, stubbornly resists intergranular corrosion within the zone tempered by the welding operation when subjected to corroding media, and which is made of a stable austenitic alloy composed of approximately 18–25% chromium, approximately 7–12% nickel, a small proportion of carbon and an additional alloy constituent having the property possessed by titanium of forming a stable chemical compound with the carbon of said alloy, the ratio of said additional alloy constituent to the carbon being such that practically the whole of the latter is bound thereto, the balance being substantially all iron.

2. An article of welded construction as defined in claim 1, in which the proportion of chromium in the alloy is approximately 18% and the proportion of nickel is approximately 9%.

3. An austenitic chromium nickel steel alloy containing approximately 18–25% chromium, approximately 7–12% nickel, a small proportion of carbon, and titanium in a proportion sufficient to combine with practically the whole of the carbon in stable combination, the balance being substantially all iron.

4. An austenitic chromium nickel steel alloy as defined in claim 3, in which the proportion of chromium is approximately 18%, that of nickel is approximately 9%, that of carbon is approximately .12%, and that of titanium is approximately .5% to 2%.

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