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C. H. HACK ET AL
METALLIC COMPOSITION
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Fig. 1.

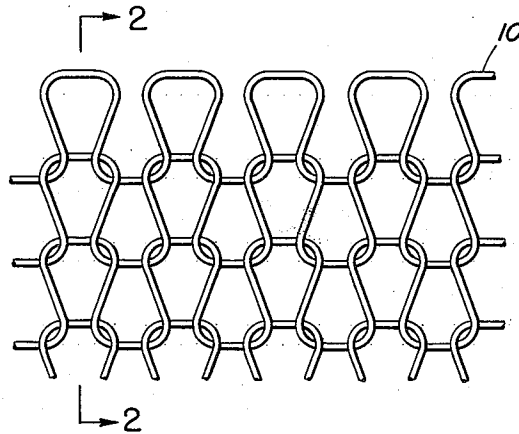


Fig. 2.



Fig. 3.

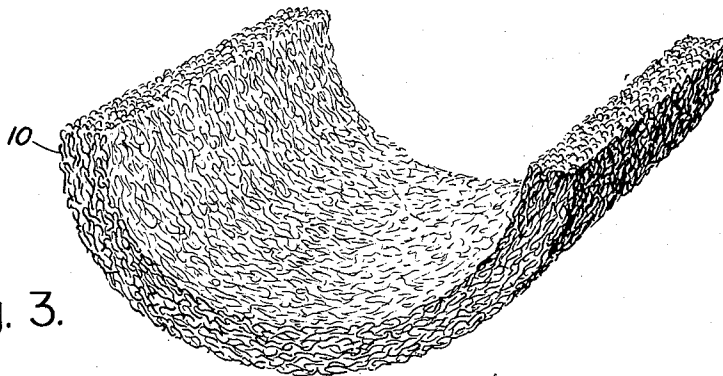
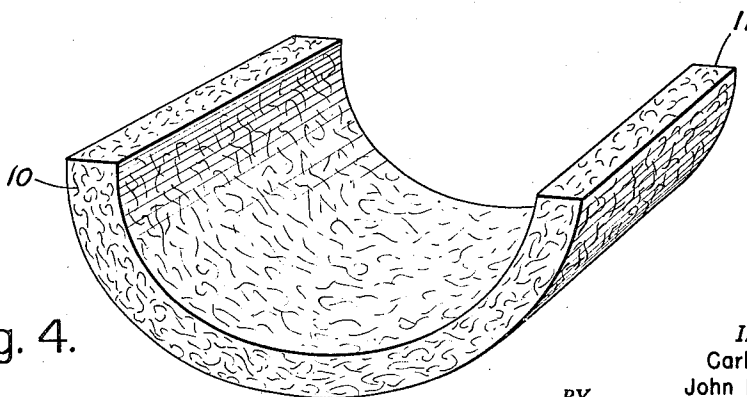


Fig. 4.



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METALLIC COMPOSITION

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3 Claims. (Cl. 29—191.6)

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This invention relates to a metallic composition adapted for use as a bearing metal.

Tin base antifriction metal such as babbitt and lead base bearing metals of varying compositions have previously been widely used in the manufacture of smooth-surface bearings. Such alloys, which are relatively soft, possess properties which suit them for many bearing applications. However, they are not particularly suited when high bearing pressures are encountered which condition necessitates the employment of harder bearing metal. Efforts to provide additional hardness in conventional alloys by increasing the copper content thereof have been unsuccessful since copper does not form a solid solution with the other metal constituents when present in amounts greater than a small proportion. For such application, the art has adopted, among others, the so-called "copper-lead" bearing metal. This composition comprises lead and copper which are melted together after which the resulting liquid is poured into molds to form bearing liners or otherwise fabricated, as desired. It is well known that if the copper content is not lower than about 70%, the lead and copper will be miscible while in the liquid phase, even though segregation occurs on solidification. This is not detrimental since the copper forms the matrix with the lead homogeneously dispersed throughout it. The "copper-lead" bearing so manufactured is, however, unfortunately too hard for many applications. The proportion of copper is too high to obtain a bearing metal of desired antifriction properties and unless specially hardened shafts are used in conjunction therewith, scoring and other troubles may ensue. Efforts to produce a softer "copper-lead" alloy containing a lower percentage of copper and lead results in separation of the liquid phases in the molten composition which makes impossible a homogeneous mixture. Thus, a gap exists in the hardness range of ordinary bearing metals between the hardest types of soft antifriction metals and the softest "copper-lead" compositions. A definite need, however, exists for compositions having properties within this range; that is, equivalent in fatigue strength, hardness and other desirable characteristics to what would be expected from compositions containing from about 10% to about 70% copper, for use in internal combustion engines, particularly diesel engines in which bearing pressures greater than can be tolerated by Babbitt metal are often encountered.

The problem of supplying a bearing of proper hardness for such applications has been attacked

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by proposing a bearing metal consisting of a harder wire screen embedded in a soft conventional antifriction composition such as a suitable lead or tin base alloy. A typical example is a material consisting of a screen set in Babbitt metal. While it is possible with such a structure to obtain the desired hardness, such composite structures as have heretofore been proposed have suffered from several serious disadvantages. The copper screen material being composed of strands of relatively straight sections of copper or copper alloy wire has resulted in a surface structure often containing aligned copper particles or areas. In a bearing surface, a series of aligned particles or a continuous longitudinal thread of copper would cause serious damage to the shaft since the shaft in effect would be riding at that section on substantially copper alone.

It is, therefore, the object of this invention to provide a metallic composition adapted for use as a bearing metal having hardness generally greater than the common antifriction metals such as Babbitt metal but not having the disadvantages of compositions such as "copper-lead" alloy. It is a further object of this invention to provide a bearing metal composition containing dispersed therein from 10% to about 70% of a relatively hard metal or alloy. It is a further object to provide such compositions which will be stronger and possess better bearing characteristics than compositions heretofore proposed and of predetermined hardness. These and other objects will become apparent from the following description.

In its broadest aspects, this invention contemplates the provision of a metallic composition which comprises a fabric consisting of interlaced loops of a relatively hard metal or alloy thread embedded in a matrix of relatively soft antifriction metal. The particular fabric structure used in the composition of this invention may be characterized as a knit fabric wherein a single thread is used to form a series of interlaced loops. One or several layers of such fabric may be employed; if several are used they may be compressed together to form a relatively rigid, compact mass. The compacted fabric structure is then treated with molten antifriction metal so that all the interstices or pores therein are filled. The resulting metallic composition is adapted for use as a bearing metal and may be formed or cast originally in suitable shapes adapted for use, or may be manufactured in the form of blocks or ingots which may be machined or otherwise formed to required configuration.

The metallic composition of this invention will

become apparent from the annexed drawings in which Fig. 1 shows an example of a type of knit wire fabric adapted for this purpose. Fig. 2 shows a sectional end view of the fabric of Fig. 1 taken along the line 2—2. Fig. 3 shows a structure formed by compacting under pressure several layers of the knit fabric of Fig. 1. Fig. 4 shows a finished metallic composition showing the wire fabric embedded in an antifriction metal matrix.

Referring now to Fig. 1, the fabric is an open knit material of, for example, copper thread 10 which is mechanically and continuously formed into the interlocking or interlaced loops substantially as shown. Such a fabric is commercially most conveniently manufactured in the form of a continuous tube; such a tube may be flattened to form two layers of fabric unbroken at the edges as will be evident. To make a compact structure containing a plurality of such layers, several sections of flattened tubing may be pressed together under suitable high pressure to form the compacted structure illustrated in Fig. 3. Such a compacted structure can readily be made to contain up to 75% copper on a volume basis. After compacting, the structure illustrated in Fig. 2 may be placed in a suitable mold and molten antifriction metal cast to fill the interstices therein and subsequently cooled to form the metallic composition illustrated in Fig. 3 in which the relatively hard copper threads 10 are embedded in the relatively soft antifriction metal matrix 11.

Any desired harder metal thread content up to about 70% by volume of the total composition may be readily produced. When cupric metal thread is used embedded in a tin or lead base antifriction metal, the hardness is proportional to the copper content and a desirable range of characteristics is obtained when the copper content ranges from about 10% to 70% by volume. Such compositions provide bearing metals of hardness greater than conventional lead or tin base alloys and up to approximately the hardness of the so-called "copper-lead" alloy. A preferred composition providing adequate hardness for use under rigorous service and possessing excellent antifriction and bearing properties contains from about 25% to 35% copper.

In order to obtain the desired content of wire thread, the type of fabric and degree of compression may be selected to give a compacted thread structure of proper densities. To obtain highest density, a number of layers of close knit fabric of fine wire, preferably flat wire, are pressed together under extreme pressure.

The type of fabric employed in the compositions of this invention may be originally knit so as to provide a fine, close, or open mesh structure depending on the size of the individual interlaced loops and the diameter of the wire. Ordinarily, the mesh is designated by the number of loops per inch and this may vary within wide limits according to requirements. When several layers of such fabric are compressed together the pressure employed will depend on the density required and may vary from a few pounds per square inch when low density compacts are desired to a number of tons per square inch when compacted structures of high density are necessary.

To illustrate the manufacture of a metallic composition of this invention particularly adapted for use as a bearing liner, the following example is given.

Example I

Four layers of knit fabric of the type illustrated in Fig. 1 made of soft copper thread of .0011 inch diameter and having seven loops to the inch were compressed in a tubular shell using an expanding mandrel. The pressure applied was equivalent to about 1200 lbs. per square inch. The resulting compacted structure, which contained 30% copper by volume, was then cleaned, fluxed with zinc chloride-ammonium chloride flux and then tinned by dipping in molten 30% tin 70% lead. The tinned compact while still hot was placed in a suitable mold and a lead base antifriction alloy containing 5% antimony, 8.5% tin and the remainder lead was centrifugally cast into the mold to fill the interstices in the copper thread compact. The resulting metallic composition contained the harder copper thread embedded in the softer antifriction matrix the copper thread being present in the amount of about 30% by volume, equivalent to about 25% by weight. A machined surface of the cast composition showed copper areas dispersed through the softer metal showing no straight line geometric pattern.

The metal thread may be made of a metal characterized by suitable hardness and strength for the purpose for which the metallic composition of this invention is utilized. For the manufacture of bearings, where even the harder component of the bearing composition should be softer than the shaft material, a cupric metal which is herein intended to include substantially pure copper as well as alloys containing a major proportion of copper, including bronze, brass and Monel metal will be suitable. In addition, silver, aluminum and their alloys may be used under particular condition. The wire thread may be of a diameter suited for the purpose of the composition and the size of the article fabricated therefrom, and may ordinarily vary from 0.02 inch to very fine wire of 0.0001 inch or even less. In the case where bearings are fabricated with only a thin layer of the metallic composition in conjunction with a stronger backing member, wire of fine diameter may advantageously be employed to give utmost dispersion of the harder metal and best reinforcing characteristics. The wire thread may be of any suitable cross sectional shape.

The antifriction metal which forms the matrix, may comprise any relatively soft metal or alloy having good bearing characteristics as this term is used by those skilled in the art. The characteristics are generally considered to be the ability to conform to irregularities in the shape or alignment of the shaft and to return readily to a smooth surface after being cut or roughened by foreign substances which may get into the bearing, low friction coefficient and suitable melting point. Conventional lead base and tin base antifriction alloys included within the general term, Babbitt metal, may be employed. The chief constituents of such alloys are tin, lead, antimony and copper. The alloys commonly used range from those having a high percentage of tin and small amounts of copper and antimony and no lead to those containing a high percentage of lead, small amounts of copper and antimony and no tin, those comprising predominantly tin being generally known as tin base antifriction metals or tin base Babbitts, and those comprising predominantly lead being known as lead base alloys of the same type. Pure lead is suitable, as well as cadmium, zinc and aluminum and other alloys of suitable softness and quality.

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It is desirable that the threads of the wire knit fabric and the matrix metal be firmly united to form a strong composition. Therefore, it may be desirable to coat the metal fabric with a suitable bonding metal prior to filling the pores or interstices of the fabric with the matrix metal. Thus, for example, a copper or bronze fabric compact may be tinned by first fluxing and dipping in molten solder according to known methods to provide improved adhesion of a lead or tin base matrix alloy.

The metallic composition of this invention will be found to have several advantages over prior art compositions when used in bearings. The fine interlaced network of harder and stronger wire provides reinforcement of the soft bearing metal without detracting from good bearing characteristics. An exposed surface of such a composition will show portions of the metal thread well dispersed in the matrix alloy. The particular type of knit fabric employed results in an arrangement of the thread particles in the matrix metal characterized by the absence of any straight line pattern. Thus, the possibility of any section of the shaft riding for any appreciable arc of travel on the hard metal alone or on an aligned series of straight sections thereof is avoided. Such properties cannot be obtained by employment of conventional wire fabrics such as cloth or screen made by weaving straight threads. Furthermore, the knit fabric employed, when formed into a compact by compressing several layers thereof, possesses marked unitary strength in the direction of its thickness as well as other dimensions by reason of the penetration and interposition of the looped threads from the several layers. Structural reinforcement as well as the desired hardness is thereby imparted to the composition. Substantially greater fatigue strength, that is resistance to destructive effect of heavy alternating loads, is obtained when the composition of this invention is used in a bearing compared to prior art alloys or compositions.

While this invention has been described and illustrated by the examples shown, it is not intended to be strictly limited thereto and other modifications and variations may be employed within the scope of the following claims.

We claim:

1. A metallic composition, useful in a bearing, comprising a compact, formed from compressed layers of fabric formed of interlaced loops of a cupric metal thread of diameter from about 0.0001 to about 0.02 inch, said fabric having about 7 loops to the inch, embedded in a matrix of a relatively soft antifriction metal so that a bearing surface formed from said composition will con-

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tain cupric metal portions interspersed between antifriction metal portions, said cupric metal portions being distributed to avoid linear, shaft scoring arrangement.

2. A metallic composition, useful in a bearing, comprising a compact, formed from compressed layers of fabric formed of interlaced loops of cupric metal thread of diameter from about 0.0001 to about 0.02 inch, said fabric having about 7 loops to the inch, embedded in a matrix of a relatively soft antifriction metal, said relatively hard metal thread being present in amount from about 10% to about 70% by volume of the composition so that a bearing surface formed from said composition will contain cupric metal portions interspersed between antifriction metal portions, said cupric metal portions being distributed to avoid linear, shaft scoring arrangement.

3. A metallic composition, useful in a bearing, comprising a compact, formed from compressed layers of fabric formed of interlaced loops of copper thread of diameter from about 0.0001 to about 0.02 inch, said fabric having about 7 loops to the inch, embedded in a matrix of a lead base antifriction metal, said copper thread being present in amount of between about 25% to 35% by volume of the composition so that a bearing surface formed from said composition will contain copper portions interspersed between lead base antifriction metal portions, said copper portions being distributed to avoid linear, shaft scoring arrangement.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,280,909	Wales et al.	Oct. 8, 1918
1,779,771	Hartwell	Oct. 28, 1930
2,212,473	Hessenbruch et al. ..	Aug. 20, 1940
2,242,441	Shoemaker	May 20, 1941
2,277,107	Imes	Mar. 24, 1942
2,332,726	Joyce	Oct. 26, 1943
2,357,578	Brownback	Sept. 5, 1944

OTHER REFERENCES

P. 588 Weld. Handbook 1942, pub. by Amer. Weld. Society, 33 W. 39th St., New York, N. Y. (Copy in Div. 14.)

P. 243 Engineer. Alloys by Norman Weldman, Ph. D. and Roger J. Metzler, pub. by American Society for Metals, 7301 Euclid Ave., Cleveland, Ohio. (Copy in Div. 14.)