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ALLOY

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This invention relates to improvements in alloys, and in particular to improvements in bearing alloys containing substantial amounts of copper and lead.

In the aeromotive and automotive fields, a demand has developed for bearing metals which will withstand higher pressures and have less tendency to score than tin-base alloys, and it has been found that copper-base bearings having a considerable amount of lead are preferable for such purposes. Lead, however, is practically insoluble in copper at temperatures below approximately 956° C., and a copper-base alloy with lead therefore has a copper matrix in which are dispersed particles of lead. The usefulness of such a copper-lead alloy depends to a large extent upon the degree and uniformity with which the lead is dispersed throughout the matrix.

At approximately 956° C. a maximum of about 36% lead is soluble in melted copper. When such a mixture has been cooled to a temperature somewhat below 956° C., but above the fusion point of lead, it has a solid phase of nearly pure copper and a liquid phase of nearly pure lead. As the mixture is further cooled to a temperature at which the entire mass solidifies, the lead tends to segregate and agglomerate. Of course, if the lead is present in larger quantities than 36% of the whole, part of it is insoluble in the molten copper to begin with. Segregation then takes place even before cooling is started, and according to one theory, that is the reason why it is difficult to prevent excessive segregation of lead when it is present in proportions larger than about 30%. In fact, it has been found very difficult to prevent segregation of lead present in alloys in which the proportion of lead exceeds approximately 27% to 28%.

It is desirable, however, that a copper-lead alloy have a relatively high lead content, provided the lead is not segregated. Alloys relatively high in lead wear better and have better frictional properties, probably due to the more uniform contact surface, and what appear to be the lubricating properties of the lead.

Previous efforts have been made to increase the lead content of copper-lead bearings, and at the same time prevent segregation of the lead, but have not been entirely satisfactory. Metals, such as tin, nickel and others, have been added to prevent segregation. Some good high lead alloys have been obtained by very rapid cooling of the molten mixture of lead and copper, but the difficulties of doing so have prevented extensive use of such alloys.

I have found that the uniform dispersion of lead throughout the copper matrix of copper alloys having a substantial lead content may be substantially increased, and the segregation of such lead prevented, by incorporating in such alloys a small amount of silver. The amount of silver may be varied somewhat, but I have found that the amount should be appreciable and in excess of 0.05% of the total alloy, and preferably in excess of one-half of one percent of the total alloy. I have found, for example, that good results can be obtained by incorporating in an alloy of copper and lead approximately 1% of metallic silver, where the range of proportions of copper and lead varies between an alloy having 75 parts of copper to 25 parts of lead and one having 50 parts of copper to 50 parts of lead. The amount of lead in general is less than the amount of copper, but should be in excess of 20% of the total alloy.

By way of illustration, I have made in the usual way, various sand castings of alloys containing substantially 70 parts of copper and 30 parts of lead. When no silver was included therein, the casting had a poor lead distribution, due to segregation of the lead, but when ½, 1, 1½, 2, 3 and 5 parts of silver were incorporated in respective castings, those castings exhibited an excellent distribution of lead throughout the copper matrix, without appreciable segregation of the lead.

I have found the lead distribution to be correspondingly poor in a similar sand casting containing about 65 parts copper and 35 parts lead, with no silver, but when ½, 1 and 1½ parts of silver were incorporated in respective castings, very good results were obtained. Similarly, in a casting containing 60 parts copper, 40 parts lead and 1 part silver, the lead was widely and relatively uniformly dispersed throughout the copper matrix. Furthermore, I have found that bearings having such high lead content with a good distribution of the lead, cause or suffer less scoring than bearings low in lead, or in which lead distribution is poor.

Castings of copper-lead alloys having a lead content as low as 25% exhibited a fairly good distribution of lead, although entirely free from silver, and any improvement in dispersion of the lead throughout the copper by the addition of silver to such alloys is less noticeable. When castings of copper-lead alloys contain as much as 50% lead, or when appreciable amounts of tin, nickel, cadmium, or tellurium are incorporated

therein, the addition of about 1% of silver appears to offer little or no beneficial aid in prevention of lead segregation, so that preferably the alloys of copper and lead are substantially free of tin, nickel, cadmium and tellurium.

Bearings made in accordance with my invention have various advantageous properties, as hereinbefore indicated. The copper-base alloys having a relatively high content of uniformly dispersed lead wear smoothly and have good frictional qualities. With the uniform lead distribution, large, unbroken, contact surface areas, which tend to cause scoring, are largely eliminated. I have also found that the alloys of copper and lead, which also contain silver, are somewhat softer than similar but silver free alloys, although the alloy is not appreciably weakened. The danger of scoring is believed to be further minimized by the softening action of the silver.

When copper-lead bearings are subjected to heavy loads, it is believed that any resulting excessive heat causes a harmful surface oxidation of the bearing surface. This surface oxidation apparently is substantially minimized or prevented by the presence of silver.

It is believed that bearings made in accordance with this invention will be particularly useful in the automotive and aeromotive fields where a relatively high speed, light load bearing is in demand. For example, a leading automobile manufacturer now uses a steel backed bearing with a lining containing about 70% copper and 30% lead. The lead content of such a bearing might advantageously be increased if accompanied by the addition of silver also to the bearing alloy, and the advantages of a bearing with a higher lead content obtained without risk of failure due to segregation of the lead.

Throughout this specification, wherever any reference is made to parts, proportions or percentages of the components of any alloy, the intention is to indicate such parts, proportions or percentages by weight.

It will be obvious that various changes in the proportions, materials and details herein described, in order to illustrate the nature of the discovery or invention, may be made by those skilled in the art within the principles and scope of the invention as expressed in the appended claims.

I claim as my invention:

1. An improved copper-lead bearing alloy in which substantial and relatively uniform dispersion of the lead throughout the copper is obtained, containing copper, lead and silver and free of any substantial amounts of tin, cadmium, nickel and tellurium, and in which the lead comprises from 30 to 50 percent of the whole, and the silver comprises from 0.5 to 5 per cent of the whole, the balance being copper.

2. An improved copper-lead bearing alloy in which substantial and relatively uniform dispersion of the lead throughout the copper is obtained, containing only copper, lead and silver, and in which the relative approximate proportions of copper and lead are in the ratio range beginning with copper 50 parts to lead 50 parts and ending with copper 75 parts to lead 25 parts, and the silver comprises greater than 0.05% and less than 10% of the whole alloy.

3. An improved copper-base alloy which consists by weight of not more than 70 and not less than 50 parts of copper, approximately one-half to 5 parts of silver, and lead sufficient to complete 100 parts.

4. An improved copper-base alloy which consists only of from 58 to 70% copper, approximately one-half of 1% to 2% of silver, and the balance lead.

5. An improved copper-lead bearing alloy in which the dispersion of the lead throughout the copper is increased materially upon the addition of a minor amount of silver, containing from 32 to 40 per cent of lead, from 0.5 to 5 per cent of silver, the balance being copper.

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