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PROCESS OF MAKING ALLOYS OF ALUMINUM BERYLLIUM

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7 Claims. (Cl. 75—138)

This invention relates to an improved process for making alloys of beryllium and aluminum.

The customary method heretofore employed for alloying beryllium and aluminum has been to melt the aluminum and then dissolve the beryllium in it. Although aluminum and beryllium can be alloyed in practically all proportions, the solution of the beryllium in melted aluminum is attended with considerable difficulty since it is necessary that the temperature of the aluminum be raised to approximately 1200° C. or more, and while this temperature is practically the melting point of beryllium the latter dissolves only very slowly. Furthermore, the beryllium being lighter in weight than aluminum the beryllium tends to float on the surface of the molten mass thus leading to considerable loss by oxidation. These difficulties are particularly marked in the making of alloys containing high percentages of beryllium.

Another difficulty of prior methods or processes is that beryllium in mass or lump form only can be employed, and since beryllium is produced commercially at temperatures below its melting point, it is initially recovered in powder or flake form. Consequently, the powder or flake beryllium must first be melted into massive pieces before it can be alloyed with aluminum, and this melting is also accompanied by considerable loss due to oxidation, usually of the order of 15 per cent. In addition, only the purest beryllium powder or flake can be fused together at all, and flake or powder contaminated with any ponderable quantity of oxide is practically impossible of being melted into massive form.

The principal object of this invention is to provide a more convenient and more economical process for alloying aluminum beryllium wherein the foregoing difficulties and objectionable features are eliminated.

This and other objects of the invention are hereinafter set forth and described.

The present invention consists essentially in the discovery that by intimately mixing together desired proportions of powdered aluminum and powdered beryllium and then compressing this mixture into a mass, the resulting mass can be readily melted under a suitable flux to produce beryllium-aluminum alloys without and free from any of the aforementioned difficulties presented by prior methods and processes.

The aluminum powder employed may be ordinary commercial aluminum powder such as is commonly used for thermit reductions, and such powder having a particle size of approximately 100 mesh is satisfactory although the exact particle size is not critical within reasonable limits.

Beryllium powder such as is recovered from the electrolysis of fused beryllium chloride, or from the reduction of fused beryllium chloride by means of magnesium, is entirely suitable for use in the present process without further processing. Such beryllium powders in large part usually pass through a forty mesh sieve and are retained on a one hundred mesh sieve, although, as in the case of the aluminum, the particular particle size is not critical.

In practicing the invention the beryllium and aluminum powders are intimately mixed together in substantially the proportions desired in the finished alloy. When the beryllium and aluminum powders are thus thoroughly mixed the resulting mixture is then compressed into a solid mass. Compression of the mixture into a solid mass may be accomplished, for example, in a cylinder provided with a close fitting piston or plunger, the cylinder being filled substantially to the top and the plunger then actuated under a pressure of several tons per square inch with the result that a solid coherent mass of metal is produced consisting of the mixture beryllium and aluminum powder. Actuation of the plunger may be carried out in a press, conveniently a hydraulic press.

The compressed mass produced as above described is removed from the cylinder and is then melted in a suitable crucible together with a suitable flux that will not react with the metals of the mass. A satisfactory flux consists of barium chloride and to this preferably is added a small admixture of barium fluoride which functions to dissolve the oxide film on the beryllium flake causing the metals to coalesce thus permitting maximum recovery of the beryllium metal. The percentage of barium fluoride may be as high as approximately 20 per cent, preferably approximately 10 per cent, by weight of the flux. Strontium chloride and calcium chloride can be used instead of barium chloride as a flux with some degree of success, their use is not practicable or efficient due to the high cost of strontium chloride and the tendency for the calcium chloride to go over to the oxy-compound.

As soon as the flux is melted and heated to a temperature of about 1000° C., the crucible is withdrawn from the furnace and the compressed mass of beryllium and aluminum powders is immersed in the molten flux and held beneath the surface thereof for a relatively short period of time so as to become thoroughly wetted and force

out entrained gases and coat the metal of the mass with the flux to prevent oxidation thereof. The crucible is then covered and replaced in the furnace and the temperature raised to the fusion point which is somewhat above the melting point of the beryllium-aluminum alloy being produced in order to obtain rapid alloying and fluidity for casting. During this treatment the alloy which is lighter in weight than the flux floats on the surface thereof under the protective covering of a thin layer of the flux which the mass ordinarily takes on. It is desirable to agitate the crucible or stir the mass so as to free the latter from entrained oxides of the metals. Heating of the crucible is continued until the mass of beryllium and aluminum powder is entirely melted at which time it is poured off into a suitable mold. The alloying of the aluminum and beryllium takes place practically as soon as fusion of the mass is completed and, therefore, there is no long or substantial period of waiting for the beryllium to dissolve with its consequent oxidation.

The temperature employed need not be excessive and temperatures only slightly above the melting point of the alloy being produced are satisfactory. Since the beryllium employed is in the form in which commonly produced the necessity for initially melting it and the losses incident thereto are entirely eliminated. The recovery of the finished alloy is as great or greater than when beryllium in mass form is used and the over-all recovery from the use of powdered beryllium is, therefore, substantially greater. Furthermore, beryllium powder containing a considerable content of beryllium oxide may be employed with success in the present process, whereas under the practice and methods heretofore known in the art, beryllium powders containing beryllium oxide cannot be used due to the fact during initial melting into mass form the beryllium oxide disperses throughout the flux in the form of minute globules which are practically useless.

The present invention, therefore, provides a substantially more convenient, more economical process for alloying aluminum and beryllium which eliminates the difficulties and objectionable features of the art as heretofore known and practiced, and while various features and details of the invention have been set forth and described herein, it is not intended that said invention be limited thereto but that changes and modifications may be made and incorporated therein within the scope of the appended claims.

I claim:

1. The process of making alloys of aluminum and beryllium which comprises mixing together predetermined proportions of powdered aluminum and powdered beryllium, compressing the mixture into a coherent mass, and fusing the said mass in a fused flux bath which is not reactive with the said mass, said flux being characterized also by its ability to force entrained gases from said mass and to prevent oxidation of the aluminum and beryllium during alloying thereof.

2. The process of making alloys of aluminum and beryllium which comprises mixing together predetermined proportions of powdered aluminum and powdered beryllium, compressing the mixture into a coherent mass, and fusing the said mass by immersion in a fused flux which is not reactive with the mass, said flux being characterized also by its ability to force entrained gases from said mass and to prevent oxidation of the aluminum and beryllium during alloying thereof.

3. The process of making alloys of aluminum and beryllium which comprises mixing together predetermined proportions of powdered aluminum and powdered beryllium, compressing the mixture into a coherent mass, and fusing the said mass by immersion in a fused flux consisting of barium chloride and barium fluoride.

4. The process of making alloys of aluminum and beryllium which comprises mixing together predetermined proportions of powdered aluminum and powdered beryllium, comprising the mixture into a coherent mass and fusing the said mass by immersion in a fused flux consisting of not less than approximately 80% barium chloride, and not more than approximately 20% barium fluoride.

5. The process of making alloys of aluminum and beryllium which comprises mixing together predetermined proportions of powdered aluminum and powdered beryllium, compressing the mixture into a coherent mass, and fusing the said mass by immersion in a fused flux consisting of approximately 10% barium fluoride and approximately 90% barium chloride.

6. The process of making alloys of aluminum and beryllium which comprises mixing together predetermined proportions of powdered aluminum and powdered beryllium, compressing the mixture into a coherent mass and fusing the said mass in a fused flux bath at a temperature not less than approximately 1000° C., said flux being non-reactive with the said mass and being characterized also by its ability to force entrained gases from said mass and to prevent oxidation of the aluminum and beryllium during alloying thereof.

7. The process of making alloys of aluminum and beryllium which comprises mixing together predetermined proportions of powdered aluminum and powdered beryllium, compressing the mixture into a coherent mass, and fusing the said mass in a fused flux bath at a temperature not less than approximately 1000° C., said flux containing not less than approximately 80% barium chloride and being non-reactive with the said mass.

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