United States Patent Office

3,843,358

Patented Oct. 22, 1974

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3,843,358

MASTER ALUMINUM COBALT ALLOY

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No Drawing. Continuation-in-part of abandoned application Ser. No. 54,563, July 13, 1970. This application Dec. 1, 1970, Ser. No. 94,191

Int. Cl. C22c *21/00*

U.S. Cl. 75—147 3 Claims

ABSTRACT OF THE DISCLOSURE

Master aluminum alloy containing from about 8% to about 64% by weight cobalt, about 8% to about 52% iron, about .04% to about 40% of magnesium, and from about 24% to about 83.96% by weight aluminum. The alloy is particularly suited for use with additional amounts of aluminum in preparing a commercial alloy which may be cast, rolled and drawn into an electrically conductive aluminum alloy wire having improved properties of increased thermal stability, tensile strength, percent ultimate elongation, ductility, fatigue resistance and yield strength. The alloy may also be used in the preparation of articles of commerce conventionally prepared from aluminum alloys.

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of our copending application Ser. No. 54,563, filed July 13, 1970, now abandoned.

DISCLOSURE

The present invention concerns an aluminum base alloy especially suited for use in preparing high strength lightweight articles of manufacture. The present alloy is particularly well suited for use in preparing wire, rod, cable, connectors, bus bars, receptacle plugs, or other electrical contact devices for conducting electricity.

It is an object of the present invention to provide a new aluminum master alloy which may be blended with additional amounts of aluminum to provide a commercial aluminum alloy which is suitable for use in manufacturing improved electrical conductors. It is an alternative object of the present invention to provide a new aluminum alloy which is suitable for use in preparing conventional articles of manufacture such as structural members, fasteners, automotive parts and the like.

In accordance with the present invention, the aluminum base master alloy is prepared by mixing cobalt, iron and magnesium with aluminum in a furnace to obtain a concentrated melt having requisite percentages of elements in solution. It has been found that suitable results are obtained with cobalt present in a weight percentage of about 8% to about 64%. Superior results are achieved when cobalt is present in a weight percentage of about 10% to about 20% and particularly superior and preferred results are obtained when cobalt is present in a percentage by weight of about 12% to about 16%.

Suitable results are obtained with iron present in a weight percentage of about 8% to about 52%. Superior results are achieved when iron is present in a weight percentage of 8% to about 16% and particularly superior and preferred results are obtained when iron is present in a percentage by weight of about 9% to about 13%.

Suitable results are obtained with magnesium present in a weight percentage of about 0.04% to about 40%. Superior results are achieved when magnesium is present in a weight percentage of about 0.5% to about 10% and particularly superior and preferred results are obtained when magnesium is present in a percentage by weight of about .6% to about 2%.

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The aluminum content of the present alloy may vary from about 24% to about 83.96% by weight with superior results being obtained when the aluminum content varies between about 60% and 81.5% by weight. Particularly superior and preferred results are obtained when aluminum is present in a weight percentage of about 70% to about 78.4%. Since the percentages for maximum and minimum aluminum do not correspond with the maximums and minimums for alloying elements, it should be apparent that suitable results are not obtained if the maximum percentages for all alloying elements are employed.

During preparation of the alloy, the aluminum component prior to adding to the melt may be supplied from a high purity aluminum or a commercial aluminum alloy so long as the trace elements other than cobalt, iron and magnesium are less than 0.05 weight percentage each and 0.1 weight percentage total. The addition of cobalt, iron and magnesium should then be adjusted depending upon the concentration of that element in the commercial aluminum alloy.

PREPARATION OF MASTER ALLOY

The master alloy is prepared in a furnace by adding aluminum, elemental cobalt, elemental iron and elemental magnesium to achieve the desired percentages for components. Of course, it should be understood that the preparation of the master alloy may begin with the production of an intermediate iron master alloy, cobalt master alloy or magnesium alloy or combinations of the two. The intermediate alloy would then be added to a furnace with requisite percentages of the remaining elements to achieve the desired master alloy element concentration.

The furnace is heated to a temperature of about 750° C. to about 1650° C. for a period of time until all the components of the alloy are in solution. During the preparation of the master alloy, it is preferred that an induction furnace be used since inherent agitation of the melt is obtained with this furnace. Other furnaces such as an electric or gas fired furnace may be used with a stirring apparatus in place of a degassing mechanism to insure uniform distribution of alloying elements in the aluminum.

After a solution of elements and aluminum is obtained, the master alloy melt is poured into ingot molds and cooled to a solid condition.

The ingots of master alloy are preferably used in preparing a commercial alloy containing at least 97% aluminum. The commercial alloy is prepared by adding a base aluminum alloy containing less than 0.1% by weight elements other than cobalt, iron and magnesium to a furnace. Conventionally the concentration of iron and magnesium in a base aluminum alloy is less than 0.3% by weight and the concentration of cobalt in a base aluminum alloy is less than 0.001% by weight. The temperature of the base aluminum alloy in the furnace is increased to a point above its melting point, normally from 1° to 100° C. above the melting point, and the base alloy melts to a liquid. Requisite amounts of master alloy ingots are then added to the melt of base alloy (due consideration being given to the concentration of alloying elements in the base alloy) to obtain a desired concentration of alloying elements in aluminum. The temperature of the mixture of base alloy and master alloy is then increased to a point above the melting point of the master alloy, normally from 1° to 100° above the master alloy melting point, and the master alloy melts and dissolves in the base alloy. Through the use of the master alloy, the alloying elements go into solution in the base alloy expediently since those elements are in solution in the aluminum of the master alloy.

It is preferred that an induction furnace be used during the preparation of the commercial alloy since inherent agitation is obtained with this furnace. Other furnaces, such as electric and gas fired furnaces, may also be used with an appropriate stirring apparatus in place or a degassing mechanism to insure proper agitation.

The previously described method of preparing a commercial alloy is preferred in the present invention. However, it should be understood that suitable results are obtained when molten master alloy is added to molten base aluminum alloy or molten base aluminum alloy is added to molten master alloy. Of course, ingots of master alloy may also be added to a furnace or metal conveying system prior to the addition of a molten base aluminum alloy.

The commercial aluminum alloy may then be cast into ingots for subsequent use in the preparation of conventional metallic articles of manufacture or may be cast into a continuous bar which is rolled and drawn into wire of various gauges and various physical properties depending upon the exact concentration of alloying elements in the aluminum of the alloy.

An alternative but suitable use for the master alloy as prepared is in the preparation of conventional articles of manufacture such as structural members, fasteners, automotive parts and the like. The master alloy may either be cast from a molten condition into the desired article of manufacture or an ingot of master alloy may be forged and otherwise worked into the desired article of manufacture.

A more complete understanding of the invention will be obtained from the following examples:

EXAMPLE NO. 1

A master alloy melt is prepared at a temperature of 1050° C. by adding 20 pounds of elemental cobalt, 14 pounds of elemental iron, 6 pounds of elemental magnesium and 60 pounds of aluminum to an induction furnace. The melt is held in the furnace until all the allowing elements are in solution as shown by spectrographic analysis of melt samples. The molten master alloy is then poured into ingot molds and cooled to a solid condition.

After cooling, an ingot is reheated to a molten condition and cast into several commercial articles of manufacture such as pans, containers and fasteners.

EXAMPLE NOS. 2 THROUGH 11

A master alloy melt is prepared as in Example No. 1 except that the following temperatures of melts and amounts of alloying elements are employed:

Example number	Co	Fe	Mg	Al	Temps., °C.
2	20	14	6	60	1,050
3	26	20	4	50	1,120
4	30	22	3	45	1,180
5	35	15	5	45	1,200
6	17	13	8	62	1,030
7	41	14	4	41	1,250
8	18	32	6	44	1,030
9	20	25	10	45	1,050
10	18	12	20	50	1,030
11	32	26	1.4	40.6	1,190

NOTE.—All of the above amounts are in pounds.

While this invention has been described in detail with particular reference to preferred embodiments thereof, it will be understood that variations and modifications can be effected within the spirit and scope of the invention as described hereinbefore and as defined in the appended claims.

We claim:

1. An aluminum alloy consisting essentially of about 10% to about 20% by weight cobalt, about 8% to about 16% by weight iron, about 0.5% to about 10% by weight magnesium, and from about 81.5% to about 60% by weight aluminum.

2. The aluminum alloy of claim **1** consisting essentially of about 12% to about 16% by weight cobalt, about 9% to about 13% by weight iron, about 0.6% to about 2% by weight magnesium and from about 78.4% to about 70% by weight aluminum.

3. Method of making a master aluminum alloy ingot consisting essentially of heating a mixture of 10% to 20% by weight cobalt, 8% to 16% by weight iron, 0.5% to 10% by weight magnesium and 81.5% to 60% by weight aluminum in a furnace at a temperature of 750° C. to 1650° C. until the mixture forms a molten mass; pouring the molten mass into an ingot mold; and cooling the mold to solidify the molten mass into an ingot.

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U.S. Cl. X.R.

75—122, 124, 129, 134 F, 170