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BEARING

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This invention relates to bearings.

An object of the present invention is to improve copper base bearings.

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

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

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.

In the prior art, bearings have been formed of copper or bronze containing various percentages of lead. While such bearings have performed with considerable satisfaction and have relatively high strength combined with low friction qualities, such bearings have not always been satisfactory in all particulars. For example, it has been difficult to obtain uniform distribution of lead throughout the copper matrix and this has resulted in some non-unifomity of bearing properties.

Bearings of the type described are frequently bonded to a steel backing for additional strength and support. Such bonding requires the application of relatively high temperatures for a comparatively long period of time. Such prolonged heating, however, interferes with the proper distribution of lead and promotes the accumulation of the lead in relatively large globules. Such large size lead inclusions are not as effective in promoting a bearing of uniformly low friction as are uniformly distributed fine particles of lead.

Lead is also subject to a certain amount of oil corrosion when used in bearings.

The present invention contemplates a copper base bearing of improved characteristics. According to the present invention, the bearing is formed of a copper base metal composition containing thallium instead of lead. It is contemplated that the bearing may be formed of metal compositions within the following range of proportions:

	Per cent
Thallium	2 to 35
Copper	Substantially the balance

The proportion of thallium used will be varied depending upon the service to which the bearing is required to be subjected. The lower percentages of thallium such as:

	Per cent
Thallium	2 to 10
Copper	Substantially the balance

will have the highest strength and are especially useful where the bearing is not provided with a steel backing shell. Such alloys can be produced by first melting the copper, then adding the thallium to the melt. In some cases a small proportion of other ingredients will also be used to improve the properties of the alloy either during melting or during use. In any event, the melt should be thoroughly stirred before pouring. The alloy can be used in the form of castings or in some cases the cast material may be forged to the desired form. Photomicrographs of the material show relatively small globules of thallium uniformly distributed throughout the casting at the grain boundaries of the copper matrix.

Bearings having this lower thallium content have sufficient strength to withstand fairly heavy loads without steel backings and may also be subjected to impact loads when used with or without steel backings.

Another class of copper-thallium bearings comprises the group having the composition:

	Per cent
Thallium	10 to 20
Copper	Substantially the balance

Such bearings are preferably provided with steel backing shells to which they may be integrally attached by fusion welding, casting, centrifugally casting, brazing or other means. Since these compositions are not as strong as the first mentioned group, the steel backing provides the necessary strength.

For some applications still higher percentages of thallium may be used, such as:

	Per cent
Thallium	20 to 35
Copper	Substantially the balance

All classes of bearings may be used in gasoline or Diesel motors and may or may not be steel backed.

The bearings of the present invention can be made by several manufacturing methods such as by the melting, mixing and casting method described above. They can also be made by simultaneously electroplating copper and thallium from a suitable plating bath.

It is also possible to manufacture the bearings by mixing the metal powders, pressing and sintering the mixture. While this method is suitable for the entire composition range disclosed, it is particularly advantageous where higher percentages of thallium are used since it is easier to prevent segregation of the thallium from taking place. In casting, a certain amount of thallium segregation may occur unless thorough mixing is achieved followed by a fairly rapid cooling.

Another method of manufacture comprises spraying mixed molten particles of copper and

thallium onto the surface to be provided with a bearing using either a Schoop gun wherein the raw materials are used in the form of wire, or a Shori gun wherein metal powders are used.

It is of advantage in some cases to improve the characteristics of the copper by the addition of relatively small quantities of materials which act either as grain refiners or hardening ingredients or both. One of the most useful materials is tin which may be present in proportions varying from .1 to 10% by weight of the composition. The tin increases the hardness and strength of the copper base and increases the resistance of the bearing to fatigue.

Instead of tin, silver may also be used to increase the strength of the copper base and it does so without greatly decreasing the thermal conductivity of the bearing. Silver also appears to provide a nucleus-forming ingredient which promotes the fine and homogeneous distribution of the free thallium phase. Nickel and manganese also act as grain refiners and improve the physical properties of the bearing.

Thallium and copper do not form solid solutions and hence the thallium is distributed in the bearing in the form of small particles interspersed with the grains of the copper matrix. These small thallium particles or globules are very ductile and soft. Moreover, cold working, such as is always present at a bearing surface, does not harden the thallium particles. It is believed that this is one factor which renders copper-thallium compositions so well suited for bearing purposes.

Since the thallium particles will melt at a temperature of approximately 578° F. they will afford liquid lubrication if the oil supply should be temporarily cut off and the bearings become overheated.

The hardness of the copper-thallium alloys at room temperature and at elevated temperatures is low. For instance, a bearing of:

	Per cent
Thallium	20
Copper	Balance

had a Brinell hardness of 36 at 80° F. and the hardness was reduced to 27 at 345° F. The bearing was found to have excellent anti-friction characteristics.

Another bearing formed of:

	Per cent
Thallium	10
Copper	Balance

was also found to have high anti-friction characteristics.

Alloys of the following compositions, when melted, thoroughly stirred and chill cast showed a uniform fine dispersion of the thallium at the grain boundaries of the copper matrix:

	Per cent
(1) Thallium	11.11
Tin	2.87
Copper	Balance
(2) Thallium	22.42
Tin	3.16
Copper	Balance

In order to still further improve the corrosion resistance of the alloy it has been found of advantage in some cases to apply a coating of indium preferably by electroplating the surface of the finished bearing and then heat treating the bearing to diffuse the indium into the surface. Indium and thallium form a series of solid solutions which are highly corrosion resistant. The indium plating can be diffused into the thallium at slightly elevated temperatures such as 300° F.

In some cases the indium can be added directly to the copper-thallium alloy prior to casting. One such bearing alloy which was found to show a very pronounced segregation of thallium globules in the grain boundaries had the composition:

	Per cent
Thallium	4.78
Indium	.45
Copper	Balance

It may also be of advantage in preparing the bearing alloy to add small amounts of alkali or alkaline earth metals as deoxidizers. These metals also effect grain refinement and may increase the hardness of the thallium somewhat.

This application is a continuation-in-part of my co-pending application for Bearings, Serial No. 230,203, filed September 16, 1938.

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 claims.

What is claimed is:

1. A bearing formed of a metal composition of 2 to 35% thallium and the balance substantially all copper.

2. A bearing formed of a metal composition of 2 to 10% thallium and the balance substantially all copper.

3. A bearing formed of a metal composition of 10 to 20% thallium and the balance substantially all copper.

4. A bearing formed of a metal composition of 20 to 35% thallium and the balance substantially all copper.

5. A copper base bearing formed of a copper base matrix and small particles of thallium distributed in the bearing at the grain boundaries of the copper base matrix, said thallium forming 2 to 35% by weight of the bearing composition.

6. A copper base bearing formed of a copper base matrix and small particles of thallium distributed in the bearing in the form of small particles interspersed with the grains of the copper matrix, said thallium forming 2 to 35% by weight of the bearing composition.

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