

UNITED STATES PATENT OFFICE

2,070,451

HARD METAL ALLOY

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No Drawing. Application October 4, 1933, Serial
No. 692,219. In Great Britain October 11,
1932

9 Claims. (Cl. 75-172)

This invention relates to the manufacture and production of hard metal alloys especially useful for tipping the points of gold nibs and the points of compass needles. Such alloys in addition to great hardness must be resistant to tarnishing and to corrosion by dilute solutions of the common acids and alkali, must have a high resistance to wear, must be capable of being readily soldered onto gold and onto copper and iron base metal alloys and must be sufficiently tough not to chip or splinter when subjected to grinding, polishing or slitting operations. At one time native grains of osmiridium were solely used for these purposes but the supplies of this natural product are not sufficiently uniform in size and shape; hence numerous alloys have been made for this purpose by melting together some or all of the constituents of osmiridium with other metals of the platinum group with or without the addition of base metals to increase the hardness. Efforts to convert native osmiridium into grains suitable for tipping nibs by melting the alloy alone or with the addition of other constituents have so far not produced grains of a quality equal to that of native grains.

We have now found that suitable alloys for the said purposes may be made by melting native or synthetic osmiridium (by which is meant throughout the specification and claims an alloy of 40 to 60 per cent of osmium); 60 to 40 per cent of iridium and 0 to 20 per cent of ruthenium or of osmium and/or ruthenium together with at least one hardening agent selected from each of the three following groups; (a) the group consisting of cobalt and nickel (3 to 25 per cent) (b) tungsten (an appreciable but effective amount up to 40 per cent) and (c) boron (0.1 to 5 per cent). The alloy should contain at least 40 per cent of osmiridium or of osmium and/or ruthenium. The remaining constituents depend on the proportion of osmiridium or osmium and/or ruthenium in the alloy. Substitution of part of the element of group (a) by a corresponding amount of an element of group (b) hardens the alloy only to a small extent but increases the hardness considerably when more than about 0.5 per cent of an element of group (c) is present.

When the alloy contains less than about 75 per cent of osmiridium we prefer to use a combination of elements of groups (a) and (b) as the greater part of the remainder, together with a small quantity as for example less than 2 per cent of an element of group (c) as a deoxidizing agent, or up to 5 per cent as a combined de-oxidizing and hardening agent. The relative

proportions of elements of group (a) and (b) used in the alloys in this case vary between 1:5 and 5:1 and we have obtained the best results by the use of cobalt and tungsten in the ratio of 3:1 or 1:3 together with boron as additional hardening agent; this forms tungsten boride which is an intensely hard compound and imparts high wear resisting properties to the alloys.

In making the alloys the constituents may be mixed together in the form of powders or small grains and the mixture melted in a suitable furnace as, for example, an electric furnace of the induction, resistance or arc type. We prefer however to add the element of group (c) in the form of an alloy with the element of group (a) or (b) for example boron as cobalt boride.

The best alloys are those the proportions of the components of which are within the following ranges:—

Osmiridium or an equivalent amount of osmium and/or ruthenium	Per cent
Tungsten	45 to 94.5
Cobalt and/or nickel	0 to 40
Boron	5 to 25
	0.5 to 3

The following example gives the percentage compositions of alloys which have proved very satisfactory but the invention is not restricted to this example.

Example

	Per cent
Native osmiridium	50
Cobalt	12
Tungsten	36
Boron, the boron being added in the form of cobalt boride	2

What we claim is:—

1. A hard metal alloy of the kind defined consisting of 40 to 94.5% of at least one metal of the group consisting of osmiridium, osmium, and ruthenium together with at least one hardening agent of each of the following groups: 3 to 25% of (a) cobalt and nickel, an appreciable but effective amount up to 40% of (b) tungsten and 0.5 to 5% of (c) boron.

2. A hard metal alloy of the kind defined consisting of 40 to 94.5% of osmiridium, 3 to 25% of a metal of the group consisting of cobalt and nickel, an appreciable but effective amount up to 40% of tungsten, and 0.5 to 5% of boron.

3. A hard metal alloy of the kind defined consisting of 40 to 94.5% of osmium, 3 to 25% of a metal of the group consisting of cobalt and nickel,

an appreciable but effective amount up to 40% of tungsten, and 0.5 to 5% of boron.

4. A hard metal alloy of the kind defined consisting of 40 to 94.5% of ruthenium, 3 to 25% of a metal of the group consisting of cobalt and nickel, an appreciable but effective amount up to 40% of tungsten, and 0.5 to 5% of boron.

5. A hard metal alloy of the kind defined consisting of 40 to 94.5% of at least one metal of the group consisting of osmiridium, osmium and ruthenium, 3 to 25% of cobalt, an appreciable but effective amount up to 40% of tungsten and 0.5 to 5% of boron.

6. A hard metal alloy of the kind defined consisting of 40 to 94.5% of at least one metal of the group consisting of osmiridium, osmium and ru-

thenium, 3 to 25% of nickel, an appreciable but effective amount up to 40% of tungsten and 0.5 to 5% of boron.

7. A hard metal alloy of the kind defined consisting of 40 to 50% of at least one metal of the group consisting of osmiridium, osmium and ruthenium, 12 to 20% of cobalt, 26% to 36% of tungsten and 2 to 4% of boron.

8. A hard metal alloy of the kind defined consisting of 50% of osmiridium, 12% of cobalt, 36% of tungsten and 2% of boron.

9. A hard metal alloy of the kind defined consisting of 50% of ruthenium, 12% to 20% of cobalt, 28 to 36% of tungsten and 2% of boron.

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