

UNITED STATES PATENT OFFICE

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METHOD OF CLADDING MAGNESIUM-LITHIUM BASE ALLOYS

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1 Claim. (Cl. 29—189)

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This invention relates to the cladding of magnesium-lithium base alloys and has for its object the provision of an improved method of cladding. My invention is based upon my discovery of a critical cladding temperature for cladding magnesium-lithium base alloys with another metal such as a corrosion-resistant metal or alloy.

Examples of magnesium-lithium base alloys suitable as base metal to be clad are described in the application of Alfred C. Loonam, Serial Number 602,171 issued as Patent No. 2,453,444 on November 9, 1948, and the applications of Alfred H. Hesse, Serial Numbers 616,160, 616,161 and 781,253. Examples of metals which have been found suitable for cladding over the magnesium-lithium base alloys are 2-S aluminum, stainless steel and binary alloys of magnesium and lithium wherein the ratio of magnesium to lithium is about 8:1. Other corrosion resistant metals or alloys can be used as cladding metal.

In accordance with my invention, I effect a permanent inter-metallic bonding of the magnesium-lithium base alloy to the cladding metal by rolling the metals together while at a temperature within the critical range of 550° F. to 800° F. and advantageously within the preferred range of 650° F. to 750° F. I prefer to effect a material reduction in thickness, say, from 40% to 75%, during the initial pass through the rolls, to reheat the metal to a temperature within the critical range, and then to pass the metal through the rolls for further reductions in thickness of 10% or more. The rolling at the critical temperature results in a good adhering bond. Further reduction in thickness by rolling may be made if desired.

It is important that the bonding surfaces of the two metals be suitably prepared before rolling. To this end, the plates or sheets which are to be bonded together are thoroughly cleansed of all surface contaminants and impurities. This may be accomplished in any convenient manner as by abrading with steel wool or washing with alcohol or xylene or some suitable solvent. The cleansed surfaces of the plates or sheets are placed in adjacent position and the plates are attached together before heating. The sheets or plates must be held together so as to prevent lateral separation during the initial rolling pass. This may be accomplished by spot welding in the case of sheets, or by tack welding at the corners of plates, or by other suitable methods. The attached assembly of plates is then heated to a temperature within the critical temperature range, preferably within the range

of 650° F. to 750° F., and rolled while at such temperature.

The following examples illustrate a method of my invention:

Example 1

Two pieces of the 8.1 Mg/Li binary alloy approximately 4" x 5" x 0.015" were clad on both sides of a 4" x 5" x 0.180" piece of the 6 Mg/Li-15% Cd-5% Ag high-strength alloy. The plates were cleaned by rubbing with steel wool until the visible oxide was removed. They were then tacked together by a number of spot welds around the periphery in order to prevent lateral separation of the plates during the first rolling pass. The assembled plates (0.210" total thickness) were next heated for several minutes at 700° F. and hot rolled one 50% reduction pass at this temperature. The pieces adhered. They were reheated at 700° F. for several minutes and given a second 50% reduction pass at this temperature. After this treatment the assembly (now 0.043" total thickness) was so well bonded that the pieces could not be separated even under the severest deformation.

Example 2

Two pieces of 2-S aluminum (commercially pure aluminum) approximately 4" x 5" x 0.025" were clad on both sides of a 4" x 5" x 0.255" piece of the 6 Mg/Li-15% Cd-5% Ag high-strength alloy. The plates were cleaned by rubbing with steel wool until the visible oxide was removed. They were then tacked together by several spot welds at each end in order to prevent lateral separation of the plates during the first rolling pass. The assembled plates (0.305" total thickness) were next heated for several minutes at 750° F. and hot rolled one 60% reduction pass at this temperature. The pieces adhered. They were then reheated for several minutes at 750° F. and given a second 60% reduction pass at this temperature. They were then reheated for several minutes at 750° F. and given a 30% reduction pass at this temperature. After this treatment the assembly (now 0.043" total thickness) was so well bonded that the pieces could not be separated even under the severest deformation.

Example 3

One piece of stainless steel approximately 1" x 3" x 0.030" was clad on one side of a 1" x 3" x 0.100" piece of the 6 Mg/Li-15% Cd-5% Ag alloy. The plates were cleaned by rubbing with steel wool. They were then tacked together by several spot welds at the ends in order to

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prevent lateral separation of the plates during the first rolling pass. The assembled plates (0.130" total thickness) were then heated for several minutes at 700° F. and hot rolled one 73% reduction pass at this temperature. Two subsequent passes reduced the thickness by 11% and 3% respectively. The assembly was heated for several minutes at 700° F. between each pass. The steel piece was not appreciably reduced by the rolling, the magnesium-lithium alloy withstanding all of the reduction. The final thickness was 0.030".

Example 4

Two pieces of the 8.1 Mg/Li binary alloy, approximately 4" x 5" x 0.023", were clad on both sides of a 4" x 5" x 0.255" piece of the Mg/Li-15% Cd-5% Ag high-strength alloy. The plates were cleaned as described in the preceding examples. They were then tacked together by several spot welds at each end to prevent lateral separation of the plates during the first rolling pass. The assembled plates (0.301" total thickness) were then heated for several minutes at 650° F. and hot rolled one 50% reduction pass. Subsequent passes reduced the thickness by 42%, 48%, and 11% respectively. The assembly was heated for several minutes at 650° F. between each pass. The final well-bonded assembly had a thickness of 0.040".

The 8.1 Mg/Li binary is not notch sensitive while the high-strength base material is very much notch sensitive. It has been found that the notch sensitivity of the clad article is considerably superior to that of the unclad base material.

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I claim:

In a method of cladding stainless steel to a 6 to 1 magnesium-lithium base alloy wherein the bonding surfaces of the metals are cleaned and the edges of the metals fastened together during heating and rolling, the improvement which comprises heating the metals so fastened together to a temperature within the range of 650° F. to 750° F., rolling the metals while at such temperature to effect a reduction in thickness of at least 40% in the first pass, reheating the clad metals to a temperature within said range, and further reducing the thickness by at least 10% in at least one pass.

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