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HARD METAL ALLOY

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The invention relates to hard metal alloys produced by melting or sintering and adapted for the manufacture of tools and working implements, and has particular reference to alloys of this class which contain both a difficultly fusible nitride and a difficultly fusible boride or silicide, separate or mixed, and wherein several nitrides may be used instead of the one nitride and several borides or silicides in lieu of the one boride or silicide. As nitrides, borides and silicides come into consideration here the nitrogen-, boron- and silicon-compounds of the metals tungsten, molybdenum, titanium, tantalum, zirconium, vanadium, niobium, thorium, and aluminum. These are the compounds referred to in the claims as refractory nitrides, borides, and silicides. It has been proved particularly suitable to add to the present alloys an auxiliary metal of comparatively low melting point, such as nickel, chromium or cobalt, separate or mixed, in quantities of less than about 25%, whereby both the toughness of the alloy is increased and, if the alloys are produced by sintering, better sintering conditions are obtained (for example lowering of the sintering temperature). The sintering may be carried on either after the compression of the starting mixture or also simultaneously with the compression. In order to avoid with certainty, in milling and mixing the starting substances, chemical conversions as they may occur if water is used as washing means, it is suitable to use for the washing operation a liquid which does not cause oxidation and evaporates without decomposition at low temperature, such as methylene chloride.

As examples for the alloys forming the subject-matter of the present invention the following compositions may be given:

I		Percent
Nitride of titanium	-----	34
Boride of titanium	-----	60
Nickel	-----	6

II		Percent
Nitride of vanadium	-----	12
Boride of tantalum	-----	78
Nickel	-----	10

III		Percent
Nitride of titanium	-----	14
Boride of titanium	-----	70
Silicide of titanium	-----	8
Cobalt	-----	8

IV		Percent
Nitride of titanium	-----	65
Silicide of titanium	-----	27
Nickel	-----	8

The alloys according to the invention are remarkable for an extreme hardness and resistance to wear. They are suited both for the manufacture of material-removing tools of all kinds and drawing dies, and also as material for parts of machinery which simultaneously are exposed to high pressures and high temperatures, such as hot pressing dies or billet containers for extruding presses.

The favorable properties of these alloys are not affected by adding to them difficultly fusible carbides, such as those of tungsten, titanium, tantalum and so forth, separate or mixed, for example in quantities up to about 20%.

What I claim and desire to secure by Letters Patent is:—

1. Sintered hard metal alloys which contain not less than 55% of a refractory nitride and material from the group consisting of refractory borides and silicides and about 1 to 25% of an auxiliary metal of comparatively low melting point, said alloys being characterized by extremely high resistance to wear.
2. Sintered hard metal alloys which contain not less than 55% of a refractory nitride and material from the group consisting of refractory borides and silicides and about 1 to 25% of an auxiliary metal of comparatively low melting point, the nitride amounting to less than about 50% of the mass, said alloys being characterized by extremely high resistance to wear.
3. Sintered hard metal alloys which contain not less than 55% of a refractory nitride and material from the group consisting of refractory borides and silicides and about 1 to 25% of an auxiliary metal of comparatively low melting point, the nitride amounting to less than about 50% of the mass, and less than about 20% of a difficultly fus-

ible carbide, said alloys being characterized by extremely high resistance to wear.

4. A hard metal alloy containing about 12 to 65% of a refractory nitride, about 78 to 27% of material from the group consisting of refractory borides and silicides, an auxiliary toughening metal in amount from about 1 to 25%, and a refractory carbide in amount not over 20%, the total nitride plus boride or silicide constituting at least 55% of the alloy, said alloy being characterized by extremely high resistance to wear.

5. A hard metal alloy containing about 12 to 65% of a refractory nitride, about 78 to 27% of material from the group consisting of refractory borides and silicides and an auxiliary toughening metal in amount not over 25%, the total nitride plus boride or silicide constituting at least 55% of the alloy, said alloy being characterized by extremely high resistance to wear.

6. A sintered hard metal alloy consisting of about 12 to 65% of a refractory nitride and about 78 to 27% of material from the group consisting of refractory borides and silicides, the total nitride plus boride or silicide constituting at least 55% of the alloy; and one or more auxiliary toughening metals selected from the group consisting of chromium and the iron group metals, in amount not exceeding 25% of the alloy, said alloy being characterized by extremely high resistance to wear.

7. A sintered hard metal alloy consisting of about 12 to 65% of a refractory nitride and about 78 to 27% of material from the group consisting of refractory borides and silicides, the total nitride plus boride or silicide constituting at least 55% of the alloys; one or more auxiliary toughening metals selected from the group consisting of chromium and the iron group metals, in amount not exceeding 25% of the alloy; and a refractory carbide in amount not exceeding 20% of the alloy, said alloy being characterized by extremely high resistance to wear.

8. A sintered hard metal alloy consisting substantially of a refractory nitride and a refractory boride in total amount over 55%; about 1 to 25% of metals selected from the iron group; and a refractory carbide not over 20%; said alloy being characterized by extremely high resistance to wear.

9. A sintered hard metal alloy consisting of about 12 to 65% of a refractory nitride and about 78 to 27% of a refractory boride, the total nitride plus boride constituting at least 55% of the alloy; about 1 to 25% of metal selected from the group nickel and cobalt; and a refractory carbide in amount not exceeding 20% of the alloy, said alloy being characterized by extremely high resistance to wear.

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