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LIGHT ALUMINUM ALLOY AND METHOD OF PRODUCING SAME.

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To all whom it may concern:

Be it known that VICTOR EVERS HYBINETTE, a citizen of the United States, residing at Monrovia, in the county of Los Angeles and State of California, has invented certain new and useful Improvements in Light Aluminum Alloys and Methods of Producing Same, of which the following is a specification.

My invention relates to a light aluminum alloy and process of making same, the principal object of my invention being to produce, by a relatively simple and easily practiced method, an aluminum alloy that is relatively light in weight and which may be advantageously used for many purposes in the mechanical arts.

Practically all light aluminum alloys that are on the market to-day have as the main ingredient, alloying metals, copper, manganese and magnesium. These alloys have to be heat treated to obtain their maximum strength and suffer also from the fault of not having sufficient elongation or sufficient ductility for cold working. It has also been known that nickel added to aluminum increases its strength somewhat, gives it a better color and particularly improves its ductility.

The object of my research work has been to compound an alloy, which combines great ductility, when soft, with great strength when hard-rolled. The basis of my alloying mixture of metals is nickel, or nickel and cobalt in any suitable proportion. As a further strengthener of the metal, I add metals of the chromium group, and for hardening purposes, I add iron, manganese, copper and similar metals in varying proportions.

When, therefore, in the following, the expression "nickel" is used, I mean thereby, nickel and cobalt in any proportion; and when the expression "the chromium group" is used, I mean thereby, the metals chromium, molybdenum and tungsten, either any one or two or three mixed in any proportion. Finally, when I speak of the "hardening group," I mean thereby, iron, manganese and copper, either one or more, mixed in any proportion.

I have found that an alloy of aluminum with considerable quantities of chromium, tungsten and molybdenum can be easily made, if these metals, eventually in the presence of other heavy metals, are first alloyed with preferably about an equal or greater quantity of nickel or cobalt and such nickel alloy afterwards introduced, preferably in the molten state, into molten aluminum.

I have discovered that the ordinary low carbon ferroalloys of the chromium group can be used for my purpose, not only without detriment, but to real advantage, inasmuch as carbon and iron contained in such ferroalloys constitute helpful ingredients. This is of considerable importance because of the lower cost of such alloys, compared with that of metals produced from oxides by reduction with aluminum. It seems that carbon, partly at least forms a gas that burns on the surface of the molten alloy and it may be that hydrogen contained in the metals, is so removed.

I find that an alloy of aluminum with nickel and metals of the chromium group can be further improved as to strength and hardness by the addition of such metals as iron, manganese, copper and possibly smaller amounts of tin, lead, silver, titanium or the like.

In the following I shall therefore refer to the different ingredients as the nickel group, the chromium group and the hardening group.

For special purposes, magnesium may be introduced as a hardener, but the alloy loses part of its ductility and resistivity to corrosion thereby.

The proportions which I have found most favorable are three parts of the nickel group, to one part of the chromium group and two parts of the hardening group.

The total amount to be used of all the metals or groups combined, depends upon the ultimate use for which the product is intended, and may be varied between one per cent and six per cent, the lower percentage having the greatest ductility and the higher, the greatest strength.

I consider molybdenum preferable to tungsten and tungsten to chromium, and in the hardening group, copper and iron are best.

I have also found that a better alloy can be made by using several metals of the different three groups, instead of one of each group.

As to the hardening group, it is unfortunately necessary to allow a considerable amount of iron in the alloy, because it is contained in the ingredients as an impurity,

but with the other two metals I obtain better results with a mixture of copper and manganese, than with either one of the metals alone. The reason why an alloy containing small quantities of several metals is more plastic than an alloy containing larger quantities of a few metals, is probably that in that way, segregations are avoided.

In the following table, I am giving the optional proportions, with the preferred proportions.

	Optional and preferred proportions.			
	Min. *Per cent.*	*Max.* *Per cent.*	*Preferred.* *Per cent.*	
Nickel	0.50	3.00	----------	Nickel group.
Cobalt	0.50	3.00	1.50	
Chromium	0.10	0.75	----------	Chromium group.
Tungsten	0.10	0.75	0.50	
Molybdenum	0.10	0.75	----------	
Copper	0.10	0.75	----------	Hardening group.
Manganese	0.10	0.75	1.00	
Iron	0.10	1.00	----------	

The best alloy that I have been able to produce so far contains about

	Per cent.
Nickel	1.50
Chromium	0.15
Tungsten	0.15
Molybdenum	0.15
Copper	0.30
Manganese	0.20
Iron	0.55
	3.00

For alloys of great ductility where strength is not so important, the hardening group can be left out entirely, but the same result can be obtained by using less of the combined metals.

I have found that silicon, which is always present in aluminum, is not detrimental and can be tolerated in the alloy to the extent of about one per cent and for casting purposes, even more.

In producing my alloy I proceed as follows:

I melt together the heavy metals in the desired proportions, in an electric furnace, or in any other type of furnace that is capable of giving sufficiently high temperature. The molten alloy is then poured into molten aluminum, in such quantity that the resulting alloy will contain approximately 60 to 75 per cent aluminum, preferably 75 per cent. This primary alloy has the faculty of dissolving very readily in molten aluminum.

The preferred alloy, when hard rolled, has a tensile strength of 50 to 60 thousand pounds per square inch, with an elongation of 3 per cent, and when annealed, a tensile strength of 30 to 35 thousand pounds, elastic limit of 20 to 25 thousand pounds and elongation of 20 to 25 per cent.

One great advantage is, that the alloy can be annealed and worked hot within wide limits of temperature, without differing results. When worked cold, it does not harden as fast as similar alloys with a copper base.

By addition of magnesium to the final alloy, a capacity for heat treatment and higher strength is imparted to the alloy.

I claim as my invention:

1. A light aluminum alloy consisting of over 90 per cent aluminum, and the remainder consisting mainly of nickel and metals of the chromium group, in the proportion of about 0.50% to 3.0% nickel and from about 0.25% to 1.50% metals of the chromium group.

2. A light aluminum alloy, as specified in claim 1, in which any of the metals, iron, manganese and copper are added for hardening purposes, in the amount of from 0.1% to 1.0%.

3. In a light aluminum alloy, as set forth in claim 2, the use of small quantities of several of the metals of the chromium group and of the hardening metals, producing an alloy of greater ductility than if a larger quantity of one metal in each group were used.

4. The process of introducing chromium, tungsten and molybdenum in aluminum consisting in first producing an alloy of nickel, with such chromium group metals and pouring such molten alloy into molten aluminum.

5. The process of producing a light aluminum alloy consisting mainly of aluminum, nickel and metals of the chromium group, in which a primary alloy is first made by using nickel with metals of the chromium group, pouring such fused alloy into molten aluminum, producing a primary alloy containing about 50 to 75 per cent aluminum and using such primary alloy for producing the final alloy.

6. The process of introducing chromium, tungsten and molybdenum in aluminum which consists in first producing an alloy of nickel with metals of the chromium group in the form of ferroalloys containing carbon and mixing such molten alloy with molten aluminum.

7. As a merchantable article of commerce, a primary alloy of from about 60–75% aluminum and the remaining 25–40% consisting of nickel to the extent of about one-third to three-quarters and the remainder consisting partly at least of metals of the chromium group.

In testimony whereof I affix my signature.

VICTOR EVERS HYBINETTE.