UNITED STATES PATENT OFFICE.

HUGH S. COOPER, OF CLEVELAND, OHIO, ASSIGNOR TO THE GENERAL ALLOYS COMPANY, A CORPORATION OF OHIO.

ALLOY.

1,277,046. Specification of Letters Patent. Patented Aug. 27, 1918.

No Drawing. Original application filed February 23, 1918, Serial No. 218,791. Divided and this application filed April 17, 1918. Serial No. 229,173.

To all whom it may concern:

Be it known that I, HUGH S. COOPER, citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Alloys, of which the following is a specification.

This invention relates to an alloy of relatively low-melting point having properties which make it superior to known high-speed steels used for cutting tools, and in this connection reference may be had to my co-pending application for Letters Patent for an alloy. Ser. No. 218,791, filed February 23, 1918, of which this application is a division. The present alloy comprises nickel or cobalt, zirconium, aluminum and silicon, or their equivalents, together with one or more metals of the chromium group, for example, tungsten, molybdenum, chromium or uranium. Thus, while the alloy described in my other application for Letters Patent has very desirable properties and characteristics and forms the base of the present alloy, I have found that the addition of one or more of the metals of the chromium group improves the cutting efficiency of the alloy. For example, the addition of about four per cent. tungsten to the quaternary alloy hereinbefore described will increase the cutting time of the tools before burning about one hundred per cent.; the addition of seven per cent. tungsten will increase the time one hundred fifty per cent.; the addition of twelve per cent. tungsten will increase the time about two hundred per cent. The limit apparently is reached with approximately twenty five per cent. tungsten, for beyond this the alloys become more brittle. Small amounts of chromium, molybdenum, or uranium may also be added in some cases and proved beneficial.

The present alloy may be produced by any suitable method or process, but I prefer to make the alloy by reduction with powdered aluminum and by practising the method described in my co-pending application. Illustrating my general method, the desired proportion of nickel oxid black, and Brazilian zirkite carrying a minimum of about 80% zirconium oxid and about 15% silica, is ground to 200 mesh, sifted, dried and thoroughly blended with the desired amount of 200 mesh aluminum. This mixture is transferred to a crucible or other suitable container lined with magnesia or alumina, and lighted with magnesium ribbon or otherwise. After the reaction when the slag has solidified the metal is tapped and transferred into a standardizing furnace and the desired amount of metal of the chromium group is then dissolved into the molten alloy. More nickel may also be added if the alloy is too hard. After standardization the alloy is poured into molds made of carbon or other suitable material. The more desirable alloys comprise one to ten per cent. silicon, one to twelve per cent. aluminum, one to twenty per cent. zirconium, one to twenty-five per cent. tungsten, and the balance nickel or cobalt. The nickel or cobalt is always in preponderating amount.

In practice, to cut down the manufacturing cost it is desirable to make a composition showing a scleroscopic hardness of eighty to ninety, but a composition of this hardness does not possess sufficient strength to be most efficient for cutting tools. An alloy showing a hardness of fifty-eight to sixty-five will cut most any metal encountered in commercial practice; therefore, more nickel is added to a given composition which is harder than fifty-eight to sixty-five, thereby increasing the strength and toughness of the composition. For example, a given composition of nickel, aluminum, silicon and zirconium having an excess hardness, may be improved by adding four per cent. of tungsten and twenty-four per cent. more nickel. However, by increasing the percentage of tungsten, the amount of nickel to be added may be reduced to less than twenty-four per cent.

The following table shows several different compositions of value and utility within the range and scope of my invention:

Aluminum, approx.	7.92	7.70	7.48
Silicon, approx.	3.80	3.50	3.40
Zirconium, approx.	6.48	6.30	6.12
Nickel, approx.	78.00	75.50	71.00
Tungsten, approx.	4.00	7.00	12.00

However, I do not limit myself to the exact proportions given; I may use more or less nickel or its equivalent, and under or over one per cent. of each of the other metals or their equivalents.

What I claim is:

1. An alloy, comprising a preponderating amount of a metal in the iron group, which is resistant to oxidation, a relatively small amount of aluminum, silicon and zirconium, and a metal in the chromium group.

2. An alloy, composed of a high per centage of nickel, a relatively small amount of aluminum, silicon and zirconium, together with a metal in the chromium group not to exceed twenty-five per cent. of the composition.

3. An alloy, comprising nickel, zirconium, aluminum, silicon, and a metal of the chromium group, in which the amount of nickel is greatest, and the amount of zirconium, and aluminum and silicon together is greater than the metal of the chromium group.

4. An alloy, comprising nickel, zirconium, aluminum, silicon and tungsten, in which the proportion of nickel is greater than all the other metals combined, and the zirconium is less than the aluminum and silicon together, and the tungsten not in excess of twenty-five per cent. of the whole.

5. An alloy, comprising a metal in the iron group, one to twenty-five per cent. of a metal in the chromium group, one to twenty-five per cent. of zirconium, one to twelve per cent. of aluminum, and one to per cent. of silicon.

6. An alloy, comprising a high per centage of nickel, relatively lesser percentages of zirconium and aluminum, and a small amount of silicon, together with a small percentage of a metal belonging to the chromium group of metals.

7. An alloy, comprising one to ten per cent. silicon, one to twelve per cent. aluminum, one to twenty per cent zirconium, and one to twenty-five per cent. tungsten, the balance being a metal of the iron group.

8. An alloy, comprising seventy to eighty per cent. nickel, four to twelve per cent. tungsten, seven to eight per cent. aluminum, six to seven per cent. zirconium, and three to four per cent. silicon.

Signed at Cleveland, in the county of Cuyahoga, and State of Ohio, this 2nd day of April, 1918.

HUGH S. COOPER.