

UNITED STATES PATENT OFFICE

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TITANIUM STEEL AND THE PROCESS OF MANUFACTURING THE SAME

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This invention relates to improvements in titanium steel and the process of manufacturing the same. U. S. Patent 1,546,176, July 14, 1925, describes titanium steels and processes of manufacturing the same, which titanium steels are free of carbon. It is now found that similar titanium steels can be manufactured which contain comparatively small amounts of carbon and silicon, and that steels thus manufactured have a uniform structure, and that all the components of the iron are contained in the steel in a state of solid solution.

It has further been discovered that the property of a small amount of titanium of about 0.2% increasing the strength of the steel is even more conspicuous in steels containing a slight amount of carbon than in steels which are free of carbon. For example, the strength of a steel containing about 0.1% of carbon and from about 0.5% to 0.8% of silicon is increased by an addition of about 0.2% of titanium from 54 kilogrammes to 82 kilogrammes per square millimeter.

In order to obtain the combination of the titanium and carbon in the form of the titanium carbides in solid solution in the steels, the ratio of carbon to titanium in the steel should not exceed approximately 5:4, and the contents of carbon and titanium should not exceed about 1% and 0.8% respectively. Under such conditions the steels are still primarily titanium and not carbon steels. They still retain a uniform texture and all the constituents are contained in the solid solution condition. In practice the actual contents of carbon and titanium will preferably not exceed about 0.2% and 0.4% respectively.

It is also found that the strength of the titanium steel containing a slight amount of carbon can be considerably increased by adding slight amounts of manganese and chromium. For example, the strength of the steel referred to in the first-named example is further increased to 100 kilogrammes per square millimeter by adding 0.5% of manganese and 0.5% of chromium.

In all the said steels the limit of elasticity is about 80% of the strength.

Notwithstanding its high strength the steel can be readily worked, and it has a high expansion and contraction. Further, the steel is distinguished by a high degree of resistance to wear. The steel can be manufactured by the processes described in the aforesaid patent, which patent relates to the manufacture of iron-titanium alloys which are free of carbon, the processes being modified only by adding so much carbon, manganese and chromium to the baths as is necessary for obtaining the desired final composition of the baths. But I may also proceed from the manufacture of the steel on the hearth on which an iron bath is refined down to a content of 0.1% of carbon and deoxidized by means of ferromanganese-, ferrochromium- or ferromanganesechromium-silicides which are nearly free of carbon, ferrotitanium free of carbon being preferably added during the tapping of the metal and preferably in liquid form. In a modification I may proceed from an over-refined bath of iron which is nearly free of carbon, the said bath being deoxidized by means of ferromanganese-, ferrochromium- or ferromanganesechromium-silicides, containing so much carbon that the deoxidized bath contains about 0.1% of carbon. To the said bath ferrotitanium which is free of carbon is added preferably in a liquid state. In another modification I proceed from an over-refined iron bath which is nearly free of carbon, I deoxidize the said bath by means of ferromanganese-, ferrochromium- or ferromanganesechromium-silicides which are nearly free of carbon, and I add thereto so much ferrotitanium in solid or liquid form and containing carbon, that the finished steel contains about 0.1% of carbon and 0.2% of titanium.

The last-named methods may be combined with each other.

In a similar way as manganese and chromium all the additions which are known to have steel improving property have the property of increasing the strength, though their influence is less conspicuous as compared to that of the metals manganese and chromium.

Such additions are boron, zirconium, tungsten, molybdenum, vanadium, and uranium.

I claim:

1. The herein described steel containing iron, about 0,1% of carbon, about 0,2% of titanium, and about 0,5% of silicon.

2. The herein described steel containing iron, about 0,1% of carbon, about 0,2% of titanium, about 0,5% of silicon, about 0,5% of manganese, and about 0,5% of chromium.

In testimony whereof I hereunto affix my signature.

WALTHER MATHESIUS.

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