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PROCESS FOR PRODUCING BERYLLIUM ALLOYS

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It is a well-known fact that beryllium alloys especially alloys of beryllium with heavy metals have excellent physical properties. Up to now the price of metallic beryllium has been so high that beryllium alloys could only be used for special purposes which allowed for a high price of the alloys. The object of the present invention is to provide a method of preparing beryllium alloys at a much lower price than hitherto possible.

According to the invention a bath of molten metal is used, containing for instance metals of the iron group of the periodic system of elements (iron, nickel, cobalt, manganese) or metals of the chromium group (chromium, molybdenum, tungsten, uranium). Carbon is dissolved in this metal bath or brought in by means of a carbon carrying gas as, for instance hydrocarbons or by adding metal carbides and the carbon containing metal bath is brought to reaction with beryllium oxide. The reaction between the beryllium oxide and the carbon dissolved in the metal bath is carried out under a reduced partial pressure of oxygen. This reduction of the partial pressure of oxygen can for example be effectuated by introducing into the reaction chamber an excess of hydrogen or other inert or reducing gases or by evacuating said reaction chamber or by other suitable means, so as, at least in part, to displace the atmosphere which would normally obtain by reason of the reduction, and thus minimize formation of beryllium carbide and reformation of beryllium oxide. The invention may be illustrated by the following example:

Nickel is melted in any known kind of melting furnace. A furnace which is especially useful to put into practice the method of the invention is a flat coil induction furnace, as described in patent application Serial Number 557,234, or a furnace as described in U. S. Patent 1,431,686. Carbon is dissolved in the nickel bath. Beryllium oxide is superposed upon the surface of the nickel bath and then the partial pressure of the oxygen in the furnace is reduced.

After a certain time all the carbon has been used up in reducing the beryllium oxide and a product is obtained which contains nickel and beryllium and which is practically free from carbon. If desired the proportion of carbon and beryllium oxide or the time of reaction may be chosen in such a manner that the final product still contains a certain amount of carbon.

Or the invention may be performed in the following way:

A certain amount of nickel free from carbon

is melted and then a mixture of beryllium oxide and carbon is superposed upon the surface of the molten nickel. After the pressure of the furnace atmosphere has been reduced, the beryllium oxide and carbon in the presence of the nickel begin to react with each other and the beryllium produced by this reaction is immediately dissolved in the nickel. At the same time a part of the carbon is dissolved by the nickel. In case it is desired to produce a beryllium nickel alloy free from carbon, the carbon dissolved in the melting bath may be removed by means of a further addition of beryllium oxide in the way described above.

Sometimes it may be useful not to use a slag containing beryllium oxide upon the bath of molten metal but to make the lining of the furnace or the hearth or the crucible of beryllium oxide and to melt a carbon containing nickel within this lining or hearth or crucible.

Furthermore the carbon incorporated in the nickel bath during the reaction between carbon and beryllium oxide may be removed by means of an oxide other than beryllium oxide, for instance, by reaction with magnesium oxide. When using magnesium oxide for removing the carbon from the melt the magnesium metal formed volatilizes without essential loss of beryllium.

In the foregoing illustrations nickel is mentioned only by way of example. Within the scope of the invention one or more other metals of the iron group may be used instead of nickel, or the nickel may be partly or totally replaced by one or more metals of the chromium group or by alloys containing metals of the iron group and metals of the chromium group. Finally the metal bath may contain or consist of other heavy metals, for instance, copper. In brief any metal which is able to alloy with beryllium and which has low vapour pressure at the temperature of the reaction may be used for the process. As beryllium in form of beryllium oxide is relatively cheap and as the process according to the invention may be exercised at low expense it is possible by the foregoing described process to produce beryllium alloys at much lower expense than hitherto.

Having broadly and specifically disclosed the present invention it is apparent that many modifications and adaptations may be made therein without departing essentially from the nature and scope thereof.

What I claim is:

1. A process for producing beryllium alloys which includes bringing into reaction with one

another carbon and beryllium oxide in contact with a metal bath, and at least in part displacing the atmosphere which would normally obtain by reason of the reduction so as to reduce the possibility of formation of beryllium carbide and the reformation of beryllium oxide.

2. A process for producing beryllium alloys which includes dissolving carbon in a metal bath, bringing the carbon containing metal bath into reaction with beryllium oxide, and at least in part displacing the atmosphere which would normally obtain by reason of the reduction so as to reduce the possibility of formation of beryllium carbide and the reformation of beryllium oxide.

3. A process for producing beryllium alloys which includes bringing into reaction with one another carbon and beryllium oxide in contact with a metal bath, and at least in part displacing the atmosphere which would normally obtain by reason of the reduction by evacuating the reaction zone so as to reduce the possibility of formation of beryllium carbide and the reformation of beryllium oxide.

4. A process of producing beryllium alloys which includes dissolving carbon in a metal bath, bringing the carbon-containing metal bath to reaction with beryllium oxide, and at least in part displacing the atmosphere which would normally obtain by reason of the reduction by evacuating the reaction zone so as to reduce the possibility of formation of beryllium carbide and the reformation of beryllium oxide.

5. A process for producing beryllium alloys which includes bringing into reaction with one another carbon and beryllium oxide in contact with a metal bath, and at least in part displacing the atmosphere which would normally obtain by reason of the reduction with hydrogen so as to reduce the possibility of formation of beryllium carbide and the reformation of beryllium oxide.

6. A process for producing beryllium alloys which includes dissolving carbon in a metal bath, bringing the carbon-containing metal bath to reaction with beryllium oxide, and at least in part displacing the atmosphere which would normally obtain by reason of the reduction with hydrogen so as to reduce the possibility of formation of beryllium carbide and the reformation of beryllium oxide.

7. A process for producing beryllium alloys which includes superposing a mixture of beryllium oxide and carbon upon the surface of a metal bath, and at least in part displacing the atmosphere which would normally obtain by reason of the reduction so as to reduce the possibility of formation of beryllium carbide and the reformation of beryllium oxide.

8. A process for producing beryllium alloys which includes bringing carbon and beryllium oxide into reaction with each other, and at least in part displacing the atmosphere which would normally obtain by reason of the reduction so as to reduce the possibility of formation of beryllium carbide and the reformation of beryllium

oxide, the reaction being effected in contact with a metal bath containing at least one metal of the iron group.

9. A process for producing beryllium alloys which includes bringing carbon and beryllium oxide into reaction with each other, and at least in part displacing the atmosphere which would normally obtain by reason of the reduction so as to reduce the possibility of formation of beryllium carbide and the reformation of beryllium oxide, the reaction being effected in contact with a metal bath containing at least one metal of the chromium group.

10. A process for producing beryllium alloys which includes bringing carbon and beryllium oxide into reaction with each other, and at least in part displacing the atmosphere which would normally obtain by reason of the reduction so as to reduce the possibility of formation of beryllium carbide and the reformation of beryllium oxide, the reaction being effected in contact with a metal bath containing copper.

11. A process for producing beryllium alloys which includes superposing a mixture of carbon and beryllium oxide upon a metal bath, bringing said carbon and beryllium oxide into reaction with each other, and at least in part displacing the atmosphere which would normally obtain by reason of the reduction so as to reduce the possibility of formation of beryllium carbide and the reformation of beryllium oxide, the proportion of carbon to beryllium oxide being so calculated that part of the carbon remains unoxidized and is dissolved in the metal bath, and thereafter removing unoxidized carbon in a second phase of the process by adding another quantity of beryllium oxide.

12. A process for producing beryllium alloys which includes bringing carbon and beryllium oxide into reaction with each other, and at least in part displacing the atmosphere which would normally obtain by reason of the reduction so as to reduce the possibility of formation of beryllium carbide and the reformation of beryllium oxide, the proportion of carbon to beryllium oxide being so calculated that part of the carbon remains unoxidized and is dissolved in the metal bath, and thereafter removing unoxidized carbon by means of an oxide other than beryllium oxide.

13. A process for producing beryllium alloys which includes bringing carbon and beryllium oxide into reaction with each other, and at least in part displacing the atmosphere which would normally obtain by reason of the reduction so as to reduce the possibility of formation of beryllium carbide and the reformation of beryllium oxide, the proportion of carbon to beryllium oxide being so calculated that part of the carbon remains unoxidized and is dissolved in the metal bath, and thereafter removing unoxidized carbon by means of magnesium oxide.

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