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ALUMINUM ALLOYS

Isamu Igarashi and Goro Kitahara, Fuse, Japan, assignors to Sumitomo Kinzoku-Kogyo Kabushiki Kaisha, Osaka, Japan

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1 Claim. (Cl. 75—141)

This invention relates to improved light alloys having high tensile strength consisting of zinc, copper, magnesium, manganese, chromium, calcium and aluminum, and has for its object to provide light alloys devoid of season cracking.

Hithertofore, such light alloys as E alloys and Sander's alloys which consist of copper, zinc, magnesium, manganese, and the rest of aluminum have been known as having high tensile strength, but where the utmost strength and durability are required, they were unsuitable for use due to their harmful nature of season cracking. This present invention accordingly is to obviate the above mentioned defect and to provide an alloy which is well adapted for use where non-season cracking is essential.

After a long series of tests and investigation, it was discovered that the addition of 0.05–1% chromium and 0.01–0.2% of calcium to the known alloys, was effective in eliminating from the alloys the defect of season cracking without sacrificing their tensile strength. Moreover, these elements are capable of making the grain structure of the alloys in the cast state much finer and consequently give them the ability to be forged; and these elements have a tendency to increase a fluidity in the molten metal in the refining process. Still further, the presence of not more than 1% of iron or silicon as impurities does not give any inferior quality to the alloys. The present invention accordingly provides aluminum alloys containing 1–3% of copper, 4–20% of zinc, 1–2% of magnesium, 0.1–2% of manganese, 0.01–0.5% of chromium, 0.01–0.2% of calcium, and less than 1% of iron and silicon as impurities.

With reference to the test pieces which had been properly quenched and tempered, the tensile tests and the season cracking test were conducted with utmost care. Strips of 1 mm. in thickness, 2 mm. in width, and 200 mm. in length, made of many different aluminum alloys were hardened by heating them up to 450° C. and suddenly cooled in water. After this, they were annealed at a temperature of 125° C. for about 24 hours. Then they were bent so that the inner surface of both ends of the strips met, and they were tied up with wires at points 20 mm. from each end, and were left alone, special attention being paid to the middle part of the strips to see whether or not cracks would appear in the course of time.

The results of the above mentioned experiments, the compositions of the test pieces used, namely, E alloy, Sander's alloy and some representative alloys of the present invention, are presented in the following table.

No.	Composition, percent							Tensile strength	Elongation at 50 mm.	Crack
	Cu	Zn	Mg	Mn	Ca	Cr	Al			
								Kg/mm.²	*Percent*	
1	2.5	20	0.5	0.5	------	------	Rest	60	10	Appears within 1 day.
2	------	8	1.5	0.5	------	------	------do----	55	15	Do.
3	2	8	1.5	0.5	------	------	------do----	59	14	Do.
4	2	8	1.5	1.2	0.02	0.25	------do----	59.6	15	No appearance even after 1 year.
5	2	8	1.5	1.5	0.04	0.25	------do----	61.0	14	Do.
6	2.5	10	1.5	1.5	0.05	0.25	------do----	60.0	14	Do.
7	2	8	1.5	0.5	0.03	0.30	------do----	59.8	15	Do.

Pieces 1 and 2 in the above table represent famous light alloys widely known as E alloy and Sander's alloy respectively. Piece 3 is about the same in the range of constituents and their composition as Nos. 4 to 7, but is lacking in chromium and calcium content. Pieces No. 4 to 7 are the alloys made according to this present invention. It is clear from the above table that an addition of a small percentage of chromium and calcium to the alloys gives them a remarkable resistance to season cracking and forgeability. The light alloys of the present invention, therefore, are peculiarly well suited for use in many purposes where high tensile strength and non-season cracking are essential as in case of materials for aeroplane manufacturing.

To make the alloys, three different mother alloys consisting of aluminum and copper, of aluminum and manganese, and of aluminum and chromium should first be prepared, and these three alloys are melted together with aluminum, to which are further added magnesium and zinc. Experiments show that an addition of 0.01 to 2% of molybdenum or 0.01 to 0.5% of titanium to the alloys increases the quality of the alloys to a large extent.

What we claim is:

Aluminum alloys consisting of 4–20% of zinc, 1–3% of copper, 1–2% of magnesium, 0.1–1.5% of manganese, 0.05–1.0% of chromium, 0.01–2% of molybdenum, 0.01–0.2% of calcium and the rest of aluminum, characterized by ready forgeability and by resistance to season cracking.

ISAMU IGARASHI.
GORO KITAHARA.