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METALLURGICAL PROCESS.

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This invention relates to metallurgical processes, and particularly to the preparation of nickel and nickel alloys for commercial use.

An object of the invention is to produce nickel and alloys of nickel which are uniformly forgeable.

Heretofore in the refinement of nickel and certain compositions of nickel, it has been customary to treat the molten metal with a small amount of manganese followed by a small amount of magnesium. The added metals act as cleansing agents, the manganese combining with the sulphur and the magnesium combining with the gases, such as oxygen, etc.

It has been found, however, that ingots produced in this manner are not uniformly forgeable due, it is thought, to small amounts of brittle nickel sulphide which remain, the theory being that nickel sulphide having a much lower melting point than nickel, the nickel sulphide forms between the grains of nickel upon solidification, thereby making the casting brittle and very difficult to work. A sulphur content as small as .005% is enough to make the metal brittle.

Among other addition agents which have been proposed, zirconium may be mentioned. This has been used to increase workability of steel and certain alloys, but is found to be unsatisfactory for use with nickel and nickel alloys.

According to the present invention, nickel and alloys of nickel are made uniformly forgeable by adding to the molten metal a small amount of vanadium, followed by the addition of a small amount of magnesium. In preparing the ingots, nickel, for example, is melted in a suitable furnace. Near the end of the melt an alloy of vanadium and nickel, containing about 25% vanadium, is added in an amount sufficient to make the vanadium content of the molten bath about 0.25% to 0.50%. This is followed shortly before the end of the melt by addition of about 0.10% magnesium. Due to the violence of the action when pure magnesium is added, an alloy of nickel and magnesium may be employed.

Vanadium has a greater affinity for sulphur than has nickel, and the nickel sulphide is broken up and the vanadium combines with the sulphur to form vanadium sulphide. The vanadium sulphide solidifies at a much higher temperature than nickel sulphide. During the solidification the vanadium sulphide is believed to be entrapped within the grains of nickel and therefore does not form in the grain boundaries. If the metal is maintained in its molten state long enough, and if sufficient sulphur is present, at least a portion of the vanadium sulphide will rise to the surface and may be drawn off as slag.

The vanadium remaining in the molten nickel after the formation of vanadium sulphide combines with a portion of the oxygen, forming an oxide of vanadium. The subsequent addition of the magnesium to the bath completes the deoxidizing process. Most of the oxides of vanadium and magnesium slag off at the top of the bath. The casting produced by this process is tough, free from blow holes and capable of being worked without difficulty.

The process described above is particularly useful for treating magnetic compositions of nickel and iron which are described in U. S. Patent No. 1, 586,884 to G. W. Elmen, issued June 1, 1926. In the manufacture of such alloys it is desirable to keep the carbon content of the alloy as low as possible and hence electrolytic nickel, having a carbon content of .03% or less, is employed. This nickel is plated from a sulphate solution and since it is somewhat porous a small portion of the electrolyte is entrapped in the pores When the plated metal is melted the electrolyte is decomposed and sulphur is absorbed by the molten nickel. By employing vanadium and magnesium as cleansing agents, the sulphur is combined with the vanadium and the alloy is made uniformly forgeable without deleteriously affecting its magnetic properties.

What is claimed is:

1. The process of treating nickel, which comprises adding small amounts of vanadium and magnesium to the nickel while in its molten state, to render the nickel forgeable.

2. The process of treating nickel, which comprises adding a small amount of vanadium followed by a small amount of magnesium to the nickel while in its molten state, to render the nickel forgeable.

3. The process of treating nickel, which comprises adding less than 1% of vanadium and less than 1% of magnesium to the nickel while in its molten state, to render the nickel forgeable.

4. The process of treating nickel, which

comprises adding about 0.25% to 0.50% of vanadium and about 0.10% of magnesium to the nickel while in its molten state, to render the nickel forgeable.

5. The process of treating an alloy of nickel and iron, which comprises adding a small amount of vanadium followed by a small amount of magnesium to the alloy while in its molten state, to render said alloy forgeable.

In witness whereof, I hereunto subscribe my name this 14th day of December A. D. 1926.

JOHN H. WHITE.