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METHOD OF MAKING ALUMINUM BASE ALLOYS

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This invention relates to the production of aluminum base alloys which contain magnesium, zinc or other alloying additions which readily oxidize in contact with air.

In the rapid development of alloys in recent years to meet specific requirements, attention has been directed chiefly to the composition of the alloys. The method of melting and compounding the alloy was considered to be of secondary importance so long as ordinary precautions were exercised in avoiding contamination during the introduction of the components of the melt and protecting the molten metal from a strongly oxidizing atmosphere.

It has now been found that the presence of gas and minute suspended oxide particles in molten aluminum base alloys has an important effect on the ultimate properties of the alloy. I have discovered that the introduction of such easily oxidizable metals as magnesium and zinc into molten aluminum in the ordinary manner tends to increase the gas content thereof, because these metals are covered by oxide film which evolves gas and water vapor when added to a melt. The use of mechanically cleaned pieces of metal does not of itself overcome the tendency to "gas" the molten aluminum charge because it is not possible to completely remove this oxide film by mechanical means on a commercial scale.

One of the objects of my invention is to provide a coating material for alloy additions of easily oxidizable metals which coating prevents diffusion of the gas and water vapor evolved from the oxide film on said alloy additions during introduction into the molten aluminum. Another object is to provide a coating which inhibits the formation of more oxide film on the alloy additions. Still another object is to provide a coating material which decomposes in contact with molten aluminum and tends to remove any gas already present in said aluminum. A further object is to provide a coating material which can be quickly and easily applied to the alloy additions.

I have discovered that poly-chlorinated hydrocarbons which are solid at room temperatures constitute an excellent material with which to coat alloy additions employed in making aluminum base alloys. Such compounds as hexachlorethane, chlorinated diphenyl and chlorinated naphthalene are representative of the poly-chlorinated paraffin and cyclic compounds that are suitable for my purpose. These compounds are solid at room temperatures, do not react with the atmosphere and do not sorb moisture. They also provide a substantially air-tight coating on the alloy addition thus preventing access of air to the metal and the formation of additional oxide film. When alloy additions coated with these poly-chlorinated hydrocarbons are introduced into the molten aluminum the coating material decomposes, drives out gas from the molten metal and inhibits the sorption of any gas and water vapor coming from the oxide film on the alloy additions.

A single poly-chlorinated hydrocarbon may be used as a coating, or a mixture of two or more can be employed. Under some circumstances in commercial practice it is more economical and efficient to use two of the chlorinated hydrocarbons. These substances may be mixed and applied to the alloy addition or first one then the other may be put on the metal.

Certain metals and alloys are more prone to oxidize in contact with the air than are other metals. Magnesium, zinc, beryllium, alkaline earth and the alkali metals, for example, readily form an oxide film when exposed to the atmosphere. Rich alloys containing these metals for alloying purposes are also susceptible to oxidation. I have found that rich alloys of copper, manganese and nickel with aluminum acquire a heavy oxide coating upon long exposure to the atmosphere. In each case the oxide film continues to increase in thickness and capacity to hold moisture and gas with the length of the exposure. The oxide films so formed appear to sorb moisture and gas, such as carbon dioxide, from the air in considerable quantity. I have found, for example, that a pig of 50–50 copper-aluminum alloy having a surface area of about 3.5 square feet, after being exposed to the air for 90 days, evolved 42,700 c. c. of gas when melted by itself. Similarly a pig of aluminum-14 per cent manganese alloy having the same surface area and exposed under the same conditions evolved 4,880 c. c. of gas when melted. A pig of magnesium of the same surface area produced 16,400 c. c. of gas when melted. The introduction of such quantities of gas into molten aluminum causes considerable trouble by rendering the metal porous and giving rise to blisters on annealed sheet. Since it is necessary to employ the readily oxidizable metals in making aluminum base alloys, it is eminently desirable to avoid any deleterious effect associated with such metals. The metals and rich alloys named hereinabove I have designated as easily oxidizable metals for the purpose of my invention.

All of these metals may be coated with a poly-chlorinated hydrocarbon thereby avoiding the introduction of large quantities of gas into the molten metal.

Although the readily oxidizable metals and alloys easily form oxide films, all of them do not oxidize with equal rapidity as indicated in the examples referred to above. It is therefore most desirable to coat the alloy additions which will introduce the most gas into the melt, especially those which have been exposed to the air for some time. The coating of poly-chlorinated hydrocarbons is particularly useful in making it possible to utilize metals and alloys which have been stored for a considerable time without danger of gassing the molten charge to which they are added. Such heavily oxide coated alloy additions may be covered with the aforesaid hydrocarbons shortly before they are introduced into the melt, no period for reaction with the oxide is required. It is essential, however, that any volatile solvent used in applying the hydrocarbon should be allowed to evaporate before adding the coated metal to the melt.

The coating of the alloy additions with a poly-chlorinated hydrocarbon is particularly efficacious since this substance decomposes at the place and time that the gas and moisture are evolved from the oxide film. Other methods of degassing molten aluminum and its alloys have been used such as bubbling certain gases through the melt, or introducing capsules filled with volatile salts. These methods have been employed after the whole melt has been contaminated with gas. According to my invention, the gas and moisture from the oxide film are swept out of the melt just at the time they are about to be introduced.

I am aware that various substances have been used heretofore to coat alloy additions. In some instances these coatings only serve to keep the air away from the oxidizable metal, and in other cases the coating material serves as a flux which does not decompose but floats on the surface of the molten bath. In neither case is the result accomplished which I have obtained, namely, avoidance of introducing gas from the oxide film and the removal of gas already in the melt.

An example of the effectiveness of my method is to be found in the preparation of an alloy composed of aluminum, about 4 per cent copper, 0.5 per cent manganese and 1 per cent magnesium. The magnesium was coated with chlorinated diphenyl and added to the melt containing the aluminum, copper and manganese. The melt in this case had been prepared from clean rich alloys having a minimum amount of oxide coating. Sheet produced from the alloy containing magnesium revealed no blisters after being annealed at 950° F. for 2 hours. Such treatment ordinarily causes any gas within the metal to expand and form blisters or protuberances on the surface of the sheet. Another heat of the same alloy which had not been made with coated magnesium was blistered by annealing under the same conditions. Similar results were obtained in the production of a 17,000 pound heat of an alloy composed of aluminum, 1 per cent magnesium and 0.5 per cent zinc. The magnesium and zinc alloy additions were coated with a mixture of hexachlorethane and chlorinated naphthalene dissolved in carbon tetrachloride. The annealed alloy failed to show any gas blisters.

The coating of poly-chlorinated hydrocarbons may be conveniently applied by preparing a solution of these substances in a volatile solvent such as carbon tetrachloride, and dipping the alloy addition in the solution or daubing the solution on the metal. In commercial practice a solution of two or more of these hydrocarbons is frequently preferred. It is also possible to fuse the hydrocarbon substances, and dip the metal in the melt or pour the liquid on the metal. Any method of applying the coating may be employed, however, which provides a complete covering of the metal. The coating may be applied shortly before adding the metal to the bath allowing enough time, of course, for the solvent to evaporate if one is used; or the metal may be coated and then stored until used. No harm is done by storing the coated metal since the poly-chlorinated hydrocarbons do not deteriorate or absorb moisture. Prior to applying the coating it is well to remove any loose dirt from the metal and thus as far as possible avoid mechanical contamination of the alloy.

The aluminum alloys to which this invention is applicable are those containing 50 per cent or more of aluminum. The term "aluminum" as used in the appended claims is employed in a generic sense which includes both the pure metal and alloys made therefrom. The poly-chlorinated hydrocarbon coating on easily oxidizable metals is effective whether these metals are added to the pure aluminum or to aluminum already containing some of the alloy ingredients.

I claim:

1. A method of making relatively gas-free aluminum base alloys containing a metal which in its form prior to being added to the said alloy is able to acquire an oxide film capable of sorbing an appreciable amount of gas and moisture when exposed to the atmosphere, said method comprising coating said oxidizable metal with at least one of the class of poly-chlorinated hydrocarbons which are normally solid at room temperature, and adding said coated metal to the molten aluminum.

2. A method of making relatively gas-free aluminum base alloys containing a metal which in its form prior to being added to the said alloy is able to acquire an oxide film capable of sorbing an appreciable amount of gas and moisture when exposed to the atmosphere, said method comprising coating said oxidizable metal with at least one of the group of poly-chlorinated hydrocarbons composed of chlorinated diphenyl, chlorinated naphthalene, and hexachlorethane, and adding said coated metal to the molten aluminum.

3. A method of making relatively gas-free aluminum base alloys containing a metal which in its form prior to being added to the said alloy is able to acquire an oxide film capable of sorbing an appreciable amount of gas and moisture when exposed to the atmosphere, said method comprising coating said metal with two poly-chlorinated hydrocarbons which are normally solid at room temperature, and adding said coated metal to the molten aluminum.

4. In a method of making relatively gas-free aluminum base alloys containing a metal which in its form prior to being added to the said alloy is able to acquire an oxide film capable of sorbing an appreciable amount of gas and moisture when exposed to the atmosphere, the steps in said method comprising coating said oxidizable metal with a carbon tetrachloride solution of a poly-chlorinated hydrocarbon which is normally solid at room temperature, allowing the

solvent to evaporate, and adding the coated metal to the molten aluminum.

5. A method of making relatively gas-free aluminum base alloys containing magnesium comprising coating the magnesium with chlorinated diphenyl prior to its addition to said alloy, and adding said coated metal to the molten aluminum.

6. A method of making relatively gas-free aluminum base alloys containing magnesium comprising coating the magnesium with hexachlorethane and chlorinated naphthalene prior to its addition to said alloy, and adding said coated metal to the molten aluminum.

7. A method of making relatively gas-free aluminum base alloys containing zinc comprising coating the zinc with a mixture of hexachlorethane and chlorinated naphthalene prior tc its addition to said alloy, and adding said coated metal to the molten aluminum.

8. In a method of making relatively gas-free aluminum base alloys containing a metal which in its form prior to being added to the said alloy is able to acquire an oxide film capable of sorbing an appreciable amount of gas and moisture when exposed to the atmosphere, the steps in said method comprising coating said oxidizable metal with a molten poly-chlorinated hydrocarbon which is normally solid at room temperature, allowing the molten hydrocarbon to solidify, and adding the coated metal to the molten aluminum.

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