Means for Treating Steel

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This invention relates to means for increasing the nitrogen content of steel to improve its machinability. In the past it has proven to be very difficult to add an appreciable quantity of nitrogen directly to molten steel due to its relative chemical inertness. Likewise a suitable carrying medium has not been found which would allow sufficient assimilation of the nitrogen by the steel and at the same time not contaminate the steel.

One object of this invention is to facilitate the addition of nitrogen to molten steel.

A second object is to increase the nitrogen content of steel.

Another object is to avoid contamination of the steel by limiting the introduction of any objectionable elements.

Further objects and advantages of this invention will be explained more fully in the following detailed description of this invention.

The method employed in this invention to increase the nitrogen content of steel involves the use of an addition agent comprising a finely divided nitrified metal. The nitrified metal may be added to molten steel at any suitable stage, for example by adding it to the ingot mold or ladle during the pouring or tapping of the molten steel. The nitrified metal is produced by subjecting some form of a finely divided metal such as steel wool to a nitrifying treatment.

This treatment comprises heating the finely divided metallic material to a temperature between 900° F. and the melting point of the material while subjected for a suitable length of time to the action of ammonia, as for example, in an atmosphere of ammonia gas. With several hours of such a treatment at about 1000°—1200° F., steel wool can be given a nitrogen content of over six per cent. Using trimmings of black sheet of tin-plate gages about 0.010 inch thick, a nitrified iron can be produced with a two per cent nitrogen content by nitrifying for 8 hours at 1150° F. By using this treatment a nitrogen content of as much as 10 per cent can be produced.

In one test of the efficiency of this type of addition agent, about 100 pounds of black tin-plate trimmings treated as described above and containing 2% nitrogen were added during pouring of a full size steel ingot weighing 6000 pounds. The nitrogen in the addition represented 0.033% of the weight of the ingot. The steel was analyzed and found to contain 0.910% nitrogen so that the efficiency obtained in adding the nitrogen was about 30 per cent.

In this invention there are very few limitations to the amount of addition agent that may be used. As a result the possible amount of nitrogen that may be added is extremely high. One factor that often limits the quantity of an addition agent is the production of violent flames or other hazardous conditions while adding the agent to the molten steel. In this invention the agent is relatively inflammable and consequently imposes no such limitations.

Another limitation of the prior art to the quantity of additions is the inclusion of objectional elements which contaminate the steel. This is avoided by the use of the nitrified metal because it is possible to control the type of finely divided metallic material employed. In fact by selecting the proper type of finely divided metallic material it is not only possible to exclude objectional elements but also to include desirable elements in the addition agent. In a final analysis, if, for instance, practically pure iron is used in the finely divided material, there is substantially no limitation placed on the quantity of addition agent other than the ability of the steel to dissolve the added material and to assimilate the available nitrogen.

This invention is not restricted to steel wool and trimmings of thin sheet since any source of finely divided metal that can be nitrified will be satisfactory for producing the nitrified metal. For example, manganese, molybdenum, and chromium in pure form or alloyed with other desirable addition metals can readily be nitrified when treated in finely divided form in the manner previously described.

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

1. An addition agent for augmenting the nitrogen content of steel comprising steel wool containing substantially 1 to 10 per cent nitrogen.
2. An addition agent for increasing the nitrogen content of ferrous metal comprising trimmings of black plate of tin plate gauge containing substantially 1 to 10 per cent of nitrogen.
3. An addition agent for increasing the nitrogen content of ferrous metal comprising a loose expanded mass of elongated fibers of ferrous metal having a high ratio of surface area to volume and containing a nitrogen content of substantially 1 to 10 per cent.

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