WE CLAIM:

1. A hard metal material comprising 5-50 volume % particles of a refractory material dispersed in a host metal, wherein the refractory material comprises particles of carbides and/or nitrides and/or borides of any one or more than one of titanium, zirconium, hafnium, vanadium, niobium, tantalum, chromium, and molybdenum.

2. The hard metal material defined in claim 2 wherein the particles of the refractory material also comprise tungsten.

3. The hard metal material defined in claim 1 or claim 2 comprises 5-40 volume % particles of the refractory material dispersed in the host metal.

4. The hard metal material defined in any one of the preceding claims comprises greater than 10 volume % particles of the refractory material dispersed in the host metal.

5. The hard metal material defined in any one of the preceding claims comprises greater than 15 volume % particles of the refractory material dispersed in the host metal.

6. The hard metal material defined in any one of the preceding claims comprises less than 30 volume % particles of the refractory material dispersed in the host metal.

7. The hard metal material defined in any one of the preceding claims comprises less than 25 volume % particles of the refractory material dispersed in the host metal.

8. The hard metal material defined in any one of the preceding claims wherein the host metal comprises a ferrous alloy (such as a steel or a cast iron), a stainless steel, an austenitic-manganese steel, or an iron-based or a nickel-based or a cobalt-based superalloy.

9. A method of manufacturing a component of a hard metal material comprising:

(a) forming a slurry of a hard metal material comprising 5-50 volume % particles of a refractory material dispersed in a liquid host metal in an inert atmosphere, and

(b) pouring the slurry into a mould and forming a casting of the component, such as in an inert atmosphere.

10. The method defined in claim 9 comprises forming the slurry and thereafter forming the casting of the component in a chamber under vacuum conditions which remove air from the chamber and supplying an inert gas, such as argon, into the chamber.

11. The method defined in claim 9 or claim 10 comprises selecting the production parameters to form the slurry in step (a) with a required fluidity for processing in step (b).

12. The method defined in claim 11 wherein the production parameters comprise any one or more of the particle size, shape, reactivity, density, and solubility of the refractory materials.

13. The method defined in any one of claims 9 to 12 wherein the refractory material is less than 400 microns particle size.

14. The method defined in any one of claims 9 to 13 wherein the refractory material is less than 150 microns particle size.

15. The method defined in any one of claims 9 to 14 comprises selecting the refractory material to have a smaller thermal contraction than the host metal.

16. The method defined in any one of claims 9 to 15 comprises selecting the density of the refractory material, compared to the density of the host metal in the liquid state to control the dispersion of the particles of the refractory material in the host metal.

17. The method defined in any one of claims 9 to 16 comprises selecting the refractory material to have minimal solid solubility in the liquid host metal.

18. A method of forming a wear resistant hard metal material, the method comprising adding (a) niobium or (b) niobium and titanium to a melt containing a host metal in a form that produces particles of niobium carbide and/or particles of a chemical mixture of niobium carbide and titanium carbide in a range of 10 to 40 wt% of the total weight of the hard metal material in a microstructure of a solidified metal alloy, and allowing the melt to solidify to form the solid hard metal material.

19. The method as defined in claim 18 comprising adding the niobium and/or the titanium to the melt to produce particles of niobium carbide and/or niobium/titanium carbides in a range of 12 wt% to 33 wt% niobium carbides and niobium/titanium carbides of the total weight of the solidified hard metal material.

20. The method as defined in claim 18 or claim 19 wherein the particles of niobium/titanium carbides have a general formula $(Nb_x, Ti_y)C$.

21. The method as defined in any one of claims 18 to 20 comprising adding niobium and/or titanium to the melt in the form of particles of niobium carbide and/or niobium/titanium carbides.

22. The method as defined in claim 21 comprising forming a slurry of particles of niobium carbide and/or niobium/titanium

carbides suspended in the melt and allowing the melt to solidify to form the solidified hard metal material.

23. A method of casting a hard metal material having a dispersion of a chemical mixture of niobium carbides and titanium carbides in a host metal which forms a matrix of the hard metal material, the method comprising selecting the density of the niobium/titanium particles in relation to the density of the host metal and therefore selectively controlling the dispersion of the niobium/titanium particles in the matrix ranging from a uniform dispersion to a non-uniform dispersion.

24. A casting of the metal alloy made by the method defined in claim 23.

25. The casting defined in claim 24 comprising a uniform dispersion of niobium/titanium particles in the matrix.

26. The casting defined in claim 24 comprising a non-uniform dispersion of niobium/titanium particles in the matrix.

27. The casting defined in any one of claims 23 to 26 wherein the metal alloy is a ferrous alloy (such as a steel or a cast iron, such as a high chromium white cast iron), a stainless steel or an austenitic manganese steel (such as a Hadfield steel).

28. A method of forming a hard metal material comprising:

(a) forming a slurry of a hard metal material comprising 5-50 volume % particles of a refractory material dispersed in a liquid host metal, and

(b) allowing the slurry to solidify to form a solid hard metal material.

29. A method of forming a wear resistant hard metal material, the method comprising adding any one or more of the nine

transition metals titanium, zirconium, hafnium, vanadium, niobium, tantalum, chromium, molybdenum and tungsten to a melt of a host metal in a form that produces particles of carbides and/or nitrides and/or borides of any one or more of the nine transition metals in a range of 5 to 50 volume % of the total volume of the hard metal material, and allowing the melt to solidify to form the solid hard metal material.

30 A method of casting a hard metal material having a dispersion of refractory material particles of carbides and/or nitrides and/or borides of any one or more of the nine transition metals titanium, zirconium, hafnium, vanadium, niobium, tantalum, chromium, molybdenum and tungsten in a host metal which forms a matrix of the hard metal material in a solid casting, the method comprising selecting the density of the refractory material particles in relation to the density of the host metal and therefore selectively controlling the dispersion of the refractory material particles in the matrix of a solid casting ranging from a uniform dispersion to a non-uniform dispersion.

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F. S. GROSER
of GROSER & GROSER
AGENT FOR THE APPLICANTS