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PROCESS FOR MAKING FOAMLIKE MASS OF METAL

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This invention relates to a sponge metal and the process of making it.

The name, "sponge metal," is used herein to designate a metal product in any desired shape and form in which the metal contains a plurality of closely adjacent spaces or voids of partial vacuum or fluid. The metal structurally resembles a solidified foamy mass of metal.

One of the objects of the invention is the process of making the sponge metal from a mixture of metals, compounds, alloys, elements, or minerals, and the resultant product therefrom.

Another object is the product of my process of making the sponge metal, and which product is a solidified, foamy mass of metal having extreme lightness in proportion to the volumetric mass of the metal and being structurally resistant to shock and strain proportional to the normal resistance of ordinary metal of the same kind, while possessing greater resiliency to impact not found where the mass of metal is solid.

Briefly described, the sponge metal of this invention may be cast, fashioned, processed, or cut to the desired shape, such as blocks, sheets, plates, tubing, or in whatever form is desired. As the cells in the metal are not intercommunicating, it possesses heat insulation properties and the metal may obviously be made resistant to oxidization, either by its inherent nature or by treatment of its exposed surface. Also the metal has sound and vibration absorbing properties.

In general, the process of making the metal comprises heating the desired metal, mixture of metals, compounds, alloys, or other minerals, etc., to a temperature between the melting point thereof at atmospheric pressure and a temperature sufficient to produce a vapor pressure of volatile material in the mixture, and under conditions where the volatile portion or portions are held in the molten mass against escape therefrom. The molten mass is then released into a lower pressure space resulting in the formation of a froth or mass of metallic, gas filled bubbles, which, after cooling will constitute the sponge metal.

As examples of mixtures that are suitable for forming sponge metal, one or more of the following combinations may be used:

Iron, aluminum, zinc
Iron, magnesium, zinc
Aluminum, magnesium, iron, mercury
Magnesium, mercury
Aluminum, mercury
Chromium, cadmium
Gold, mercury

In carrying out this process, any conventional apparatus may be employed capable of withstanding the necessary heat and pressure, it being understood that the volatile portion of the material treated is prevented from escape so as to produce the desired vapor pressure.

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As a concrete example, assuming aluminum and mercury are used, these may be mixed in the proportion of 90 parts of aluminum to 10 parts of mercury, and are melted in a closed chamber or under conditions preventing escape of the mercury vapor. The proportions are, of course, greatly dependent upon the capacity of the enclosure to produce a desired vapor pressure, that is, the less vapor pressure space the less mercury is required, and the greater the space the more is needed.

At atmospheric pressure, the aluminum should melt at about 658° C. and as the boiling point of mercury is about 357° C. it will be seen that a vapor pressure due to the volatilizing of the mercury may be increased to the point where the mercury in the mixture is stabilized or is not vaporized unless there is a reduction in pressure. When this condition is reached and the pressure is released, which may be by withdrawing the molten mass from the high pressure chamber to a low pressure space, there will be a volatilizing of the mercury in the mass causing it to become foamy or sponge-like. Upon cooling a sponge metal will result.

Where iron, aluminum and zinc are used, the relative proportions of aluminum to iron may be from about 1% iron to 90% aluminum by weight, or from 90% to 10% aluminum, and from 1% to 20% of zinc relative to the entire mass will supply the desired amount of zinc for supplying the vapor. A higher temperature will normally result in less zinc being required.

In all instances in compositions of different metals their melting points will vary from that of the respective metals, hence exact melting point temperatures cannot be given.

In zinc alloys, the zinc in the alloy will be sufficient to produce the necessary gas, and where mercury is used, from 1% to 10% by weight of the entire mass is generally adequate, and where no amalgam is formed, there will be some free mercury in the cells in the sponge metal, but the empty spaces will nevertheless be formed.

Iron alone with 1% to 20% zinc, or magnesium and iron with 1 to 20% magnesium, or magnesium and zinc may be used to form the metal.

As an example of a mineral and a metal, gold and mercuric oxide melted together in a confined space will produce sponge metal.

The pressure produced will vary in proportion to temperature, composition and solubility, but as a general principal in all instances the heating is to the point where vapor pressure of volatile material or materials is above the pressure of the space into which the molten material is to be released, or a relatively rapid lowering of pressure in the space in which the material is melted is the equivalent if the molten material is not drawn from the space in which it is melted.

The above principle being understood, it is, of

3 course, obvious that the invention is not restricted to exact metals disclosed, but to any metallic mixture, compound, alloy, etc., in which a metal or mineral is incorporated therein that has a relatively lower boiling point than the main body of the mass so as to produce the vapor pressure in the molten mass sufficient to create the conditions in which a release of the vapor pressure will result in subsequent volatilizing of the said metal or mineral in the mass to produce the cellular structure when the mass is cooled in the low pressure space or area.

While earlier herein the statement was made that the cells in the sponge metal were not intercommunicating, this statement is to be taken generally, since some intercommunication between certain cells cannot be avoided.

Having described my invention, I claim:

1. The process of making a metal containing substantially throughout its body completely enclosed voids that comprises melting the metal below its boiling point at atmospheric pressure out of contact with the atmosphere in the presence of material relatively volatile with respect to the treated metal at a temperature above the boiling point of the latter at atmospheric pressure, and under pressure sufficient to substantially raise the boiling point of the said latter material, thereafter reducing the said latter pressure to below the boiling point pressure of said latter material, and thereafter cooling to produce the solidified metal containing the enclosed voids.

2. The process of making a metal containing substantially throughout its body completely enclosed spaces that comprises melting the metal below its boiling point at atmospheric pressure out of contact with the atmosphere in the presence of material relatively volatile with respect to the treated metal at a temperature above the boiling point of the latter at atmospheric pressure, and under pressure sufficient to prevent the escape of the relatively volatile material therefrom, thereafter reducing the said latter pressure to below the boiling point pressure of said relatively volatile material, and thereafter cooling to produce the solidified metal containing the enclosed spaces.

3. The process of making a metal containing substantially throughout its body closely adjacent completely enclosed spaces that comprises melting the metal below its boiling point at atmospheric pressure out of contact with the atmosphere in the presence of material relatively volatile with respect to the treated metal at a temperature above the boiling point of the latter at atmospheric pressure, and under pressure sufficient to substantially raise the boiling point of the said relatively volatile material, thereafter reducing the said latter pressure to below the boiling point pressure of said relatively volatile material, and thereafter cooling to produce the solidified metal containing the enclosed spaces.

4. The process of making a metal containing substantially throughout its body closely adjacent completely enclosed non-communicating spaces that comprises melting the metal below its boiling point at atmospheric pressure out of contact with the atmosphere in the presence of another metal relatively volatile with respect to the treated metal at a temperature above the boiling point of the latter at atmospheric pressure, and under pressure sufficient to substantially raise the boiling point of the said relatively volatile metal, thereafter reducing the said latter pressure to

4 below the boiling point pressure of said relatively volatile metal, and thereafter cooling to produce the solidified metal containing the enclosed spaces.

5 5. The process of making a solidified foam-like mass of metal containing substantially throughout its body closely adjacent completely enclosed non-communicating spaces that comprises melting the metal below its boiling point at atmospheric pressure out of contact with the atmosphere in the presence of another metal relatively volatile with respect to the treated metal at a temperature above the boiling point of the latter at atmospheric pressure, and under pressure sufficient to substantially raise the boiling point of the said relatively volatile metal, thereafter releasing into a lower pressure space the molten metal to form a foam-like mass of metal, and thereafter cooling said mass to produce the solidified metallic mass containing the enclosed spaces.

6. The process of making a solidified foam-like mass of metal containing substantially throughout its body closely adjacent non-communicating completely enclosed spaces which comprises mixing molten metal at a temperature below its boiling point at atmospheric pressure out of contact with the atmosphere with another metal relatively volatile with respect to the treated metal, and under pressure sufficient to substantially raise the boiling point of the said relatively volatile metal, thereafter releasing into a lower pressure space the molten metal to form a foam-like mass of metal, and thereafter cooling said mass to produce the solidified foam-like metallic mass.

7. The process of making a solidified foam-like mass of metal containing substantially throughout its body closely adjacent non-communicating completely enclosed spaces which comprises mixing molten metal at a temperature below its boiling point at atmospheric pressure out of contact with the atmosphere with another material relatively volatile with respect to the treated metal, and under pressure sufficient to substantially raise the boiling point of the said relatively volatile material, thereafter releasing into a lower pressure space the molten metal to form a foam-like mass of metal, and thereafter cooling said mass to produce the solidified foam-like metallic mass.

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