

UNITED STATES PATENT OFFICE

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TREATMENT OF IRON AND STEEL

No Drawing.

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The invention relates to a process for treating iron and steel, and includes correlated improvements and discoveries whereby and wherewith certain useful properties of iron and/or steel are enhanced.

The invention has as an object the treatment of iron and steel in a manner whereby a hardening or toughening of the surface results, and/or there is a marked increase in resistance to corrosion.

The invention has as a further object the providing of a treatment of iron and/or steel in an atmosphere of nitrogen, whereby there is obtained iron and/or steel having improved properties.

An additional object of the invention is to provide a process for treating iron and/or steel in an atmosphere containing nitrogen by a procedure which is economical and simple.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the several steps and the relation and order of one or more of such steps with respect to each of the others thereof, which will be exemplified in the process hereinafter disclosed, and the scope of the application of which will be indicated in the claims.

In the practice of the invention iron and/or steel of various types, as for example, wrought iron, hard steels, soft steels, semi-steels, chrome steels, tungsten steels, molybdenum steels and other alloyed steels, whether binary, ternary or other alloys, may be subjected to a treatment involving heating at an elevated temperature in an atmosphere containing nascent nitrogen, preferably obtained by heating the iron and/or steel in the presence of a nitrogen-containing substance at a temperature at which nitrogen in the nascent state is released from the nitrogen-containing compound. This temperature, while sufficient to release nascent ni-

trogen, should not be above, i. e., less than 1100 degrees C. due to deformation of the material and other unsatisfactory results. The accomplishment of the treatment may be in any suitable space which preferably is enclosed such as a properly fitted furnace or crucible, so that the nitrogen atmosphere may be maintained without undue access of air.

The atmosphere of nitrogen to be maintained is one in which there is available a considerable amount of nascent nitrogen and for the setting up of such an atmosphere, use may be made of various nitrogen-containing substances which may be in the solid or in the liquid state or as a mixture of these, for example, urea, cyanamide, sodium amide, hexamethylenetetramine, potassium amide, naphthylene diamine, dicyan diamide, phenyl hydrazine, acetamide and guanidine. The nitrogen-containing substance may be introduced into the heated zone subsequent to the introduction of the iron and/or steel, the heat being continued until interaction has occurred, or the nitrogen-containing substance may be introduced into the receptacle in conjunction with the iron and/or steel and the mixture then heated to a temperature sufficient to release nitrogen, or two vessels may be used, one containing the iron and/or steel and the other the source of nitrogen or any other suitable arrangement may be used.

As an illustrative embodiment of a manner in which my invention may be practiced, the following description is given:

A charge of steel, for example, molybdenum steel is introduced into a crucible, such as those commonly used in the so-called crucible process for the manufacture of steel, in conjunction with urea. The mixture is then placed into an enclosed space, as a crucible furnace, wherein the mixed mass is heated to an elevated temperature which will occasion the release of nitrogen at least partly in the nascent state, which tempera-

ture may be from about 250° to 500° C., and the heating maintained for a period sufficient to permit interaction between the nitrogen-containing substance and the molybdenum steel, whereby the properties of the steel are enhanced. The period of time, it will be realized, will vary, depending upon the amount of material undergoing treatment, the temperature to which the mass is heated and the rate of decomposition of the nitrogen-containing substance. For the treatment of molybdenum steels a period of several hours will be required.

While the action of the atmosphere of nitrogen-containing nascent nitrogen upon the iron and/or steel at an elevated temperature is not accurately known, nevertheless, it seems most probable that the hardening or toughening of the surface of the iron and/or steel is effected, probably, through the action of the nitrogen upon the ferrite with the formation of a nitrid of iron. It is believed that the nitrid or nitrids thus formed, are not simple in structure, but are as complex, if not more complex than the carbides of iron which are present in iron and steels.

It will be understood, of course, that the invention is not limited in any way by the preceding statement as to the character of the action which is believed to take place, but that in its broad sense the invention comprises a process in which iron and/or steel is subjected to the influence of an atmosphere of nitrogen at an elevated temperature, and, also, that the term iron as used in the appended claims includes irons and steels.

It is also to be considered that while nitrogen-containing substances specifically enumerated herein may not, under ordinary conditions, release nitrogen, nevertheless the action herein contemplated is in the presence of iron which it is believed may catalyze the decomposition reaction.

Since certain changes may be made in carrying out the above process without departing from the scope of the invention, it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A process for treating iron, which comprises introducing the same into a crucible in conjunction with urea and then heating to a temperature sufficient to release nascent nitrogen from urea.

2. A process for treating molybdenum

steel, which comprises introducing said steel into an enclosed space in conjunction with urea, and heating to a temperature sufficient to release nascent nitrogen from said urea.

3. A process for treating iron which comprises heating the same in the presence of urea to a temperature and for a time sufficient to cause nitrogenation.

4. A process for treating molybdenum steel which comprises heating said steel in the presence of urea to a temperature and for a time sufficient to cause nitrogenation.

In testimony whereof I affix my signature.

MARX HIRSCH.