

UNITED STATES PATENT OFFICE

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METALLURGICAL PROCESS

No Drawing.

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

5 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
10 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 mag-
15 nesium 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
20 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
25 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.
30 This has been used to increase the 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
35 and alloys of nickel are made uniformly forgeable by adding a small amount of tantalum or columbium to the molten metal as a cleansing agent. In preparing the ingots, nickel, for example, is melted in a suitable
40 furnace. Near the end of the melt tantalum or columbium is added in the form of an alloy in an amount sufficient to make the tantalum or columbium content of the molten
45 bath about 0.25% to 0.50%. In either case the second metal of the added alloy is nickel; in one case the added alloy preferably comprises about 30% tantalum and 70% nickel, and in the other case about 31% columbium
50 and 69% nickel. A mixture of tantalum and

columbium may also be used with the nickel, in place of tantalum or columbium alone.

Tantalum and columbium have a greater affinity for sulphur than has nickel, and the nickel sulphide is broken up and the tan-
55 talum or columbium, as the case may be, combines with the sulphur to form a sulphide of tantalum or columbium. Both tantalum sulphide and columbium sulphide solidify at a
60 much higher temperature than nickel sulphide. During the solidification the tantalum sulphide or columbium sulphide is believed to be entrapped within the grains of nickel and therefore does not form in the
65 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 tantalum sulphide or columbium sulphide will rise to the surface and may be drawn
70 off as slag.

Tantalum and columbium have the property of not only desulphurizing but also of deoxidizing the molten nickel. Most of the
75 oxides of tantalum or columbium 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 such magnetic com-
80 positions of nickel and iron as 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
85 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
90 portion of the electrolyte is entrapped in the pores. When the plated nickel is melted the electrolyte is decomposed and sulphur is absorbed by the molten nickel. By employing
95 tantalum or columbium as cleansing agents, the sulphur is combined with the added metal and the alloy is made uniformly forgeable without deleteriously affecting its magnetic properties.

In the claims the expression "metal having properties similar to those of tantalum" in- 100

cludes both columbium and tantalum and combinations of these metals.

What is claimed is:

1. The process of treating an alloy of
5 nickel and iron which comprises adding to
the nickel-iron alloy while it is in a molten
state an amount of another alloy of nickel
and a substance having properties similar to
those of tantalum, the nickel predominating,
10 said amount being such that said substance
will have a mass less than 1% of the total
nickel-iron content of the resulting alloy.

2. The process of treating an alloy of
15 nickel and iron which comprises adding to
the alloy while in its molten state a small
amount of a metal having properties similar
to those of tantalum, said alloy having after
a heat treatment magnetic properties better
than those of iron, said magnetic properties
20 being unaffected by the addition of said
metal.

3. The process of treating a nickel-iron al-
loy in which the nickel predominates and
which is capable of having developed there-
25 in by means of a heat treatment a perme-
ability higher than that of iron at low mag-
netizing forces which comprises adding to
said alloy while in its molten state less than
1% of a metal having properties similar to
30 those of tantalum to render said alloy highly
forgeable without impairing its permeabil-
ity.

4. The process of treating a nickel-iron
alloy in which the nickel predominates and
35 which is capable of having developed there-
in by means of a heat treatment a perme-
ability higher than that of iron at low mag-
netizing forces which comprises adding to
said alloy while in its molten state about
40 .25% to .5% of a metal having properties
similar to those of tantalum to render said
alloy highly forgeable without impairing
its permeability.

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

JOHN H. WHITE.

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