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UNITED STATES PATENT OFFICE.

RODERICK L. JOHNSTON, OF NEW YORK, N. Y., ROBERT S. ARCHER, OF EAST CLEVELAND, AND ZAY JEFFRIES, OF CLEVELAND HEIGHTS, OHIO, ASSIGNORS TO ALUMINUM COMPANY OF AMERICA, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

ALUMINUM ALLOY.

No Drawing. Application filed November 27, 1920. Serial No. 426,793.

To all whom it may concern:

Be it known that we, RODERICK L. JOHNSTON, ROBERT S. ARCHER, and ZAY JEFFRIES, all citizens of the United States, the said Johnston residing at New York, Kings County, State of New York, and the remaining two at East Cleveland and Cleveland Heights, respectively, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Aluminum Alloys, of which the following is a full, clear, and exact description.

The presence of small amounts of silicon in aluminum and in aluminum alloys is usually considered objectionable. In the course of an investigation upon the effects of silicon we have discovered that by using a substantial amount of silicon, materially greater than the quantity usually found as an impurity, with the addition of a metal or metals, for example one or more of those hereinafter named, it is possible to produce an alloy having excellent casting qualities combined with good physical properties.

Among the metals capable of forming solid solutions in the aluminum we have found copper and zinc particularly advantageous. The metals referred to may be used singly or in combination. In the use of copper alone, the silicon content of the alloy should in general be not less than about 3 per cent nor more than about 10 per cent, and the copper should be preferably from about 2 per cent to about 5 per cent; the proportions of copper and silicon being variable, however, according to the particular combination of properties desired. In general, the attainment of good casting qualities depends largely upon the relative proportions of the silicon and copper, the latter being preferably reduced as the former is increased, and vice versa. Increasing the copper, at least up to the limit of its capacity for entering into solid solution in the aluminum, tends in general to increase the tensile strength, especially if subjected to a suitable heat treatment, say that described in the copending application of Zay Jeffries and Robert S. Archer, Serial No. 435,024. A test bar cast in sand in the ordinary way, of an aluminum alloy containing 10 per cent silicon and 3 per cent copper, showed a tensile strength of about 23,000 pounds per square inch and an elongation of about 1.5 per cent in two inches. Such a bar, after heat treatment by the method described in the above mentioned application, showed an increase of tensile strength up to 30,000 pounds per square inch and an increase of elongation up to 2.5 per cent. A bar of the same alloy but cast in a chill mold, in order to cause rapid solidification of the molten metal, was found to have a tensile strength of about 30,000 pounds per square inch and an elongation of about 2.7 per cent, even without heat treatment. A similar bar, heat treated, had a tensile strength of 40,000 pounds per square inch and 6 per cent elongation. On the other hand, a chill-cast heat-treated bar of an alloy containing about 6 per cent silicon and about 4 per cent copper was found to have a tensile strength exceeding 42,000 pounds per square inch and an elongation exceeding 8 per cent in 2 inches.

The addition of zinc up to about 5 per cent has a slight effect on the tensile strength of the alloy. Above that amount a greater increase of tensile strength is observed. The presence of the zinc is often an advantage by reason of the whiter color of the polished alloy. We have found that with the addition of an alkali metal or metals to the alloy, as described in the copending application of Junius D. Edwards, Francis C. Frary and Harry V. Churchill, Serial No. 426,796, now Patent No. 1,410,461, issued March 21, 1922, very satisfactory physical properties can be obtained along with the other advantages incident to the presence of the zinc, particularly if the alloy to which alkali metal has been added is cast in such a manner, as for example by the use of a chill mold, that the molten metal is caused to solidify rapidly. For instance, an alloy containing about 10 per cent zinc and about 8 per cent silicon, to which alkali metal had been added and which was cast in a chill mold, has been found to have a tensile strength exceeding 42,000 pounds per square inch, with an elongation up to 7 per cent in two inches. A similar casting, after being subjected to

the heat treatment described in the above mentioned application of Archer and Jeffries, showed a decrease of tensile strength to about 35,000 pounds per square inch, but an increase of elongation up to 14 per cent.

In the case of aluminum-silicon alloys containing both copper and zinc, a sand cast test bar of an alloy containing 8 per cent silicon, 10 per cent zinc and 2.5 per cent copper, was found to have a tensile strength of 27,000 pounds per square inch and an elongation of 1.5 per cent. This alloy is also susceptible to improvement by addition of alkali metal before casting; sand cast specimens of the alloy so treated having a tensile strength of 30,000 pounds per square inch with an elongation of 2 per cent, while chill cast specimens have a tensile strength of 38,000 pounds per square inch and an elongation of 3.5 per cent. Heat treatment by the method described in the application of Archer and Jeffries before referred to has been found to increase the tensile strength of the chill cast alloy up to 45,000 pounds per square inch and at the same time increase the elongation to 7.5 per cent.

In the alloys referred to above we have observed that the elongation is better if the iron content is low, and for that reason there are many cases where the iron should not exceed about 0.6 per cent. In other cases much higher iron can be used, especially in chill castings, as for example pressure die castings.

The alloys described herein are also well adapted to forging and like operations.

We claim:

1. An alloy composed chiefly of aluminum, containing a substantial amount of silicon and substantial amounts of copper and zinc.

2. An alloy composed chiefly of aluminum, containing a substantial amount of silicon, copper not exceeding about 5 per cent, and a substantial amount of zinc.

3. An alloy composed chiefly of aluminum, containing a substantial amount of silicon, copper not exceeding about 5 per cent, and zinc not exceeding about 15 per cent.

4. An alloy composed chiefly of aluminum, containing substantial amounts of silicon and copper, and zinc up to about 15 per cent.

5. An alloy composed chiefly of aluminum, containing silicon in substantial amount but not exceeding about 10 per cent, and substantial amounts of copper and zinc.

6. An alloy composed chiefly of aluminum, containing between 3 and 10 per cent silicon, approximately, and substantial amounts of copper and zinc.

7. An alloy composed chiefly of aluminum, containing between 3 and 10 per cent silicon, approximately, copper between 2 and 5 per cent, approximately, and a substantial amount of zinc.

8. An alloy composed chiefly of aluminum, containing between 3 and 10 per cent silicon, approximately, a substantial amount of copper, and zinc between 5 and 15 per cent, approximately.

9. An alloy composed chiefly of aluminum and low in iron, containing copper between 2 and 5 per cent, and silicon between 3 and 10 per cent, approximately.

10. An alloy composed chiefly of aluminum and low in iron, containing 4 per cent copper and 6 per cent silicon, approximately.

11. An alloy composed chiefly of aluminum, containing a substantial amount of silicon and substantial amounts of copper and zinc, with an iron content not exceeding about 0.6 per cent.

12. An alloy composed chiefly of aluminum, containing copper between 2 and 5 per cent, and silicon between 3 and 10 per cent, approximately, with an iron content not exceeding about 0.6 per cent.

In testimony whereof we hereto affix our signatures.

RODERICK L. JOHNSTON.
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ZAY JEFFRIES.