May 14, 1940. L. G. KLINKER 2,200,369

PROCESS OF MAKING METALLIC MOLDING POWDERS

Original Filed July 18, 1938

Fig. 1

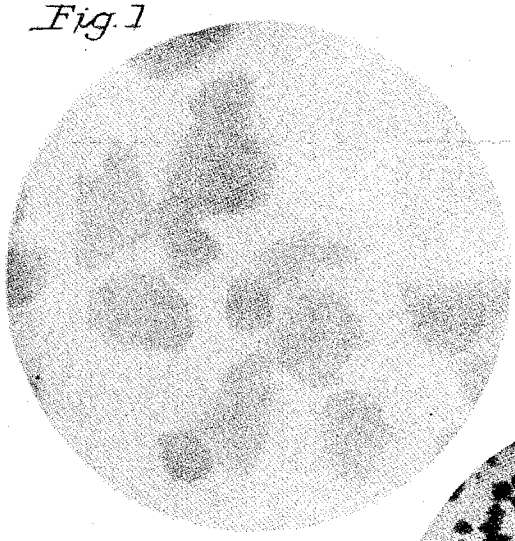


Fig. 2.

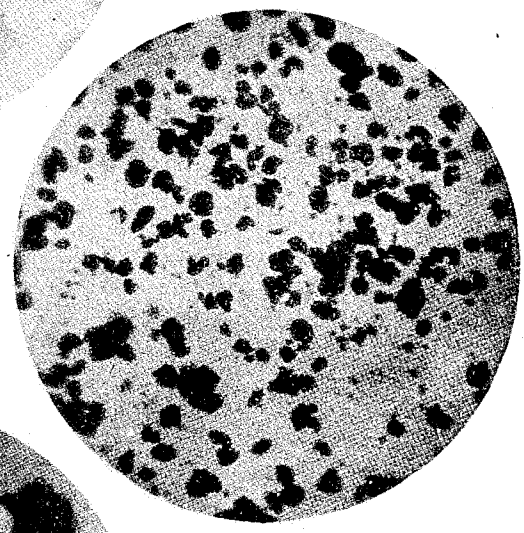
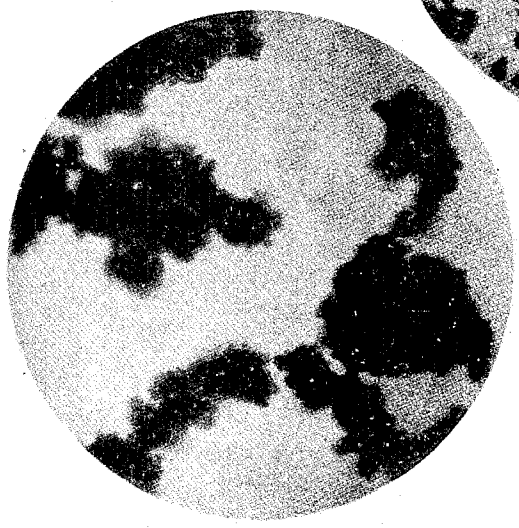


Fig. 3.



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PROCESS OF MAKING METALLIC MOLDING POWDERS

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3 Claims. (Cl. 75—22)

The present invention relates to metallic molding powders and the preparation thereof, and more especially for powders which are cold molded into metallic articles which are sintered after molding. Various articles are now made by the powder molding process in which a metallic powder is compressed to form the article and the article is then heated to a temperature sufficient to cause a sintering of the metallic particles. In the manufacture of molded articles from metal powders it has been known that electrolytic metal powders cold mold into "green" pieces having more strength for a given mold pressure than powders formed by grinding metals or reducing them chemically. This characteristic of electrolytically formed powders is believed to be due to their dendritic structure which gives rough surfaces and interlock when the molding pressure is applied.

One purpose of my process is the preparation of a powder which has the rough surface or dendritic-like characteristics of electrolytically formed metal powders but produced from a ground or otherwise naturally smooth surface powder. In general, I prefer to form the basic metal powder by a grinding operation. With most metals the powder produced consists of essentially smooth and more or less spherical particles. This powder is ground to a fine size, usually so that all of the particles will pass a 100 or 150 mesh to the inch screen. The grinding operation is preferably carried out in an oxidizing atmosphere, which results in a fairly good coating of metal oxide on the particles. This powder is then mixed with another and preferably considerably finer metal powder, and the mixture is heated in a reducing atmosphere so as to cause a sintering of the finer particles of the second metallic powder upon the smooth surfaces of the particles of the first powder. The particles of the second metal powder are sintered to the surfaces somewhat like tentacles, so that when the particles are cold molded, these tentacle-like projections interlock to give a greater green strength. I have also found that this greater strength persists in the finally formed articles.

The sintering to roughen the surfaces of the particles and give them the molding characteristics of the dendritic electrolytic powders is carried out at a temperature and sufficient length of time to cause the particles to become thoroughly sintered together. This results in a sintered mass which, after cooling, is reground to serve as a molding powder for making the finished articles.

In the drawing—

Fig. 1 is a photomicrograph of particles of metal produced by the grinding process;

Fig. 2 is a photomicrograph of finer metal particles used for sintering to the surfaces of the particles shown in Fig. 1;

Fig. 3 is a photomicrograph of particles of the type shown in Fig. 1 with particles of the type shown in Fig. 2 sintered to their surfaces.

I will now explain the present invention further with particular reference to certain specific embodiments.

Small articles of irregular outline such, for example as latch plates for automobile bodies, are made by the powder process from powdered steel or iron and binding metal such as copper, since by this process they can be made cheaper than by casting and machining and have sufficient strength for the purposes required. As a specific example, I prepare a powder by grinding steel or cast iron to a fineness to pass through about a 100 mesh screen. The grinding is carried out in the air and the particles become coated with iron oxide. A second iron powder, preferably of a somewhat dissimilar composition and of a finer mesh, say through about a 250 mesh screen, is prepared and mixed with the first powder. The powder is then placed in a furnace and heated in a reducing atmosphere to a temperature sufficient to cause the iron particles to become sintered together. During the sintering treatment in a reducing atmosphere, the iron oxide on the surface of the particles becomes reduced to metallic iron and I have found that this is of considerable advantage in causing a rapid and firm sintering of the smaller particles to the surfaces of the larger particles so as to give them a roughened dendritic or tentacle-like surface. After the sintering is completed, the mass is cooled and ground to form the molding powder, which consists largely of the ground particles which were initially smooth but the surfaces of which now are roughened by the sintering thereto of the smaller particles of metal. This powder has, in general, the molding characteristics of powders produced electrolytically and may be substituted therefor in the usual molding and sintering operations to form the finished articles according to well known practice.

Another specific example is the preparation of powders used for making bronze bearings by the powder molding process. Bronze, preferably

waste turnings or borings from the making of cast bronze bearings, is ground to a fine powder, preferably to all pass a 100 or 150 mesh screen. The grinding is carried out under oxidizing conditions so that the particles of this powder are coated with a film of oxide. A finely powdered copper is prepared, preferably of a somewhat smaller mesh size, and mixed with the bronze powder. The mixture is then heated in a reducing atmosphere to a temperature sufficient to cause the copper particles to become sintered to the bronze particles and "copperize" them. This temperature is between 500 and 1800° F. and preferably in the neighborhood of 1300° F. It should be below the fusing point of the bronze or the copper but high enough to cause sintering of the copper particles to the surface of the bronze particles. The oxide film on the bronze particles is reduced during the sintering treatment and the nascent reduced metal apparently contributes to a ready and very adherent sintering of the copper particles to the surface of the bronze particles.

The sintered mass is ground to form a molding powder to be used for making bronze bearings by any suitable powder molding process.

In the drawing, Fig. 1 is a photomicrograph of particles of the bronze powder produced by grinding, and it will be noted that these particles are of a general nodular or spherical shape and have smooth surfaces. Fig. 2 is a photomicrograph of the powdered copper, which is preferably ground to finer grain size. Fig. 3 is a photomicrograph of the particles of the copperized molding powder after the initial sintering and after regrinding. It will be noted that these particles have roughened surfaces formed by the adhesion and sintering to the initially smooth surfaces of the bronze particles of the smaller copper particles.

In the manufacture of bearings from the copperized bronze powder, the bronze powder is preferably mixed with a small amount, say about 5% of powdered tin, and the articles cold molded and sintered into bearings.

While it is preferred to use a dissimilar metal as the finer coating powder, a single metal may be ground to form a mixture of coarser and finer particles and the mixtures sintered so as to cause the finer particles to be sintered to and roughen the surfaces of the larger particles.

While it is preferred to mix the basic metal powder with a second and more finely ground metal powder and sinter the particles of the second metal to the surfaces of the particles of the first metal to roughen them, a roughening metal may be otherwise deposited and sintered, as by mixing the first powder with a reducible compound of the second metal. For example, in place of iron, iron-oxide may be used, or in place of copper, copper-oxide may be used. Other reducible metal compounds may be employed instead of the oxides, such as the metallic compounds, and in the case of copper, copper cyanide, copper oxalate, etc., may be used. Under a reducing atmosphere these metallic compounds are reduced to yield minute metal particles, which are sintered to the surfaces of the basic metal particles.

While I prefer to mechanically grind or disintegrate the metal to form the powders, the powders may be formed otherwise, as by reduction of metal compounds by heat, such as by heating iron carbonyl which decomposes forming spherical iron powder particles. Such processes, in general, yield powders having smoother surfaces than electrolytically formed powders and such powders are greatly improved by our treatment for molding purposes. Such powders are heated in an oxidizing atmosphere to form oxide films on the particles before they are used in any process.

The "green" articles produced (the articles cold molded before sintering) have a greater strength than those formed of powders produced by grinding. Also the finished sintered articles have a greater strength, since the interlocking of the rough surfaces apparently not only contributes to the green strength but also to the final strength of the article. In making the finished articles, my powders may be used in usual molding operations either by themselves or being mixed with other powders.

While I have specifically described the preferred embodiments of my invention, it is to be understood that the invention may be otherwise embodied and practiced within the scope of the following claims.

I claim:

1. The process of making metallic molding powders which comprises grinding a metal under oxidizing conditions to form an oxide-coated powder, mixing with it a second powder of a material of the class consisting of metals and reducible metal compounds, sintering the mixture in a reducing atmosphere, and regrinding.

2. The process of making metallic molding powders which comprises forming a powdered metal having smooth oxide-coated particles, mixing it with another powdered metal and heating the mixture in a reducing atmosphere to reduce the oxide coating and sinter the metallic particles and roughen the smooth surfaces, and reducing the sintered mass to a molding powder.

3. The process of making metallic molding powders which comprises forming a powdered metal having oxide-coated particles, mixing with it a material of the class consisting of finely powdered metals and reducible metal compounds, sintering the mixture in a reducing atmosphere, and pulverizing.

LOUIS G. KLINKER.