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METHOD OF ROLLING RUSTLESS IRON AND
PRODUCT THEREOF

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This invention relates to rustless iron manufactures and more particularly to highly heat resistant manufactures of the class indicated.

Among the objects of my invention is the production of strong, ductile and readily workable products or manufactures, such as sheet, strip and bar stock, which are highly heat resistant and corrosion resistant under conditions of acid, alkali or salt atmospheres at high temperatures, and yet which lend themselves to convenient and economical working, as by machining, punching, blanking, deep-drawing, spinning, upsetting or other known and commercially used forming operations, into various ultimate articles of manufacture, such as oil burner parts, roasting trays, heat treatment boxes, airplane exhaust stacks, tubes for heat exchange apparatus, furnace parts and supports, fluid valves for oxidizing gases, as in blow torches and oxy-acetylene welding apparatus, and the like.

The invention accordingly consists in the features of construction, combination of elements and mixture of materials as described herein and 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 rustless iron and steel in sheet, strip and bar stock of low and intermediate chromium contents (12% to 17%) are useful in the production of a wide variety of hardenable articles, such as tools, cutlery and the like, as well as a number of unhardenable products, such as decorative trim for architectural applications, automobile trim and similar uses where corrosion resistant characteristics are desired at room temperature, or at temperatures somewhat above this value, and under conditions fostering corrosion. This class of manufactures, and the various articles made therefrom, however, are neither designed nor adaptable for high temperature duty, especially high temperature duty under strongly oxidizing or reducing conditions.

One of the outstanding objects of my invention is the efficient and economical production of heat resistant sheet, strip or bar stock, which is strong, reasonably ductile and unhardenable by heat treatment, in convenient sizes for handling and shipping to customer fabricators for use in the ready fabrication of a variety of highly heat resistant articles, a number of which are set forth above, peculiarly adapted to withstand the corrosive effects of furnace gases, sulphur fumes, moisture and like oxidizing or reducing agents at high temperatures.

Referring now more particularly to the practice of my invention, ingots, blooms or billets of rustless iron, produced for example as described in my Patent No. 1,925,182 of September 5, 1933 entitled "Process for the manufacture of rustless iron", and analyzing approximately 20% to 22% chromium, .05% to .20% carbon, with a permissible silicon content up to about 2%, and the balance substantially iron, are hot rolled into sheet and strip. This hot-rolled sheet and strip is then annealed and pickled and then preferably cold rolled to sheet or strip of desired thickness. The sheet or strip is subsequently trimmed or slitted and made into a roll convenient for handling.

To achieve sheet, strip or bar stock of high tensile strength, good impact value and fine surface texture, clean and free of surface scale at a minimum of expense, the rolling operation is preferably carried out at room temperature using smooth, burnished, hardened and tempered alloy steel rolls. A total reduction of the sheet or strip bar stock of at least about 50% in the cold rolling operation assures a high grade product.

While the large percentages of chromium employed give the product desired heat resistant characteristics, the workability of the material is inclined to suffer. The very low carbon contents employed, however, permit an increased workability of the metal in the presence of these high percentages of chromium, achieving a manufacture of reasonably good working characteristics but one which is essentially unhardenable by heat treatment.

The sheet or strip is dense, tough, strong and shows a clean, bright surface. This product or manufacture lends itself to a number of hot and cold working operations to achieve a wide variety of articles, parts and accessories of exceptional heat resistant characteristics under oxidizing or reducing atmospheres at sustained or intermittent high temperature conditions up to about 1050° C.

The rustless iron sheet or strip may be formed as by punching, blanking, deep-drawing, spinning, upsetting and the like and then welded either with the electric arc or the oxy-acetylene torch in accordance with known welding practice, to form heat treating or carburizing boxes, calcining or roasting trays, tubes for heat exchangers and oil cracking apparatus, airplane exhaust stacks, oil burner parts and the like.

The rustless iron bar stock may be readily cut, turned, drilled, threaded and otherwise machined

to give a variety of articles, accessories and machine parts for high temperature uses, such as fluid valves for oxidizing gases, furnace bars and supporting elements, needle valves for blow torches and oxy-acetylene welding apparatus, orifices and valve seats for machinery or apparatus where high temperature oxidizing and reducing conditions are encountered.

The workability of the heat resistant rustless iron sheet, strip or bar stock, is appreciably improved by including in the metal a supplementary addition of manganese of from about .25% to 2%. Since the cost of making this supplementary addition is not particularly great, the improved working characteristics of the metal usually warrant such an addition.

Sheet, strip or bar stock of somewhat improved resistance to chloride atmospheres under high temperature conditions is achieved by supplementing the analysis set forth above with approximately .25% to 2% of molybdenum; furthermore, this supplementary element effects a sounder and more dense metal of generally improved corrosion resistant and heat resistant characteristics. The use of a minimum of this material is desired, however, since it is quite expensive and directly adds to the cost of the metal.

Supplementary additions of other ingredients, such as nickel and/or copper in amounts of about .25% to 2% contribute to certain of the physical characteristics of the product or manufacture. The supplementary addition of nickel aids in the refinement of grain structure, increases the toughness and tensile strength somewhat and likewise increases the hardness of the metal. Copper acts in a way similar to the nickel addition, although to a lesser extent, and, furthermore, aids in certain forming operations of the sheet or strip, such as in the matter of deep-drawing.

While in the illustrative embodiment of my invention set forth above heat resistant sheet, strip or bar stock, unhardenable by heat treatment, containing, in addition to iron, chromium and carbon, is specifically described, it will be understood that such a manufacture including one or more of the supplementary ingredients, silicon, manganese, molybdenum, nickel and copper, either singly or in combination, may be employed in accordance with the teachings of my invention to achieve many highly beneficial results.

Thus it will be seen that there has been provided in this invention a product or manufacture in which the various objects hereinbefore set forth, together with many thoroughly practical advantages, are successfully achieved. It will be seen that the highly heat resistant sheet, strip and bar stock, of high chromium contents and low carbon contents, which are unhardenable by heat treatment, readily lend themselves to economical and efficient working or forming into a wide variety of heat resistant articles, accessories or apparatus parts adapted to withstand the many trying conditions of actual high temperature use.

As many possible embodiments may be made of my invention and as many changes may be made in the embodiment 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. As an article of manufacture heat-resistant sheet or strip of high tensile strength and of fine texture comprising approximately, chromium 20 per cent to 22 per cent, carbon .05 per cent to .20 per cent, with the balance substantially iron, and cold-rolled to a total reduction in sectional area of about 50 per cent.

2. In the production of heat-resistant sheet or strip of high tensile strength and of fine texture, the art which includes, hot-rolling ingots, blooms or billets analyzing approximately, chromium 20 per cent to 22 per cent, carbon .05 per cent to .20 per cent, and the balance substantially iron, to sheet or strip and then cold-rolling these products to effect a reduction in area of at least about 50 per cent in order to achieve sheet or strip of desired strength and texture.

3. In the production of heat-resistant sheet or strip of high tensile strength and of fine texture, the art which includes, cold-rolling hot-rolled sheet or strip comprising approximately, chromium 20 per cent to 22 per cent, carbon .05 per cent to .20 per cent, and the balance substantially iron to effect a reduction in sectional area of at least about 50 per cent thereby achieving desired strength and texture.

4. As an article of manufacture heat-resistant sheet or strip of high tensile strength, good impact value and fine texture, comprising approximately 20 per cent to 22 per cent chromium, .25 per cent to 2 per cent silicon, .05 per cent to .2 per cent carbon and the balance substantially iron, and cold rolled to a total reduction in sectional area to at least about 50 per cent.

5. As an article of manufacture heat-resistant sheet or strip of high tensile strength, good impact value and fine texture, comprising approximately 20 per cent to 22 per cent chromium, .25 per cent to 2 per cent molybdenum, .05 per cent to .2 per cent carbon and the balance substantially iron, and cold rolled to a total reduction in sectional area to at least about 50 per cent.

6. As an article of manufacture heat-resistant sheet or strip of high tensile strength, good impact value and fine texture, comprising approximately 20 per cent to 22 per cent chromium, .25 per cent to 2 per cent nickel, .05 per cent to .2 per cent carbon and the balance substantially iron, and cold rolled to a total reduction in sectional area to at least about 50 per cent.

7. As an article of manufacture heat-resistant sheet or strip of high tensile strength, good impact value and fine texture, comprising approximately 20 per cent to 22 per cent chromium, approximately .05 carbon and the balance substantially iron and cold rolled to a total reduction in sectional area to at least approximately 50 per cent.

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