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ALLOY STEEL ARTICLES

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4 Claims. (Cl. 138—47)

This application is a division of my earlier co-pending application 28,377, filed June 25, 1935, and entitled Alloy and manufactures, and the invention relates to austenitic chromium-nickel alloy irons and steels, and to articles and manufactures of the same.

One of the objects of my invention is the production of high-grade austenitic chromium-nickel alloy irons and steels, which are strong, tough and durable and which are readily worked or formed into a variety of tubular articles, products and manufactures, which are especially adapted to high temperature duty over long periods of constant use under a wide variety of corrosive conditions.

Another object is the production of alloy irons and steels of the character indicated which lend themselves to direct and economical working, as by forging and upsetting and subsequent cutting, drilling, threading and other machining operations, to achieve a variety of commercial tubular articles and manufactures.

Another object is the production of alloy irons and steels of the character indicated, which lend themselves to ready forming, as by piercing into seamless tubes and pipes as used in oil cracking stills, condensers, boilers and like equipment in a number of modern chemical industries where severe corrosive conditions are encountered at high temperatures and pressures.

Other objects of my invention in part will be obvious and in part pointed out hereinafter.

The invention accordingly consists in the combination of elements, composition of ingredients and mixture of materials and in the articles, products and manufactures thereof, as described herein, the scope of the application of which is indicated in the following claims.

As conducive to a clearer understanding of certain features of my invention it may be noted at this point that the austenitic chromium-nickel irons and steels containing approximately, 10% to 25% chromium, 7% to 15% nickel, and the balance substantially iron, are used in the production of a wide variety of corrosion-resistant and mildly heat-resistant products or articles of manufacture. These austenitic irons and steels, especially the 18-8 irons and steels containing approximately, 18% chromium, 8% nickel, and the balance substantially iron, are used in a number of interior or exterior architectural applications, such as decorative trim, ornamentation and fixtures. Similarly, these irons and steels are employed for a variety of kitchen, soda foun-

tain, dairy and hospital applications, as in cooking and serving utensils, containers and appliances, counter and furniture trim and the like, where permanently bright corrosion-resistant metal capable of withstanding the corrosive action of various vegetable and fruit acids, is desired. Likewise, these irons and steels are widely adapted for various chemical plant apparatus and equipment where metal resistant to the corrosive attack of acids, alkalies and salts at room temperature, or slightly elevated temperatures, is required.

These austenitic chromium-nickel irons and steels, however, are not especially adapted for extremely high temperature duty, particularly high temperature duty under strongly oxidizing or corrosive conditions, or conditions of friction, abrasion and wear, largely because of the susceptibility of these irons and steels to intergranular corrosion.

One of the outstanding objects of my invention is the production of strong, tough and durable irons and steels of the character indicated, which lend themselves to ready working or forming into a variety of tubular articles, products and manufactures of the character referred to above, which are peculiarly adapted to withstand long periods of constant use at high temperatures in the presence of a variety of corrosive agents.

Referring now more particularly to the practice of my invention, austenitic alloy iron or steel analyzing approximately, 18% chromium, 8% nickel, .50% to 1% titanium, .50% to 1.0% vanadium, .07% to .1% carbon, and the balance substantially iron, with the usual percentages of silicon, manganese, sulphur and phosphorus, is produced in any suitable manner, as for example, as described in Patent No. 1,925,182 granted September 5, 1933, to Alexander L. Feild and entitled Process for the manufacture of rustless iron. The metal is first produced as ingots, which are fashioned into blooms, billets or tube rounds, in accordance with known methods. The tube rounds are pierced, forming seamless tubes, and the blooms or billets are hot-rolled into sheet bar and strip bar sizes which are, for example, cold-rolled into sheet or strip of desired thickness, and subsequently fashioned into tubular articles, as more particularly noted hereinafter.

My alloy iron or steel is corrosion-resistant and heat-resistant withstanding the exacting conditions of high temperature duty over long periods of continuous use. For example, a bar of my austenitic chromium-nickel iron analyzing

approximately, 18% chromium, 8% nickel, 5% titanium, 1% vanadium, .0% carbon, and the balance substantially iron, has a life of about several hundred hours under a stress of 8,000 pounds per square inch and at a temperature of 1500° F. under ordinary atmospheric conditions, while the usual 18-8 chromium-nickel iron analyzing approximately, 18% chromium, 8% nickel, .0% carbon, and the balance substantially iron, has a life of about 10 hours under like conditions.

In addition to having a life under the severe operating conditions of high temperatures in the presence of a variety of corrosive or corrosion-fostering agents greatly in excess of heretofore known alloy irons and steels, my austenitic chromium-nickel alloy iron or steel is strong and tough and lends itself to a variety of working and forming operations. The metal is readily forged. Furthermore, the metal lends itself to piercing, forming seamless tubes or pipes. Likewise, the metal lends itself to a variety of hot and cold working or forming operations, either from sheet, strip or bar stock, such as punching, blanking, deep-drawing, spinning and the like. My alloy iron or steel is easily welded, either employing the oxy-acetylene torch or the electric arc (employing welding rods of approximately the same analysis as the stock welded), as in the production of welded tubular articles as used in a variety of chemical industries, where a combination of corrosive conditions at high temperatures are encountered. (The welded articles and manufactures are preferably heat-treated in accordance with known methods to establish a fully austenitic condition of the metal after the welding operation is completed to assure maximum chemical resistance of the metal in use.)

My austenitic alloy iron or steel is useful in the production of a great many articles, products and manufactures, such as seamless tubes, fluid valves, couplings, all for high temperature duty, as in oil cracking stills, boilers, condensers, evaporator units, chemical calciners and the like, for semi-chemical use in the oil, photographic film, canning and dairy, paint and dye industries. In addition, my alloy iron or steel is worked or formed as above indicated, achieving a further variety of high temperature duty articles, products and manufactures, such as exhaust manifolds and stacks for internal combustion engines, possessing great durability and long life under high temperature operating conditions where the wash and scour of hot corrosive or corrosion-fostering gases are encountered.

Thus, it will be seen that there is provided in this invention modified austenitic chromium-nickel alloy irons and steels and articles, products and manufactures of the same in which the objects hereinbefore noted, together with many thoroughly practical advantages, are successfully achieved. It will be seen that the alloy irons and steels are strong, tough and durable, corrosion-resistant, heat-resistant and resistant to embrittlement and fatigue and, furthermore, that the irons and steels are readily worked into a variety of articles, products and manufactures, which are peculiarly adapted to withstand continuous high temperature duty over long periods of time and under the many varying conditions encountered in actual, practical use.

While as illustrative of the practice of my invention austenitic chromium-nickel alloy irons and steels and articles, products and manufactures thereof, containing approximately, 18%

chromium, 8% nickel, .50% to 1% titanium, .50% to 1.0% vanadium, .07% to .1% carbon, and the balance substantially iron, are specifically described, good results are achieved where the chromium content ranges between 10% and 25%, the nickel content between 7% and 15%, the titanium between .30% and 1.5%, the vanadium between .30% and 1.5% and the carbon content between .03% and .20%. A somewhat higher carbon content is permissible in the irons and steels of the higher chromium and nickel contents although it is to be understood that the presence of carbon is not essential and is tolerated only because it is impractical to free the metal of this element. Best results are achieved where the sum of the titanium and vanadium contents, within the range indicated, is in proportion to the carbon content.

Certain practical advantages in achieving alloy irons and steels possessing great strength and unusually long life at high operating temperatures under a wide variety of corrosive or corrosion-fostering liquids, vapors or gases, are achieved by adding the further ingredient, tungsten, in the amount of about 2% to 4%, to the analysis of the modified chromium-nickel alloy irons and steels described above. Such irons and steels are readily worked or formed as indicated above, into a variety of articles, products and manufactures, possessing excellent wear resisting characteristics in combination with resistance to scaling, pitting, intercrystalline corrosion, embrittlement or fatigue.

While modified chromium-nickel alloy irons and steels described above, both with and without the ingredient tungsten, or articles, products and manufactures of the same, are especially resistant to many corrosive agents at high temperatures, including sulphur-bearing gases and vapors, in addition to the corrosive agents normally present in the atmosphere, the resistance to the corrosive attack of certain of these agents, especially the sulphur-bearing gases, is measurably improved by a supplementary addition of manganese in an amount of about .5% to 4%, especially in the amount of about 2% to 3%. The alloy irons and steels containing supplementary percentages of manganese are more easily handled in the molten condition, they are more readily worked or formed in various forming operations, and, to some extent, they are more easily welded than the irons and steels more particularly described above.

As many possible embodiments may be made of my invention and as many changes may be made in the embodiments hereinbefore set forth, it will be understood that all matter described herein is to be interpreted as illustrative, and not in a limiting sense.

I claim:

1. Wrought alloy austenitic 10 to 25 per cent chromium, 7 to 15 per cent nickel and .03 to .20 per cent carbon, stainless steel tubular articles characterized by their freedom from corrosion embrittlement and by their resistance to the wash and scour of corrosive fluids, used under conditions of high internal pressures and at high temperatures, said characteristics being produced by the inclusion in said alloy steel of .3 to 1.5 per cent titanium and .3 to 1.5 per cent vanadium.

2. Wrought alloy austenitic 10 to 25 per cent chromium, 7 to 15 per cent nickel and .03 to .20 per cent carbon, stainless steel tubular articles

characterized by their freedom from corrosion embrittlement and by their resistance to the wash and scour of corrosive fluids, used under conditions of high internal pressures and at high temperatures, said characteristics being produced by the inclusion in said alloy steel of .3 to 1.5 per cent titanium, .3 to 1.5 per cent vanadium, and 2 to 4 per cent tungsten.

5 3. Wrought alloy austenitic 10 to 25 per cent chromium, 7 to 15 per cent nickel and .03 to .20 per cent carbon, stainless steel tubular articles characterized by their freedom from corrosion embrittlement and by their resistance to the wash and scour of corrosive fluids, used under
10 conditions of high internal pressures and at high
15 temperatures, said characteristics being pro-

duced by the inclusion in said alloy steel of .3 to 1.5 per cent titanium, .3 to 1.5 per cent vanadium and .5 to 4 per cent manganese.

4. Wrought alloy austenitic 10 to 25 per cent chromium, 7 to 15 per cent nickel and .03 to .20 per cent carbon, stainless steel tubular articles characterized by their freedom from corrosion embrittlement and by their resistance to the wash and scour of corrosive fluids, used under conditions of high internal pressures and at high
10 temperatures, said characteristics being produced by the inclusion in said alloy steel of .3 to 1.5 per cent titanium, .3 to 1.5 per cent vanadium, 2 to 4 per cent tungsten and .5 to 4 per
15 cent manganese.

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