CLAIMS

1. Processes for producing ~~low nitrogen,~~ essentially nitride-free chromium or chromium plus niobium-containing nickel-based alloys comprising:

a) charging elements or compounds of elements which do not dissolve appreciable amounts of nitrogen in the molten state to a refractory crucible within a vacuum induction furnace and melting said elements or compounds therein ~~under reduced pressure~~;

b) effecting heterogeneous carbon-based bubble nucleation in a controlled manner, thereby effecting substantial removal of nitrogen and oxygen from the melt;

c) upon cessation of bubble formation, adding a chromium or a chromium-containing master alloy to the melt, the added chromium or the chromium-containing master alloy having a nitrogen content of below 10 ppm, said chromium or chromium-containing alloy having been prepared by:

vacuum-degassing a thermite mixture to an initial pressure less than 1 mbar, the thermite mixture comprising chromium compounds and metallic reducing agents, contained within a vacuum vessel capable of withstanding a thermite reaction;

igniting the thermite mixture to effect reduction of the chromium compounds within said vessel;

solidifying the reaction products; and

cooling the reaction products,

wherein igniting, solidifying and cooling are conducted under a pressure below 1 bar;

d) melting and distributing said added chromium or chromium-containing master alloy throughout the melt;

e) bringing the resulting combined melt to a temperature and surrounding pressure to permit tapping; and

f) tapping the resulting melt, directly or indirectly, to a metallic mold and allowing the melt to solidify and cool ~~under reduced pressure~~.

2. Process according to claim 1, wherein the reducing agent employed in the process to which the chromium or chromium-containing alloys were previously subjected is aluminum.

3. Process according to claim 1 or 2, wherein the thermite mixture employed in the process to which the chromium or chromium-containing alloys were previously subjected additionally comprises at least one energy booster.

4. Process according to any of claims 1 to 3, wherein the thermite mixture additionally contains an element selected from the group consisting of nickel, iron, cobalt, boron, carbon, silicon, aluminum, titanium, zirconium, hafnium, vanadium, niobium, tantalum, molybdenum, tungsten, rhenium, copper and mixture(s) thereof in their metallic form or as compounds thereof capable of metallothermic reduction.

5. Process according to any of claims 1-4, wherein after vacuum-degassing and before ignition, the pressure within the vacuum vessel is increased up to ~~about~~ 200 mbar by introduction of a non-nitrogenous gas.

6. Process according to any of Claims 1-5, wherein cooling the reaction products includes cooling the reaction products to ambient temperature under a pressure below 1 bar.

7. Process according to any of Claims 1-6, wherein melting said elements or compounds includes melting said elements or compounds under reduced pressure lower than 0.1 mbar.

8. Process according to any of Claims 1-7, wherein the added chromium or chromium-containing master alloy has a nitrogen content of below 5 ppm.

9. Process according to any of Claims 1-7, wherein the added chromium or the chromium-containing master alloy has a nitrogen content of below 10 ppm.

10. Process according to any of Claims 1-9, further comprising back filling the vessel with an inert gas to a pressure of 100-200 mbar after vacuum-degassing and before ignition.

11. Process according to any of Claims 1-10, wherein igniting and solidifying are conducted under a pressure up to 200 mbar.

12. Process according to any of Claims 1-10, wherein igniting and solidifying are conducted under a pressure of 200 mbar.

13. Process according to any of Claims 1-10, wherein igniting and solidifying are conducted under a pressure between 100 to 200 mbar.

14. Process according to any of Claims 1-13, wherein melting and distributing said added chromium or chromium-containing master alloy throughout the melt includes melting and distributing said added chromium or chromium-containing master alloy under reduced pressure.

~~15. Process according to any of Claims 1-14, wherein vacuum-degassing the thermite mixture includes vacuum-degassing the thermite mixture to an initial pressure less than 1 mbar.~~

~~16~~15. Process according to any of Claims 1-~~15~~14, wherein the produced chromium or chromium plus niobium-containing nickel-based alloys contain less than 5 ppm nitrogen.

~~17~~16. Process according to any of Claims 1-~~15~~14, wherein the produced chromium or chromium plus niobium-containing nickel-based alloys contain less than 10 ppm nitrogen.

~~18~~17. Process according to any of Claims 1-~~17~~ 16 wherein the heterogeneous carbon-based bubble nucleation of the resulting melts is effected by the controlled injection of graphite.

~~19~~18. Process according to any of Claims 1-~~18~~17, wherein the resulting alloy is re-melted in a vacuum arc re-melting furnace, allowed to homogenize, and then forged into a desired shape.

~~20~~19. Process as defined in any of Claims 1-~~19~~18, wherein the carbon-based bubble nucleation is effected by controlled insertion of carbon in the form of a member selected from the group consisting of particulate carbon, carbon in the form of a bar, tube or cylinder, and combinations thereof.

~~21~~20. ~~Low nitrogen, essentially~~Essentially nitride-free chromium and chromium plus niobium-containing nickel-based alloys produced by the process of any of claims 1-~~20~~ 19 containing ~~below 10~~less than 2 ppm nitrogen.

~~22. Low nitrogen, essentially nitride-free chromium and chromium plus niobium-containing nickel-based alloys according to any of claims 1-20 containing 5 ppm or less nitrogen.~~

~~23. Low nitrogen, essentially nitride-free chromium and chromium plus niobium-containing nickel-based alloys according to any of claims 1-20 containing essentially no detectable nitrogen.~~

~~24~~21. Alloy 718 produced by the process of any of claims 1-~~20~~ 19 containing ~~below 10~~less than 2 ppm nitrogen.

~~25. Alloy 718 produced by the process of any of claims 1-20 containing below 5 ppm nitrogen.~~

~~26. Alloy 718 produced by the process of any of claims 1-20 containing essentially no detectable nitrogen.~~

~~27~~22. A chromium-containing alloy additionally containing one or more elements selected from the group consisting of nickel, iron, cobalt, boron, carbon, silicon, aluminum,

titanium, zirconium, hafnium, vanadium, niobium, tantalum, molybdenum, tungsten, rhenium, copper, and mixtures thereof having a nitrogen content less than ~~10~~ 2 ppm, prepared by the process of any of claims 1-~~20~~19.