

## UNITED STATES PATENT OFFICE

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## SILVER BEARING

Franz E. Hensel and Earl I. Larsen, Indianapolis, Ind., assignors to F. E. Mallory & Co., Inc., Indianapolis, Ind., a corporation of Delaware

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1 Claim. (Cl. 308—237)

This invention relates to sintered metal powder bearings.

It is an object of the present invention to produce bearings with improved anti-friction characteristics.

It is a further object of the invention to produce bearings which will withstand high bearing loads when operated at high speeds.

Other objects of the invention will be apparent from the following description taken in connection with the appended claim.

The present invention comprises the combination of elements, methods of manufacture and the product thereof, brought out and exemplified in the disclosure hereinafter set forth, the scope of the invention being indicated in the appended claim.

While a preferred embodiment of the invention is described herein, it is contemplated that considerable variation may be made in the method of procedure and the combination of elements without departing from the spirit of the invention.

Silver has already been suggested for bearing purposes. Various means have been employed to produce bearings. The two methods which have obtained commercial importance are the casting of silver to steel shells and the plating of silver onto preformed steel shells. Other methods which have been under consideration are the preparation of a silver steel bimetal from which bearings may be formed.

It has been found that fine silver by itself has certain disadvantages when used in the form of a bearing, and therefore the recent constructions consist in attaching a layer of lead to the silver. In many cases this has given cause for corrosion and very thin layers of indium have been applied and diffused into the layer of lead in order to increase the corrosion resistance. Others have suggested a layer of tin over the fine silver in order to improve the bearing qualities.

Tests have also been made on the casting of silver lead alloys and on plating with silver lead alloys. However, it has been impossible to obtain a very homogeneous product containing any substantial amounts of lead, since silver and lead are almost immiscible. The maximum amount of lead that can be incorporated in silver by melting does not exceed 2 to 3%. The advantage of the lead addition, however, starts with higher percentages, where free lead particles are present, improving the frictional characteristics.

The present invention contemplates the manu-

5 facture of silver base bearings from metal powders by means of pressing and sintering operations, thereby overcoming all of the previous difficulties that have made the production of silver lead compositions impractical for commercial purposes. This new method allows the selection of powders of definite particle size according to the final results desired.

10 We have prepared a number of samples in accordance with the present invention and have obtained a product of extreme uniformity. We have found that it is possible to start with the powders of both silver and lead and produce a mixture, which after pressing and sintering, will have suitable bearing qualities.

15 According to a modification in our method the particles of one metal powder, for instance silver powder, are coated with another metal, for instance lead, the coated particles being pressed and sintered to form a bearing. It is likewise possible to use lead powder coated with silver. The layer of either silver or lead should preferably be applied by means of a plating process. The methods of silver plating are well known in the art. The lead particles can be placed into a container filled with the plating solution, and subjected to intermittent stirring during the plating process. There are a multiplicity of constructions regarding methods of conducting current into the particles to be plated, all or any of which may be used. The plating of the lead particles with silver is preferable to the plating of lead on the silver particles, because the silver will form a coherent and nonporous film around the lead and during sintering will prevent the lead from sweating out.

20 The methods of lead plating are also well known in the art. It might be mentioned that the silver plating can be carried out with considerably more ease than lead plating.

25 Another modification comprises compressing silver powder into a porous body of suitable shape, sintering the pressed body, and then impregnating the porous sintered body with molten lead. It is possible, in some cases, to combine the sintering and impregnating operations by immersing the porous pressed silver body in a bath of lead heated to a temperature suitable for sintering the silver, such as 500 to 800° C.

30 It is possible to vary the porosity of the silver powder compact by varying the applied pressure. For example, at 32° C. a pressure of 5 tons per square inch results in a density of 7.2 grams per c. c., 10 tons in a density of 8.1 grams, 20 tons in 9.3 grams, 30 tons in 9.8 grams and ultimately

80 tons produced a density of 10.3 grams per c. c. The hardness of the silver compacts also increases with pressing pressure from about -75 Rockwell F at 5 tons per square inch to +85 Rockwell F at 80 tons.

We have further discovered that by hot pressing the silver powder in a heated die a higher density can be obtained at lower pressures. We have also found that there is a certain optimum temperature at which maximum density may be obtained for a given pressure together with maximum hardness. For example, if a temperature of 400° C. is used a lower ultimate hardness is obtained in the silver compacts than at 32° C. although higher densities are obtained for given pressures. However, by using a pressing temperature in the order of 300° C. the ultimate hardness is about the same as that obtained at 32° C. We prefer, therefore, to use pressing temperatures in the order of 300° C. At this temperature the maximum hardness is reached at a considerably lower pressure than at 32° C.

Also, if the silver is hot pressed an additional sintering operation is not ordinarily required, although it may be used in some cases to improve the cohesion.

In the case of pressing at room temperature, it is necessary to apply a sintering operation between temperatures ranging from 500 to 900 degrees C. The cohesion is a function of time and temperature and it can be generally stated that at the higher temperatures, such as 800° C., the compact will sinter together much more firmly. However, for a large number of applications, a lower sintering temperature, such as 600° C., may be perfectly satisfactory, particularly in view of the fact that the compact is being impregnated with lead or babbitt.

If very high densities in the silver matrix are desired, then a repressing operation can be applied, after the sintering, and afterwards, the low melting point constituent, such as lead or babbitt, may be incorporated by means of impregnation.

For a number of applications we have found that it is quite possible to eliminate the addition of lead and to press and sinter the silver particles under such conditions as to obtain a predetermined degree of porosity. The porous bearings are impregnated with lubricating media, such as lubricating oils, greases, waxes and the like. A small amount of graphite may be added to the metal powders in any of the above cases to in-

crease the lubricating qualities of the bearings.

In some cases where the bearing is to be subjected to heavy loads it may be necessary to back it up by a solid metal, such as a ferrous alloy or a cuprous alloy backing. The bonding of the silver base powder to the backing materials can be accomplished by various means, such as coating the ferrous or cuprous alloy with metals forming an alloy both with the silver and the base, such metals or alloys being in the case of an iron backing, copper, tin, zinc and in the case of a copper backing, tin, zinc, cadmium or similar metals.

While lead is the preferred low melting material other low melting point bearing metals may be substituted therefor, such as lead alloys, babbitt, white bearing alloys, zinc, tin and cadmium and their alloys, aluminum, antimony, bismuth and thallium.

The term "silver" or "silver base" includes not only silver but also silver alloys, which may be substituted without deleteriously affecting the bearing performance.

In practicing the present invention, the percentages of lead or other low melting metal contained in the sintered silver lead bearings may vary from a fraction of a percent up to 40 weight percent.

In the cases where the lead in the bearings must be protected from corrosion, we have found it advisable to apply, preferably by electroplating, a very thin coating of indium to the lead particles, which, during the sintering operation, will diffuse into the lead and increase greatly the resistance to the corrosive attack of the oil or other lubricants which are being used.

While the present invention as to its objects and advantages has been described herein as carried out in specific embodiments thereof, it is not desired to be limited thereby but it is intended to cover the invention broadly within the spirit and scope of the appended claim.

What is claimed is:

A bearing comprising a metal body formed of a pressed and sintered mass of silver powder having a density between 7.2 grams per c. c. and 10.3 grams per c. c., said mass of silver powder comprising a self-bonded porous body, said porous body being impregnated with lead filling the interstices in the sinter-bonded silver powder body.

FRANZ R. HENSEL.  
EARL I. LARSEN.