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CORROSION-RESISTANT AGE-HARDENABLE ALUMINUM COMPOSITE METAL

Karl Leo Meissner, Duren, Germany

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This invention relates to corrosion-resistant age-hardenable aluminum composite metals.

The term "composite metal" employed herein is intended to denote a metal consisting of a base metal or alloy with plated-on layers of another metal or alloy.

As is known, valuable technical improvements have been obtained recently with respect to corrosion resistance of aluminum alloys used for constructional purposes, by plating-on materials of higher corrosion resistance but of small mechanical strength upon aluminum alloys having a high mechanical strength themselves but only a small resistance to corrosion. Thus for example it has been proposed, inter alia, to use pure aluminum as the plating material and also certain anti-corrosive alloys of aluminum such, as for example, aluminum-manganese, aluminum-beryllium, or aluminum-silicon. With these alloys also chief significance was attached to the fact that they should possess a high resistance to corrosion which is not very much different from that of pure aluminum itself.

Although all these alloys doubtless introduced quite a considerable advance as compared with the earlier state of the art, nevertheless, certain disadvantages have to be endured. When employing pure aluminum these disadvantages consist in that on account of the very large disparity in the mechanical strength properties of the components, the finished composite metals could only be computed to possess a percentage of their theoretical tensile strength, corresponding to the cross-section of the base alloy. Inasmuch as the dimensions of the plating layer usually amount to 10% of the entire thickness in the case of such an alloy 10% of dead weight is included therein, a circumstance which is made disagreeably evident during the employment of an alloy for traffic vehicles and especially for aircraft. Apart from this the surface of pure aluminum is very highly sensitive to mechanical damage.

These drawbacks were avoided to some extent when employing corrosion-resistant alloys having a harder surface. However, even in the case of these alloys, great differences in the tensile strength properties invariably occurred, in so far as these alloys were not age-hardenable at all, or not age-hardenable under the same conditions as in the case of the base alloy, since they were merely annealed soft.

The fact that hitherto alloys free from copper have, without exception, been proposed as plating layers because alloys containing copper are known not to possess any special resistance to corrosion, was the reason for two further drawbacks.

One was the rather considerable potential difference between the copper-free plating layer and the base alloy, whilst moreover in the complete absence of copper-primarily when employing pure aluminum—the effect was produced which was feared by consumers, that when using very thin sheets such as are frequently employed for aircraft construction work, copper would migrate into the plating layer by diffusion when the high temperature treatment is prolonged or is repeated several times. The first mentioned drawback is made evident by the fact that at places where the plated layer and the base alloy are together exposed to corrosion, for example at cut edges, rivets and so forth, the plating layer accordingly more readily undergoes corrosion.

The present invention aims at minimizing these dangers to such an extent that they can be considered to be obviated for practical purposes. According to the present invention, all aluminum alloys are proposed to be used as a plating layer for an age-hardenable base alloy of high strength, which have a higher potential than the base alloy. All alloys suitable for this purpose can be identified without difficulty by measuring the potential of the base alloy and of the plating alloy against a normal calomel electrode in common salt solution in known manner.

Thus, for example, an age-hardenable alloy of the type of duralumin can be employed as a base alloy and containing from 4 to 4.5% copper, 0.5 to 0.7% magnesium, and 0.3 to 0.6% manganese, whilst an alloy of the same type having a small copper content such as, for example, from 0.5 to 3%, can be employed on the other hand as the plating alloy. The remaining alloying constituents of the plating layer can be selected in a similar manner to those of the base alloy. An aluminum alloy of this type used as a plating layer which is, as is known per se, not so corrosion-resistant as pure aluminum, exhibits the advantage, however, when plated on to an alloy having a lower potential that the entire cross-section of the work piece can be relied on to possess a uniform mechanical strength, whilst moreover the potential difference between the plating layer and the base alloy is substantially smaller, so that even conditions of intensified corrosion of the plating layer can be withstood at cut edges and at rivet heads, that is to say at all places where the base alloy and the plating layer are together exposed to corrosion. A further advantage of such a composite

metal is also the fact that the danger of the migration of copper atoms from the base alloy into the plating layer—which already contains perceptible quantities of copper—is very substantially reduced in comparison with the danger which was feared in the case of an alloy free from copper and particularly in the case of pure aluminum.

Employing an alloy of low copper content as the plating layer also enables rivets to be employed which are made from alloys having a lower copper content, like those which have already previously been used for this purpose in the industry. These known alloys possessed certain advantages for rivets, inasmuch as while they have an adequate shearing strength they have more favourable working properties than the alloys having a higher copper content. The employment of such rivets, however, was discontinued owing to the fact that they possessed too small a corrosion resistance when used in conjunction with sheet metal the composition of which showed a higher copper content. This drawback is avoided, however, in the case of the present invention, when the compositions of the rivets and that of the plating layer are selected so as to be the same. Alloys are advantageously selected for use as plating alloys which can be age-hardened under the same conditions as the base alloy.

I claim:—

1. A composite metallic material comprising a base of age-hardenable aluminum alloy and a covering layer plated on both sides of said base and consisting of a copper-containing aluminum alloy of higher potential than said base.

2. A composite metallic material comprising a base of age-hardenable copper-containing aluminum alloy and a covering layer plated on at least one side of said base and consisting of a copper-containing aluminum alloy of higher potential and lower copper content than said base.

3. A composite metallic material comprising a base of age-hardenable aluminum alloy and a covering layer plated on both sides of said base and consisting of an age-hardenable copper-containing aluminum alloy of higher potential than said base.

4. A composite metallic material comprising a base of age-hardenable copper-containing aluminum alloy and a covering layer plated on at least one side of said base and consisting of an age-hardenable copper-containing aluminum alloy of higher potential and lower copper content than said base.

5. A composite metallic material comprising a base of age-hardenable aluminum alloy and a covering layer plated on at least one side of said base and consisting of copper containing aluminum alloy of higher potential than said base, and age-hardenable under the same conditions as said base.

6. A composite metallic material comprising a base of age-hardenable copper-containing aluminum alloy and a covering layer plated on at least one side of said base and consisting of a copper-containing aluminum alloy of higher potential and lower copper content than said base, and age-hardenable under the same conditions as said base.

7. Articles composed of at least two pieces of composite metallic material comprising a base of age-hardenable aluminium alloy and a covering layer plated on at least one side of said base and consisting of a copper-containing aluminium alloy of higher potential than said base, secured together by rivets composed of the copper-containing alloy constituting the covering layer.

8. Articles composed of at least two pieces of composite metallic material comprising a base of age-hardenable copper-containing aluminium alloy and a covering layer plated on at least one side of said base and consisting of a copper-containing aluminium alloy of higher potential and lower copper content than said base, secured together by rivets composed of the alloy constituting the covering layer.

9. Articles composed of at least two pieces of composite metallic material comprising a base of age-hardenable copper-containing aluminium alloy and a covering layer plated on at least one side of said base and consisting of an age-hardenable copper-containing aluminium alloy of higher potential and lower copper content than said base, and age-hardenable under the same conditions as said base, secured together by rivets composed of the alloy constituting the covering layer.

KARL LEO MEISSNER.