

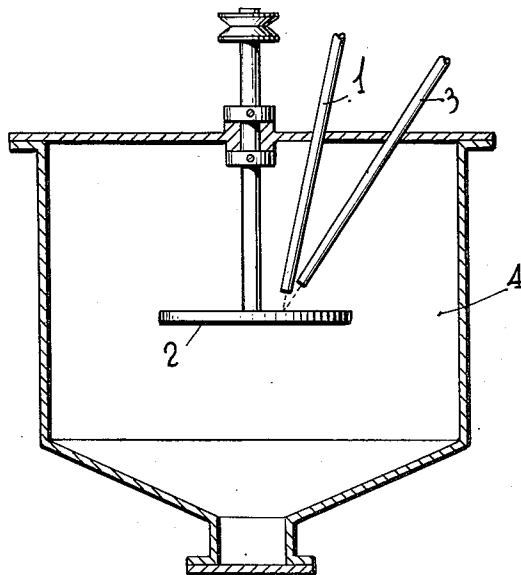
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PROCESS FOR THE CONVERSION OF METALS INTO FINELY DIVIDED FORM

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PROCESS FOR THE CONVERSION OF
METALS INTO FINELY DIVIDED FORM

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The present invention relates to an improved process for converting metals into a finely divided form.

This application is a continuation-in-part of my co-pending application S. N. 192,423, filed February 24, 1938.

It is an object of the present invention to provide a process for converting metals into an extremely finely divided form which has low power requirements and which gives large yields per apparatus employed.

The process in accordance with the present invention is of special value in comminuting metals which are to be employed in the powder metallurgy art.

Various types of rotating disc processes and apparatus have been developed for the comminution of fused materials in which a stream of fused material is directed against a rotating disc-like element. However, such processes and apparatus have not heretofore been practical for the production of extremely finely divided products and normally only a granular material was obtained which, in many cases, was necessarily subjected to a further comminution operation in order to obtain a finely divided product.

In accordance with the present invention, the metal to be comminuted is fused and supplied to a rapidly rotating disc and subjected to strong cooling substantially at the point of its impact with the rotating disc, which preferably rotates about a vertical axis. Care, however, must be taken that the fused metal is not subjected to any substantial cooling before it contacts the rotating disc so that the fused metal be as fluid as practically possible. Excellent results are obtained in accordance with the present invention if a discreet stream of cooling fluid, preferably a liquid having a boiling point substantially below the melting point of the fused metal, is directed toward the rotating disc simultaneously with a stream of the fused metal to be comminuted so that such streams contact substantially at the point where the fused metal strikes the rotating disc, but not earlier.

Such stream of cooling fluid must be sufficient to exert a strong cooling effect upon the fused metal being comminuted substantially at the point at which it strikes the rotating disc so that it effects solidification of the metal particles substantially at the point where they are formed when the fused metal strikes the rapidly rotating element. The cooling fluid, when supplied in this manner, serves several purposes. For example, it serves to suspend and separate

the metal particles so that they do not agglomerate or adhere to the surface of the rotating element. Furthermore, when a cooling liquid is employed in accordance with the preferred modification of the present invention, which liquid possesses a boiling point substantially below the melting point of the metal being comminuted, the resultant explosive evaporation of the cooling liquid materially aids in the comminution obtained and envelopes the resulting particles with vapor which prevents re-agglomeration of the particles which are formed.

The process in accordance with the present invention is carried out, for example, by supplying a thin stream of a molten metal to a rapidly rotating disc which is housed within a casing to catch the resulting finely divided product and simultaneously supplying a stream of cooling fluid substantially to the point at which the molten metal strikes the rotating disc in order to provide intensive cooling of the melt at this point and to effect solidification of the fine particles substantially as they are formed and before they leave the rotating disc. The comminution effect obtained results from a combination of the impact of the fused metal upon the rotating disc and the centrifugal forces exerted thereupon, as well as from the action of the stream of cooling fluid which is supplied to the disc in the aforementioned manner. In order to effect extremely fine comminution care must be taken that the fused metal remains extremely fluid until it strikes the rotating disc, and consequently the stream of cooling fluid supplied during the comminution should only come into contact with such fused metal substantially at the point where it contacts the rotating disc.

The fineness of the product obtained in accordance with the present process may be regulated within a certain extent by altering the velocity with which the stream of molten metal strikes the rotating disc and by regulating the speed of rotation of the disc, as the greater the velocity of the stream of molten metal and the greater the speed of rotation of the disc, the finer will be the resulting product.

In some instances it may be advisable to supply further quantities of a cooling fluid to the apparatus besides that supplied at the point of contact of the fused metal with the rotating disc. For example, cooling gases or liquids may be sprayed into the casing surrounding the comminuting disc. Also, the rotating disc may be hollow and the interior thereof be supplied with a cooling medium. It is to be understood, how-

ever, that the aforementioned cooling means are only intended to supplement the cooling obtained by the stream of cooling fluid which is caused to impinge against the disc at the point where the fused metal contacts the rotating disc and not to replace it.

The cooling fluids employed in accordance with the present invention are selected with reference to the type of comminuted product sought. If mere comminution with no chemical change is desired, the cooling fluids must be inert with respect to the metal treated. However, in some instances it may be desired to effect a chemical change in the metal treated and, in such instances, cooling fluids may be selected which effect such chemical change. For example, gases such as chlorine, oxygen and ammonia may be employed as reactive cooling fluids whereby iron oxide, aluminum oxide, zinc chloride, sodium amide and the like may be obtained directly from the corresponding metals. Water may be employed as a non-reactive cooling fluid for the comminution of many metals in view of the extremely rapid cooling obtained in accordance with the present invention. If, however, very reactive metals are sought to be comminuted, other inert organic cooling liquids, such as benzene, may be employed.

In some instances it may be desirable to provide a bath of liquid in the bottom of the casing for the comminuting disc to catch the comminuted metal as it is thrown from the rotating disc and to quench such material completely. Such liquid may be either inert with respect to the comminuted material or chemically reactive therewith, depending upon whether the comminuted material is desired to be recovered in unchanged or in reacted condition.

Special precautions may also be taken to preserve an inert atmosphere in the comminution apparatus. However, when inert cooling fluids are employed, these usually suffice to provide the inert atmosphere. If special reaction conditions are desired, it is also possible to introduce reactants into the comminuting chamber in addition to the cooling fluid introduced.

The quantities of cooling fluid which are employed in accordance with the present invention in the stream which is directed toward the rotating disc simultaneously with the fused material to be comminuted must be sufficient to effect as rapid a cooling of the comminuted material as possible. For example, if a cooling liquid be employed a sufficient quantity should be supplied to the disc so that substantial portions thereof are not vaporized in cooling the fused material so that such liquid portion is sprayed off the disc in conjunction with the comminuted material. In other words, the latent heat of vaporization of the quantity of cooling fluid supplied must be substantially greater than the latent heat of fusion of the quantity of the metal supplied. When water is employed as the cooling fluid in the comminution of fused metals, it has been found that 5 to 200 liters may be supplied to the disc for every 10 kgs. of molten metal. Advantageously, 50 to 150 liters of water are employed per 10 kgs. of metal and the best results are obtained when approximately 100 liters of water are supplied for every 10 kgs. of molten metal. Of course, if other liquids are employed, the quantities thereof which are employed must be altered with respect to the latent heat of vaporization of the cooling liquid in question. For example, if a liquid having a lower

latent heat of vaporization than water is employed, the quantities thereof which are employed must be correspondingly greater. Also, when gases are employed as the cooling media, the proportions employed must be considerably greater than when a liquid is employed.

The process in accordance with the present invention is exceptionally well suited for the production of iron powder, copper powders, alloy powders, such as silver-copper alloys, water being preferably employed as the cooling fluid which is supplied to the rotating disc simultaneously with the fused material. Metal powders may, for example, be obtained which can pass through a sieve having at least 50 meshes per square centimeter without a residue.

In the preferred modification of the invention for the comminution of metals, such as, for example, copper or iron, a stream of molten metal of about 5 mm. cross-section is supplied to the rotating disc which preferably rotates at a velocity of at least 2000 revolutions per minute and simultaneously directing about 100 liters of water toward the rotating disc for every 10 kgs. of molten metal supplied so that such water strikes the disc substantially at the point at which the stream of molten metal strikes it.

The accompanying drawing shows an apparatus suitable for carrying out the process in accordance with the present invention in side elevation with the casing partially broken away.

In such drawing, 1 represents a conduit for supplying a stream of the fused material to be comminuted to the rotating disc 2. The conduit 3 serves to supply the stream of cooling fluid to the rotating disc substantially at the point at which the fused material strikes the disc. The rotating disc 2 and the lower ends of conduits 1 and 3 are enclosed in casing 4.

While I have described herein some embodiments of my invention, I wish it to be known that I do not intend to limit myself thereby, except within the scope of the appended claims.

I claim:

1. A process for converting metals into finely comminuted material which comprises directing a stream of fused metal which is of such a temperature that it is in the form of a thin liquid against a rotary disc rotating at a speed of at least 2000 revolutions per minute and simultaneously directing a discrete stream of water against the rotary disc substantially at the point at which the stream of fused metal strikes such disc, the rate of feed of the water being sufficient to effect intensive cooling of the fused material immediately upon striking the rotary disc and that a substantial quantity thereof is not converted to steam and is sprayed off the disc simultaneously with the comminuted material.

2. A process for converting metals into finely comminuted material which comprises directing a stream of fused metal which is of such a temperature that it is in the form of a thin liquid against a rotary disc rotating at a speed of at least 2000 revolutions per minute and simultaneously directing a discrete stream of water against the rotary disc substantially at the point at which the stream of fused metal strikes such disc, the rate of feed of the water being 5 to 200 liters for every 10 kilograms of the fused metal supplied to the rotating disc.

3. A process for converting metals into finely comminuted material which comprises directing a stream of fused metal which is of such a temperature that it is in the form of a thin liquid

against a rotary disc rotating at a speed of at least 2000 revolutions per minute and simultaneously directing a discrete stream of water against the rotary disc substantially at the point at which the stream of fused metal strikes such disc, the rate of feed of the water being 50 to 150 liters for every 10 kilograms of the fused metal supplied to the rotating disc.

4. A process for converting metals into finely comminuted material which comprises directing a stream of fused metal which is of such a temperature that it is in the form of a thin liquid against a rotary disc rotating at a speed of at least 2000 revolutions per minute and simultaneously directing a discrete stream of water against the rotary disc substantially at the point at which the stream of fused metal strikes such disc, the rate of feed of the water being about 100 liters for every 10 kilograms of the fused metal supplied to the rotating disc.

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5. A process for converting metals into finely comminuted material, which comprises directing a stream of fused metal which is of such a temperature that it is in the form of a thin liquid against a rotary disc rotating at a speed of at least 2000 revolutions per minute and simultaneously directing a discrete stream of a cooling liquid having a boiling point substantially below the melting point of the metals being comminuted against the rotary disc substantially at the point at which the stream of fused metal strikes such disc, the rate of feed of the cooling liquid being sufficient to effect intensive cooling of the fused material immediately upon striking the rotary disc and that a substantial quantity thereof is not vaporized and is sprayed off the disc simultaneously with the comminuted material.

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