

UNITED STATES PATENT OFFICE

2,235,232

METAL ALLOY

Lewis A. McElroy, Erie, Pa., assignor to The
Macolite Company, Millcreek Township, Erie
County, Pa., a corporation of Pennsylvania

No Drawing. Application December 27, 1938,
Serial No. 247,949

1 Claim. (Cl. 75-176)

This invention relates to a metal alloy particularly designed for use in the manufacture of articles such as tools and cutting implements wherein are required the qualities of hardness, toughness and elasticity, together with the capacity of taking and retaining a sharp cutting edge.

The alloy of my invention has greatly increased toughness and resistance to shock over the average chrome, cobalt and tungsten alloys in general use as cutting tools.

An alloy of tungsten, chromium and cobalt has for years been used as a cutting alloy. This shows valuable qualities of red shortness or the ability to retain its hardness even at red heat. It is also very hard, but quite brittle and will not stand shock. This limits somewhat its use as a metal cutting alloy as the tool will shatter when it receives a sudden shock as it often does when turning down rough out-of-round forgings where the tool contacts the metal only in spots as the forging revolves in the lathe.

To counteract this brittleness molybdenum is sometimes added to the alloy. This metal being softer and more ductile, has the effect of toughening the alloy, but at the same time, due to its qualities it reduces the hardness of the alloy with the resultant effect that its cutting qualities are impaired.

By a new method I am able to counteract this brittleness and at the same time retain the hardness and other valuable qualities of the original alloy. I accomplish this by the addition of varying percentages of zirconium having deoxidizing properties, and especially valuable in enabling me to obtain the desired properties in the alloy of my invention.

In carrying out my invention I preferably use a high frequency electric transformer and crucible, capable of maintaining a temperature of 3500 degrees Fahrenheit, and my method differs mainly from the method in common use, in that by the use of zirconium I am able to obtain a very fine grained structure.

To accomplish this, certain percentages of chromium, cobalt and tungsten are placed in a crucible and melted at a high heat between 3000 and 3500 degrees Fahrenheit, preferably about 3400 degrees Fahrenheit.

The chromium and cobalt with a melting point of less than 3000 degrees Fahrenheit will have melted but the tungsten with a melting point of approximately 6150 degrees Fahrenheit will not have melted, but will have been dissolved and taken into solution by the matrix of the other

two metals, namely chromium and cobalt. When the desired temperature, approximately 3400 degrees Fahrenheit has been reached I introduce the zirconium in a closed container, so that it may be immediately immersed in the molten bath without exposure to the atmosphere.

The molten bath is then held in this temperature for a period of from twenty to thirty minutes, or longer, before pouring into molds and casting into the shapes desired.

Without the obstructing and deoxidizing agent present, when the alloy cools, the grains grow to large size and the tungsten is thrown out of solution on the grain borders. Because of this large grain size, the amount of tungsten collecting between the grains is large and the adhesion of the grains to each other is weakened, causing brittleness of the alloy.

By the addition of zirconium the oxides of the metal formed in melting the alloy are reduced and zirconium oxide is formed. This is a very minute particle. These oxides are scattered throughout the alloy. On cooling, when the grains start forming, a separate grain starts with each one of these particles as a nuclei. Consequently with so many grains starting to form at once their size is quite small when they come in contact with each other and their growth is stopped. Whereas, without the presence of an obstructing and deoxidizing agent, there are only a few nuclei for the grains to start on, and only a small number of grains forming. Therefore, they grow to large size before coming in contact with each other and their growth is stopped. Thus it is that by the amount of zirconium used the size of the grain in the alloy can be controlled, and what is more important, the amount of tungsten that is thrown out will be thoroughly distributed throughout the mass, and will not exist in large concentrated plates as it is when no obstructing and oxidizing agent is used.

Thus, by changing my method of producing the alloy from the simple one of just remelting the metals desired in the alloy, to that whereby these metals are subject to the obstructing and deoxidizing effects of zirconium, after the melting has taken place, melted at a temperature of over 3000 degrees Fahrenheit, holding it at that temperature for a period of from twenty to thirty minutes, or longer, I am able to control the structure and grain refinement of the mass so that the resultant cutting qualities of the alloy are far superior to that obtained in the past.

As an example: I have produced an alloy con-

- sisting of 35% of chromium, 47% of cobalt, 15% of tungsten, with 3% of zirconium added to the bath at the proper time and under the proper conditions as hereinbefore described, that not
- 5 only retains its hardness and cutting edge at all cutting temperatures, but also has the added quality of cutting at exceptionally high speed, and being able to resist sudden shock without shattering.
- 10 Lathe tools made of my alloy, when used to turn down high carbon chrome-nickel-molybdenum steel forgings have enabled the lathe operator to increase the R. P. M. of his lathe fully 50% faster than that permissible when using
- 15 other tools, and at the same time taking deeper cuts and feeds.
- As a specific example: A certain machining operation on a high carbon chrome-nickel-molybdenum steel forging at a local forge com-
- 20 pany took approximately twenty-four hours to complete.

When a tool made of my alloy was used to

turn down a similar forging, the tool speed was increased from 30 feet per minute to 85 feet per minute with the result that the operation was completed in nine hours.

Depending upon the particular purpose for 5 which the alloy is to be used, I vary the percentages of the ingredients of my alloy.

I have secured good results using 32% of chromium, 50% of cobalt, 15% of tungsten with 3% of zirconium added as hereinbefore described. 10

On a high carbon steel shaft 12 inches in diameter, turned down with a tool made of my alloy, the tool traveled 30 inches on the shaft in five minutes, or at the rate of 226 feet per minute. 15

What I claim as new is:

A metal alloy consisting of zirconium, 1 to 10%, and the balance to make 100% of chromium, cobalt and tungsten in the proportions based on the total mass, chromium 25 to 40%, 20 cobalt 40 to 60%, tungsten 10 to 20%.

L. A. McELROY.