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LEAD ALLOY BEARING METAL

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2 Claims. (Cl. 75—167)

This invention relates in general to lead alloys hardened in varying degree and having characteristics making them suitable for bearings and containing an inhibitor to prevent or reduce certain deleterious results obtained from the known bearing alloys. The instant case is a continuation of my co-pending application Serial No. 224,113, filed August 10, 1938.

A principal object of the invention is the provision of a bearing alloy which will resist the corrosive action of the oils used in lubricating bearings, such as the bearings used in railway service generally, automobiles, Diesel engines, and the like.

Another important object of the invention is the provision of a bearing alloy which will resist the destructive effects of oxidation products such as napthenic or other acids which generally result from the use of lubricating oils.

It is known that lubricating oils frequently contain free fatty acids which are used in the oils in order to increase the film strength and/or the viscosity of the oil. These fatty acids (for example, lard oil) have been found to dissolve a lead-base bearing metal, and in this connection it may be noted that cadmium silver, cadmium nickel and lead bronze bearing alloys generally used in the machine bearing field are likewise attacked by fatty acids. It is a further object of the instant invention to provide a bearing metal which will overcome these deleterious results.

Numerous other objects and advantages of the invention will be apparent as it is better understood from the following description, which discloses a preferred embodiment thereof.

In the instant application, the primary hardening agent is calcium, and it is used in amounts sufficient so that a number of calcium-lead crystals Pb_3Ca are produced, which give the alloy its capacity of withstanding wear and resisting impact necessary to make the alloy usable for certain types of bearings. That is, the calcium is used in such quantity that a portion of it goes into solid solution with the lead, while another portion forms the before-mentioned calcium-lead crystals.

It has been found that tin, in addition to being a secondary hardener, is a valuable inhibitor not merely of oil corrosion, but resists the deleterious effect of naphthenic acids, sulphur and its allied compounds and free fatty acids, when used in amounts over 2.2%. Accordingly, this invention contemplates the use of tin in amounts of 2.2% or over as a secondary hardener and an inhibitor of oil corrosion.

The alloy referred to differs from the bearing alloy described and claimed in United States patents to Robert J. Shoemaker, Nos. 1,745,721; 1,808,793 and 1,916,496, in which lithium, potassium and magnesium are variously employed as hardening agents, since it has been found that those ingredients might impart a deleterious corrosive effect to the alloy, particularly when used in thin bearing linings where the alloy may be only $\frac{1}{32}$ inch to $\frac{1}{16}$ inch thick, as in bearings for automobiles, Diesel engines, and the like. It has also been found that potassium and lithium are rather unstable and dross off readily on remelts.

The instant invention contemplates, if desired, not merely the use of as high as 2.0% calcium, but the avoidance of the use of lithium, and/or potassium, if found desirable, without the loss of the desirable characteristics usually imparted to alloys thereby, in addition to any desired inhibitor.

The alloy further differs in its characteristics from the lead alloy intended particularly for cable coverings, pipes, and like articles described and claimed in United States patent to Robert J. Shoemaker, No. 1,813,324, patented July 7, 1931, in which such small quantities of tin are used as to render the alloy therein described and claimed valueless as an inhibitor of oil corrosion. Furthermore, tin is used in said patent solely as a secondary hardener and in amounts not exceeding 2.0%, preferably 1.0%.

The present invention also contemplates, where a higher degree of hardness is desired, the use of auxiliary hardeners, such as mercury. However, as mercury is poisonous and to some extent dangerous if used in large quantities for the purpose of enhancing the hardness of the alloy, the present invention contemplates the use of other auxiliary hardeners in place of all or part of the mercury, to wit: silver, barium, strontium, copper, manganese, in quantities to be indicated.

It is well-known that oil exerts a corrosive effect upon a bearing by dissolving the lining metal and thereby increasing the clearance between the axle or driven part and the bearing, causing not merely high running temperatures but bearing failures, and it has been found that by using the alloy herein described, these difficulties are almost if not entirely overcome.

A preferred formula is as follows, percentages being by weight of the allow, taking into account, so far as possible, oxidation and other compounding losses:

	Per cent
Calcium	0.075
Tin	5.0
Lead	Balance

These preferred quantities may be varied as follows:

	Per cent
Calcium	0.05 to 2.0
Tin	2.2 to 10.0
Lead	Balance

If the calcium is used in quantities above 2.0%, the alloy when melted will be too viscous. If the tin is used in quantities above 10.0%, the alloy becomes too brittle, the melting point is reduced, and the hardness of the alloy is correspondingly decreased. Where a higher degree of hardness is desired, I add, in addition to the tin, an auxiliary hardener such as mercury, and in such case, a preferred formula is as follows, percentages being by weight of the alloy, taking into account, so far as possible, oxidation and other compounding losses:

	Per cent
Calcium	0.075
Tin	5.0
Mercury	0.25
Lead	Balance

These preferred quantities may be varied as follows:

	Per cent
Calcium	0.05 to 2.0
Tin	2.2 to 10.0
Mercury	0.1 to 1.0
Lead	Balance

If the mercury is used in quantities above 1.0% it will volatilize.

The use of aluminum is optional in either alloy, but practically necessary if the alloy is to be remelted. It is an anti-drossing agent preventing oxidation of the calcium. Since it is largely customary in the industry to remelt bearings of this type, it is also necessary to keep the barium content not in excess of 0.1%, as more than that amount will render the alloy unstable.

Another preferred formula in which aluminum is employed is as follows, percentages being by weight of the alloy, taking into account, so far as possible, oxidation and other compounding losses:

	Per cent
Calcium	0.075
Tin	5.0
Mercury	0.25
Aluminum	0.05
Lead	Balance

These preferred quantities may be varied as follows:

	Per cent
Calcium	0.05 to 2.0
Tin	2.2 to 10.0
Mercury	0.1 to 1.0
Aluminum	0.02 to 0.15
Lead	Balance

The use of mercury in excess of 1.0% will add considerably to the hardness of the alloy. For example, the hardness of the alloy made in accordance with the preferred formula given above, is about 20° on the Brinell scale with the metal at 700° F. The hardness may be increased to 25° by using mercury up to 1.0%; but the employment of mercury in this quantity is likely to result in the production of poisonous fumes in the compounding or handling of the molten alloy. To avoid this, where a higher degree of hardness is desired, it is possible to employ, in the place of the mercury (or in addition to mercury in quantities from 0.1% to 1.0%) any of the following metals in the quantities indicated:

	Per cent
Silver	0.5 to 2.0
Barium	0.02 to 0.1
Strontium	0.02 to 0.5
Copper	0.05 to 1.0
Manganese	0.05 to 0.5
Cadmium	0.5 to 5.0

The method of compounding the above-described alloy is as follows: the lead is melted and heated to a temperature of approximately 1500° F. under a covering of calcium chloride or other suitable flux. The aluminum is introduced, preferably as an alloy consisting of 50% aluminum and 50% tin by weight. Since the amount of aluminum is very small, the tin introduced in this way is practically negligible. The calcium is introduced as metallic calcium or as an alloy consisting preferably of approximately 5% calcium and 95% lead by weight. If any of the auxiliary hardeners, silver, barium, strontium, copper, or manganese are employed, it may be introduced at this state, either as the pure metal or in the form of a tin or other desired alloy. The melt is then allowed to cool to a temperature just above the melting point of lead, say to 700° F., and the calcium-chloride covering is skimmed off; or the bath can be allowed to solidity and then remelted to about 700° F., whereupon, in either case, the mercury, tin and/or cadmium are added.

Another formula in compounding this alloy is as follows:

	Per cent
Calcium	0.08
Tin	4.5 to 10.0
Lead	Balance

and where a higher degree of hardness is desired, any one of the following in the amount specified:

	Per cent
Mercury	0.25
Silver	1.0
Barium	0.05
Strontium	0.25
Copper	0.25
Manganese	0.25
Cadmium	1.0

Another preferred formula in compounding this alloy, where a high degree of hardness is desired, is as follows:

	Per cent
Calcium	0.5
Tin	3.0
Mercury	0.45
Cadmium	1.0
Lead	Balance

These preferred quantities may be varied as follows:

	Per cent
Calcium	0.1 to 2.0
Tin	2.5 to 10.0
Mercury	0.1 to 1.0
Cadmium	0.5 to 5.0
Lead	Balance

The alloy of the preferred formula will have a hardness of 24° Brinell, a tensile strength of 12,000 pounds, a compressive strength of 18,000 pounds per square inch and an elongation of 9 to 12% in two inches.

This invention also contemplates the electrolytic deposition of tin upon a finished bearing

when the alloy contains the minimum limits of tin given, since it has been found that tin is a valuable inhibitor of oil corrosion on bearing metal in general. In those cases in which tin is deposited, it may vary in thickness as desired, usually from 0.002 to 0.15 of an inch, although these limits may be varied in accordance with the particular problem presented. It will be understood also that the instant invention contemplates the use of larger proportions of tin than those recited in the formulae given herein, if found desirable.

It is thought that the invention and many of its attendant advantages will be understood from the foregoing description and it will be apparent that various changes may be made in the recited formulae without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the formulae hereinbefore described being merely preferred embodiments thereof.

I claim:

1. A hardened lead alloy containing a primary hardener comprising 0.05 to 2.0% of calcium, an inhibitor of oil corrosion comprising 2.2 to 10.0% of tin, and balance substantially all lead.

2. A hardened lead alloy for bearings containing the following substances in quantities by weight as follows: a primary hardener comprising approximately 0.08% of calcium, an inhibitor of oil corrosion comprising approximately 4.5% of tin, and balance substantially all lead.

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