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ALUMINUM ALLOY

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This invention relates to aluminum base alloys which are possessed of high tensile properties, excellent resistance to corrosion, and the further property of retaining a substantial part of their original surface appearance after continued exposure to the atmosphere.

There are uses of aluminum base alloys where high strength, good corrosion-resistance and good appearance are primary requisites. Exemplary of such uses are window frames. Such frames are often built up from extruded or rolled aluminum base alloy shapes. Since the distinctive color of aluminum lends itself readily to modern design, aluminum base alloys which will retain their natural color and appearance under constant exposure to ordinary or industrial atmospheres are in great demand. The alloys must also, if adaptable to such uses, be of high strength and must likewise be resistant to corrosion in the sense that upon long exposure the tensile properties of the alloys do not materially depreciate. The known high strength aluminum base alloys have, more or less, fulfilled the above-noted requirements, but there has been a need for an alloy which would combine, to a larger extent, high strength, corrosion-resistance and a stable surface appearance. It is the general object of this invention to provide alloys of this nature.

Among the high strength aluminum base alloys which are best adapted to the uses and purposes above mentioned are the alloys described in the United States Patent No. 1,472,739 to Robert S. Archer and Zay Jeffries. The alloys described in this patent are characterized by the simultaneous presence therein of magnesium and silicon and primarily derive their good tensile properties from the action and effect of these alloying elements under the influence of heat-treatment and artificial aging. When magnesium and silicon are together present in aluminum, they form a complex which is usually recognized as the intermetallic compound, Mg_2Si. The compound is to a certain extent soluble in the aluminum. When aluminum containing this compound is thermally treated at temperatures above about 500° centrigrade but below the temperature at which incipient fusion takes place in the alloy, a portion of the Mg_2Si forms a solid solution with the aluminum, increasing the strength of that metal. If the alloy is then cooled more or less rapidly and thereafter artificially aged by heating to temperatures of about 100° to 200° centigrade, the strength of the alloy is further increased.

In experimenting with this general type of aluminum base alloy we have discovered certain alloys which are generally superior thereto. We have discovered that if an alloy of high tensile properties, excellent corrosion-resistance and stable surface appearance is desired, the best combination of these properties can be obtained when neither an excess of magnesium nor an excess of silicon is present in the alloy, but that the magnesium and silicon should be present in such amounts as will combine substantially completely to form the intermetallic compound Mg_2Si. Furthermore, as we have discovered, the alloy should contain from 0.1 to 1.0 per cent by weight in total of one or more of the class of metals herein defined to be chromium, manganese, molybdenum, tungsten, vanadium, zirconium, titanium, and uranium. This class of elements has two common properties, one being the hardening of the aluminum with which they are mixed, and the other being the fact that in our novel alloys they achieve their stated purpose without injuring the other desirable properties of the alloy. Likewise they cooperate jointly or severally, as the case may be, to produce the novel composition the properties of which are herein described. One or more of these metals may be present in the alloy but they should not exceed in total the limits of 0.1 to 1.0 per cent by weight. When the elements are used singly in the alloy the chromium should not exceed 0.1 to 1.0 per cent by weight, the manganese should not exceed 0.1 to 1.0 per cent by weight, the molybdenum should not exceed 0.1 to 1.0 per cent by weight, the tungsten should not exceed 0.1 to 0.5 per cent by weight, and va-

nadium should not exceed 0.1 to 1.0 per cent by weight, the zirconium should not exceed 0.1 to 1.0 per cent by weight, the titanium should not exceed 0.1 to 0.5 per cent by weight, and the uranium should not exceed 0.1 to 1.0 per cent by weight. The aluminum from which the alloy is compounded should not contain more than 0.3 per cent by weight of impurities, said amount of impurities, of course, being exclusive of magnesium, silicon, and the elements of the class above named.

The alloys contemplated by our invention are those which contain about 0.5 to 3.0 per cent by weight of Mg_2Si (or magnesium and silicon in amount and ratio to form such amounts of Mg_2Si), which contain no substantial excess of magnesium or silicon over the amounts necessary to form Mg_2Si and which contain 0.1 to 1.0 per cent in total of at least one of the elements chromium, manganese, molybdenum, tungsten, vanadium, zirconium, titanium, and uranium, the balance of the alloy being aluminum containing not more than 0.3 per cent by weight of impurities exclusive, of course, of silicon, magnesium, chromium, manganese, molybdenum, tungsten, vanadium, zirconium, titanium, and uranium. Alloys of this composition have tensile properties sufficiently high to meet many engineering specifications. They have, moreover, an excellent corrosion-resistance and stability of surface appearance. In this combination of properties they excel other high strength aluminum base alloys known and, in addition to these properties, alloys of this composition are readily worked into usual and even intricate forms and shapes.

The alloys above described may be heat-treated and aged and otherwise thermally treated according to the methods known to the art and may by means of the known methods of working be fabricated into many shapes. The alloys may likewise be cast according to usual foundry practices.

Of the alloys which are the subject of this invention certain are preferred, especially as material from which to form window frames and like articles. These are the alloys of higher strength which still retain excellent workability. These alloys contain about 1.5 to 2.0 per cent by weight of Mg_2Si, about 0.1 to 1.0 per cent by weight of at least one of the class of elements chromium, manganese, molybdenum, tungsten, vanadium, zirconium, titanium, and uranium, and the balance being aluminum containing not more than about 0.3 per cent by weight of impurities exclusive of magnesium, silicon, chromium, manganese, molybdenum, tungsten, vanadium, zirconium, titanium, and uranium. For example, alloys containing 1.5 to 2.0 per cent by weight of Mg_2Si, 0.1 to 1.5 per cent by weight of chromium, the balance being aluminum of the purity above named, have, in extruded form and after heat-treatment at about 515° centigrade followed by cooling and artificial aging at about 160° centigrade for about 18 hours, an average tensile strength of 35,000 to 39,000 pounds per square inch, an average yield strength of 30,000 to 34,000 pounds per square inch, and an elongation of about 14 to 17 per cent in 2 inches.

It is a further beneficial property of the novel alloys herein described that they are, under the commercial methods of working and heat-treatment, singularly free from the phenomena of grain growth or large or uneven sized grains and that, partly because of this fact, they present in the worked condition a surface which is even and smooth.

This application is a division of our co-pending application Serial No. 645,127, filed Nov. 30, 1932.

We claim as our invention:

An alloy containing about 0.5 to 3.0 per cent by weight of the intermetallic compound Mg_2Si and about 0.1 to 1.0 per cent by weight of molybdenum, the balance being aluminum which does not contain more than 0.3 per cent by weight of impurities exclusive of magnesium, silicon, and molybdenum.

In testimony whereof we hereto affix our signatures.

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