Oct. 19, 1943. K. D. McMAHAN 2,332,330

METHOD FOR JOINING ALUMINUM STRUCTURES

Filed Dec. 15, 1941

Fig. 1.

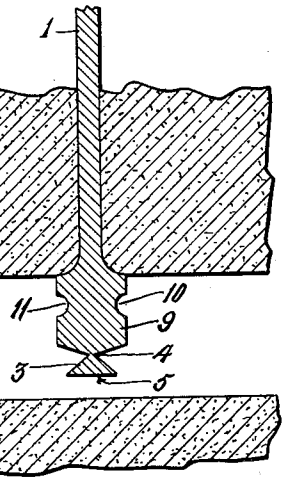


Fig. 2.

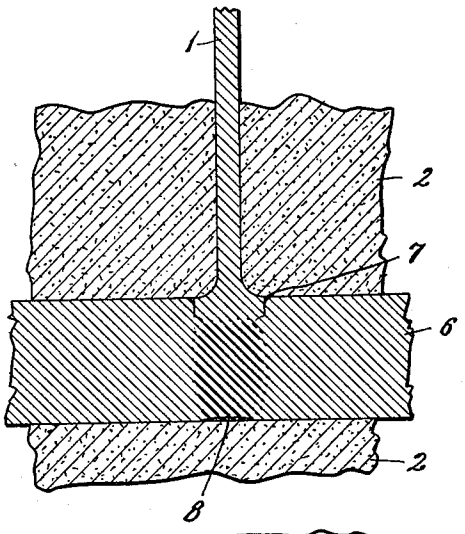


Fig. 3.

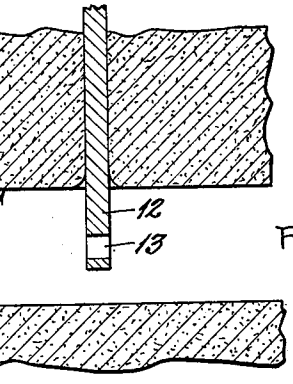


Fig. 4.

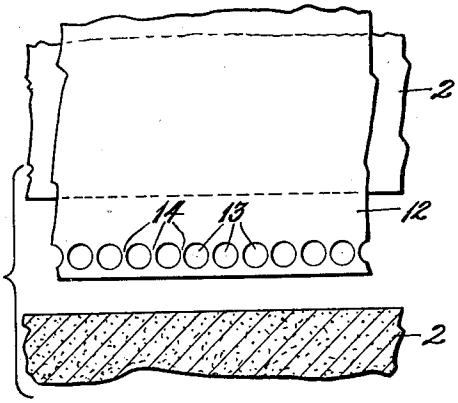
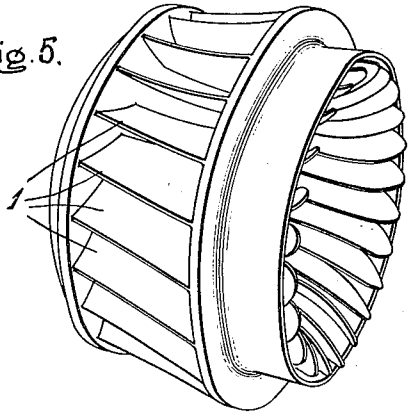


Fig. 5.



Inventor:
Kenton D. McMahan,
by Harry E. Dunham
His Attorney.

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METHOD FOR JOINING ALUMINUM STRUCTURES

Kenton D. McMahan, Scotia, N. Y., assignor to General Electric Company, a corporation of New York

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5 Claims. (Cl. 22—203)

The present invention relates to a method for joining metals having substantially the same melting point and more particularly to a method for joining aluminum or aluminum alloy structures. The word "aluminum" as employed in the specification and claims is intended to include both aluminum and aluminum base alloys.

Heretofore great difficulty has been encountered in attempts to braze cast aluminum. While the use of various flux materials has been suggested for that purpose, so far as applicant is aware, there is no commercially successful method for brazing cast aluminum. If molten aluminum is cast around a solid aluminum structure an oxide film on the solid aluminum prevents fusion of the cast and solid metal. If a flux is employed in such a process, for example in joining an aluminum fan blade to a supporting aluminum structure by casting the supporting structure about the fan blade, there is a tendency to form a bond at the extreme end of the blade but the flux is merely added to the oxide layer on the blade and prevents fusion between the molten and the solid metal, and furthermore causes corrosion between the parts which eventually results in failure of the joint.

One of the objects of the present invention is to provide an efficient and reliable method for obtaining strong, sound junctions between metal structures having substantially equal melting points and particularly between aluminum or aluminum alloy structures. Further objects will appear hereinafter.

The novel features which are characteristic of my invention are set forth with particularity in the appended claims. My invention, however, will best be understood from reference to the following specification when considered in connection with the accompanying drawing in which Fig. 1 is a cross sectional view of an aluminum fan blade positioned in a sand mold and embodying the features of my invention; Fig. 2 is a cross sectional view of the same blade after molten aluminum has been poured into the mold; Fig. 3 is a cross sectional view of a modified form of my invention; Fig. 4 is a view partly in elevation and partly in cross section of the fan blade and mold shown in Fig. 3; while Fig. 5 is a fan constructed in accordance with my invention.

In carrying out my invention, a structure which may be an aluminum fan blade 1 is positioned in a sand mold 2. In operation the blade 1 may be supported at opposite ends thereof as indicated in Fig. 5 of the drawing. The extreme outer end of the blade 1 is provided with a somewhat bulbous portion 3 which is shown as triangular in shape in Fig. 1 but may be any desired form. The part 3 is joined to the blade proper by means of a reduced, very thin section or junction 4. If desired a small amount of flux 5 may be applied to the lower surface of the part 3, as indicated in Fig. 1, to facilitate transfer of heat from the molten metal into that part.

The problem of making the blade 1 fuse into a molten mass of aluminum is primarily one of heat transfer across an oxide layer and of heat conduction away from the junction 4 and through the blade 1. Where a blade is employed which has a bulbous or dovetailed outer end portion 3 connected to the main body of the blade by a very narrow or thin section of metal as indicated in Fig. 1, the greatly reduced volume of metal in the narrow section substantially isolates the enlarged portion 3 from the main body of blade 1 with respect to thermal conductivity. This effect in combination with the flux coated portion of the part 3 results in complete melting of that part when molten aluminum 6 is poured into the sand mold 2 and around the portion 3 of the blade. The oxide coating on the blade proper is thereby broken and the line of contact between the blade and molten metal widens to the full thickness of the blade, as indicated by the shaded portion of Fig. 2 with the result that the end portion of the blade fuses into the molten metal and sets with it thereby forming a strong, durable bond.

During fusion, the oxide layer on the aluminum is pushed to the outer surface of the cast aluminum as indicated at 7 in Fig. 2 of the drawing. At this point the oxide layer is without harmful effect. When the enlarged or dovetailed portion 3 is completely melted any flux 8 which has been applied to the outer surfaces will float to the outer surface of the cast aluminum as indicated in Fig. 2 and may be removed by a cleaning or machining operation. In Figs. 1 and 2 the fan blade 1 is shown as having a somewhat enlarged portion 9 adjacent its outer end provided with opposite parallel grooves 10 and 11. It is unnecessary, however, to employ either grooves or an enlarged section.

In Figs. 3 and 4 there is disclosed a substantially flat blade 12. The outer or lower end of this blade is provided with a series of closely adjacent punched-out portions 13 which give the effect of a thin necked down or dovetailed section. When

molten aluminum is poured around the outer end of the table 12 the thin sections 14 act in substantially the same manner as the reduced section 4 shown in Fig. 1.

The word "aluminum" as employed in the present specification and claims is intended to include aluminum base alloys as well as aluminum. Furthermore, while the present method is illustrated in connection with aluminum or aluminum alloys it may be employed in joining other metals. The metals to be joined, however, should have substantially the same melting point.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. The method of joining two aluminum structures which comprises providing a bulbous portion connected to the main body portion through a reduced section of metal to thereby substantially thermally isolate said bulbous portion from the main body portion of said structure, positioning said aluminum structure in a mold and pouring molten aluminum around said reduced section and bulbous portion.

2. The method of joining two aluminum structures which comprises materially reducing the volume of metal in one of said structures adjacent one end thereof to thereby provide a greatly restricted passage for heat transfer between the end body portion and main body portion of said structure, positioning said structure in a mold and pouring molten aluminum into said mold to thereby surround and melt said end portion.

3. The method of joining two aluminum structures which comprises materially reducing the volume of metal in one of said structures adjacent one end thereof to thereby substantially thermally isolate said end portion of said structure from the main body portion thereof, positioning said structure in a mold and pouring molten aluminum therein to thereby melt said end portion and reduced portion of said structure.

4. The method of joining two aluminum structures which comprises materially reducing the volume of metal in one of said structures adjacent one end thereof to thereby substantially thermally isolate said end portion of said structure from the main body portion thereof, positioning said structure in a mold and pouring molten aluminum around said reduced portion and the portions of said structure adjacent thereto whereby said molten metal when cooled forms an integral structure with said first-mentioned structure.

5. The method of joining two metal structures having substantially equal melting points which comprises providing one of said structures with an auxiliary portion integrally connected with the main body portion of said structure by a thin section of metal which substantially thermally isolates said auxiliary portion from said main body portion, positioning said structure in a mold and pouring molten metal around said auxiliary portion to thereby melt said auxiliary portion and a portion of said main body portion.

KENTON D. McMAHAN.