

UNITED STATES PATENT OFFICE

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ALLOY, AND CUTTING TOOL MADE THEREFROM

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The invention comprises non-rusting alloys of great hardness, suitable for use in making lathe and other machine tools for cutting metals, and for many other purposes. The alloys of the invention may be regarded as comprising a base of cobalt and tungsten to which has been added boron and in some cases chromium also.

The binary alloys consisting substantially entirely of cobalt and tungsten, with the tungsten not above 30%, are forgeable and are suitable material for wood-working tools, and in general for such tools as are usually made of mild tempered steels. On increasing the tungsten content of such alloys their hardness is somewhat increased and they become non-forgeable, but even with the tungsten as high as 50% the metal is too soft to be used for cutting any material harder than the softest steels. With 50% tungsten the melting point of the alloy is so high that it is not advantageous to increase the tungsten content further.

I have found that a small content of boron, for example 0.2% to 1.25%, greatly increases the hardness of cobalt-tungsten alloys, and if the constituent elements of the boron-containing alloy are properly proportioned the alloy is a suitable material for tools for the high-speed cutting of steel and cast iron. The hardening effect of the boron is well illustrated by the following comparison: An alloy containing 45% tungsten with most of the balance cobalt and no boron had a Brinell hardness of 444 and a scleroscope hardness of 43. Another alloy which differed from the first principally in that it contained 0.66% boron, had a Brinell hardness of 578 and a scleroscope hardness of 56. A third similar alloy containing less boron, (0.39%) had a Brinell hardness of 555 and a scleroscope hardness of 56. The second and third alloys had cutting properties far superior to those of the boron-free alloy.

The cobalt-tungsten-boron alloys are fur-

ther improved both as to hardness and cutting quality by an addition of chromium. One alloy which gave good results as a lathe tool for the high-speed cutting of cast iron and steel had the following composition:

	Per cent
W -----	40.78
Cr -----	11.51
Bo -----	0.61
C -----	0.77

with the remainder chiefly cobalt. The Brinell hardness of this alloy was 600 and the scleroscope 63.

When no chromium, or a very small quantity is added, the boron content may be as high as 1.25%. With a proper boron content the chromium content may be as high as 12%. However, the maximum boron and chromium contents mentioned above should not be present in a single alloy, as the use of both the hardening agents in such quantities causes the alloy to be too brittle. The maximum quantity of boron which can profitably be added when the chromium content is around 12% seems to be a little less than 1%.

I prefer that the tungsten shall not exceed 50% in order that the melting point of the alloy may not be too high. However, alloys with tungsten in excess of 50% have good cutting qualities and I do not intend to restrict myself to tungsten contents of less than 50%. When chromium is present in considerable quantities the tungsten should be somewhat lower than would otherwise be desirable, in order that the alloy may not be too brittle, but the tungsten content should always be above 35% when maximum hardness is desired.

The carbon should not exceed 1.5% and preferably should be below 1.0%. Excessive quantities of carbon in the alloy cause it to be weak and brittle.

The alloy can be made without special difficulty by melting together commercial

grades of cobalt, tungsten and chromium or their alloys with each other. The raw materials must of course be suitably low in carbon. The commercial materials which are available always contain small amounts of impurities such as carbon, manganese, iron and silicon, and, in the case of cobalt, nickel. The quantities of these impurities introduced by reasonably pure raw materials or from other adventitious sources have no serious detrimental effect on the final alloy. If desired, a small addition of manganese may be used for deoxidizing the alloy. The boron may be added to the charge for melting as a compound or alloy such as boron carbide, manganese-boron, or chromium-boron.

The alloys of the invention are non-forgable and tools are prepared from them by casting and grinding as in the case of certain other alloys now in commercial use. To develop the hardness of the alloys they are best cast in highly heat-conductive molds when cutting tools are to be made. If the composition to be cast is such that there is no fear that the resulting casting will be too brittle, a strongly chilling mold, such as a graphite mold, may be used. If, however, the alloy is of a composition adapted to develop a hardness approaching the maximum, a mold of somewhat less chilling capacity, such as a carbon mold, is preferably used.

Alloys comprised in my invention exhibit a high degree of red-hardness, by which is meant that their hardness is almost unimpaired at temperatures up to redness. This property is indispensable in tools for high-speed cutting, and the superiority of the alloys of the invention over alloys of comparable composition but free from boron is chiefly due to the greater red-hardness of the former.

The best lathe tools which I have thus far been able to make from the new alloys described herein are of the following composition:

Tungsten -----	40-50%
Chromium -----	8-12%
Boron -----	0.5-1.0%,

with the remainder chiefly cobalt.

I claim:

1. An alloy consisting chiefly of tungsten, cobalt, and chromium, and containing upward of 35% tungsten, upward of 30% cobalt, a substantial proportion of chromium less than 12%, and between 0.2% and 1.25% of boron.

2. An alloy consisting chiefly of tungsten, cobalt, and chromium, and containing 35% to 50% tungsten, upward of 30% cobalt, a substantial proportion of chromium less than 12%, and between 0.2% and 1.25% of boron.

3. An alloy containing 40% to 50% tungsten, 8% to 12% chromium, and 0.5% to 1.0% boron, with the remainder chiefly cobalt.

4. A tool suitable for high-speed cutting of steel composed of an alloy containing 40% to 50% tungsten, 8% to 12% chromium, and 0.5% to 1.0% boron, with the remainder chiefly cobalt.

5. An alloy suitable as material for tools for the high-speed cutting of steel, said alloy containing at least 30% of cobalt; at least 35% of tungsten, not more than 12% of chromium, and boron 0.2% to 1.25%.

6. An alloy suitable as material for tools for the high-speed cutting of steel, said alloy containing at least 30% of cobalt; at least 35% of tungsten; not more than 12% of chromium; and 0.5% to 1.0% of boron; and being substantially free from nickel.

In testimony whereof, I affix my signature.

BURNHAM E. FIELD.