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LEAD ALLOY

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4 Claims. (Cl. 75—166)

My invention relates to a lead alloy. It relates, particularly, to an improved lead base bearing alloy containing minor amounts of silver, gold, or combinations of these two metals.

This application is a division of my co-pending application, Serial No. 353,243 filed August 19, 1940.

It is the purpose of this invention to provide babbitts equivalent in all important properties to tin-base babbitts yet without the use of tin, or with only a very minor proportion of tin. In seeking this equivalence of properties I have been guided by the principle that the substitute babbitt should have similar strength and hardness at room and at operating temperatures, particularly at high operating temperature around 300° F. to the standard tin base babbitts in order to secure that balance of the strength necessary to provide fatigue resistance, resistance to "squashing" out, and the ability of conform that is so desirable a characteristic of the tin base babbitts.

I have discovered that this may be accomplished by the addition of a small amount of silver to the ordinary lead-base type of babbitt containing at least 75 per cent lead, preferably with a simultaneous reduction in the tin content of those higher in tin, and with or without some reduction in the antimony content.

In my development of babbitts of the lead-antimony-silver type, I have recognized that in order to avoid corrosion by some ingredients in new or used lubricating oils, it may be desirable to include a small amount of tin in babbitts to be used in such oils at high temperature. Moreover, inasmuch as a useful source of raw material for the lead and antimony contents of my babbitts would be old battery plates and since these often contain small amounts of tin, as well as from the possibility that in plant practice some contamination may be effected by ordinary tin or lead base babbitts containing a little copper, it is important from the practical point of view that the silver-containing babbitts be compatible with small amounts of tin and copper as well as with lead and antimony, even though these elements may not be essential in securing the desired hardness over the operating range of temperature.

I have further found that another useful substitute for tin-base babbitt can also be made by replacing all or part of the silver in my lead-antimony-silver, lead - antimony - silver - tin or lead-antimony-silver-tin-copper alloys by gold, so that gold may be considered as an equivalent to or substitution for silver in this connection. While the cost of gold excludes it as an alloying element for this purpose under ordinary economic conditions, since it is at present 100 times as expensive as silver that is bought on the open market, nevertheless, from the point of view of strategic materials, stored gold owned by the Government might conceivably be released for industrial use in a time of acute tin shortage, so that its inclusion in the classification of potentially useful alloying elements for babbitt is justified.

These silver or gold additions may be made to a variety of lead-base babbits known to the prior art.

Lead-base babbitts may be hardened by additions, sometimes with the simultaneous subtraction of a little of the antimony, of other hardening elements up to about 1¼% copper, 1½% nickel, 1½% cadmium, ¾% arsenic, so that additions of, or replacement of antimony by, these other elements in the approximate amounts stated are additions from a recognized group of hardening elements for lead-base alloys.

In my improved lead-base babbitts, I may utilize any of these elements, in the approximate amounts stated, to supplement the antimony, which is the chief hardening element, holding the total of antimony plus other hardening elements low enough to avoid excessive brittleness. To the members of this general group of babbitts I make an addition of silver or gold, or both, to improve their strength and hardness at elevated operating temperatures, especially at the important temperature range around 300° F. By this addition the alloys are given properties very much closer to those of the tin-base babbitts which it is desired to duplicate.

The alloys of this invention are represented in the following table which compares these alloys with the previously known lead-base babbitts. In the tests for comparing these alloys, the babbitt was aged at 300° F. for 24 hours and Brinell tested at 300° F. The Brinell impression was made with a 2.5 mm. diameter ball and a 2 kg.

load, the load being applied for five minutes. This test being at elevated temperatures correlates well with operating conditions.

	Chemical composition in percent						Brinell hardness number
	Tin	Lead	Antimony	Copper	Silver	Gold	
Soft tin-base babbitt	89		7.5	3.5			4.40
Hard tin-base babbitt	83.33		8.33	8.33			5.50
New lead-base alloy		89.5	8			2.5	5.25
Do		87.4	8			4.6	5.45
Do		84.5	10		5.5		4.60
Do		82.6	12		5.4		4.45
Do	3	86.5	10		0.5		4.75
Do	3	86	10		1.0		5.05
Do	3	84.1	10		2.9		5.20
Do	3	81.5	10		5.5		4.80
Do	5	75	15		5		4.70
Do	2	77.5	15	0.25	5.25		6.60

From the data presented above and from other tests it appears that alloys of 2 to 6% tin, 6 to 12% antimony and 1 to 6% silver or gold, balance lead, practically duplicates the properties of the regular tin base babbitts with 83 to 90% tin, and that by using 2 to 4% tin, 12 to 18% antimony, 1 to 6% silver or gold and up to ½% copper, babbitts of still higher hardness and hot-hardness than the normal tin base babbitts can be made.

These tin and antimony contents are sufficient to make the alloys resistant to corrosion by acid or oxidized oils that corrode cadmium-base bearings and attack the unalloyed lead in copper-lead bearings.

That is, I have produced lead base babbitts having the hot-hardness and hence the conformability and embeddability of high grade tin base babbitt, with good bondability and resistance to corrosion. While the primary object of this invention is to provide alloys substitutable for tin-base babbitt in time of tin shortage, from the point of view of national defense, yet the alloys are advantageous from the standpoint of ordinary economics.

At the following prices, tin 50¢/lb., antimony 14¢/lb., copper 12¢/lb., lead 5¢/lb., silver (purchased on the open market 35¢/troy ounce—i. e.—$5.10/avoir. lb.), the metals in an alloy of 83⅓% Sn, 8⅓% Sb, 8⅓%Cu cost about 44¢ per lb. of babbitt, whereas one of my preferred alloys containing 84% Pb, 3% Sn, 10% Sb, 3% Ag the metal cost is about 22½¢ per lb. of babbitt. Taking into account the difference in specific gravities the cost of a volume of this lead base babbitt equivalent to 1 lb. of the tin base babbitt is about 32¢. Taking the relative volumes into account, every ton of my babbitt used as a replacement for the tin-base babbitt avoids the necessity of importing about 1125 lbs. of tin.

The hardening elements may be varied over wider ranges than are shown in the examples cited above, for example, the tin may be dropped to ½% or increased to 10, and the substitution of other hardening elements such as nickel up to about 2% as an equivalent for copper, arsenic up to around 2% as an equivalent for part of the antimony; and cadmium up to around 5% as an equivalent for various of the hardening elements, are admissible in babbitts whose hot-hardness is to be improved by the addition of silver and/or gold. The amount of silver or gold used to improve hot-hardness can vary from about ½% to about 10% or even more, but the best use of these precious metal additions, from the point of view of properties conferred for cost incurred, appears to be in the range 1½ to 3½% though when a "super-babbitt" is desired, the amount can well be raised to 3½–6½%.

The balancing of the various hardening elements, tin, antimony, copper, nickel, arsenic, cadmium and other less commonly used but equivalent hardening elements in a lead-base babbitt so as to secure a combination of hardness without too great attendant brittleness, is known in the art. My alloys are to be similarly balanced, and to the balanced compositions silver or gold is to be added. In the prior art lead-base alloys containing more than about 3 to 5% tin, which would be considered balanced in the absence of silver or gold, it is preferable to reduce the tin to around 3% or less, replacing some of the excess tin by silver or gold within my suggested limits.

I do not include the alkali and alkaline earth elements among those equivalent to the preferred hardening elements, since it is preferable to avoid the difficulties of controlling the composition of a melt containing these easily oxidized elements. While cadmium is included among the suitable hardening elements, it is not essential, and its propensity toward drossing makes it desirable to exclude it entirely, or at least to limit it to not over 5%.

Those skilled in the art will see that my invention can be briefly stated as adjusting the common lead-base bearing alloys by holding the tin at a low level and adding a small amount of silver or gold to confer permanent hot hardness and give bondability. While these alloys have been developed with their use as babbitts especially in mind, they may, of course, be used for other purposes, such as in type metal, for example.

Having thus described my invention, what I claim is:

1. An alloy containing ½ to 10 per cent tin 6 to 18 per cent antimony, 1 to 10 per cent silver and the balance substantially lead plus the usual impurities, said alloy being characterized by high and permanent hot-hardness and good bondability, as compared with similar alloys lacking the silver.

2. An alloy consisting of 2 to 6 per cent tin 6 to 18 per cent antimony, 1½ to 3½ per cent silver and the balance substantially all lead plus the usual impurities.

3. An alloy consisting of ½ to 10 per cent tin 6 to 18 per cent antimony, 1 to 10 per cent silver and the balance substantially all lead plus the usual impurities.

4. An alloy consisting of ½ to 10 per cent tin 6 to 18 per cent antimony, 1 to 6 per cent silver and the balance substantially all lead plus the usual impurities, said alloy being characterized by high and permanent hot-hardness and good bondability, as compared with similar alloys lacking the silver.

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