Jan. 9, 1968 M. E. SIKORSKI 3,362,815

LOW FRICTION ALLOY BEARINGS

Filed Dec. 10, 1964

FIG. 1

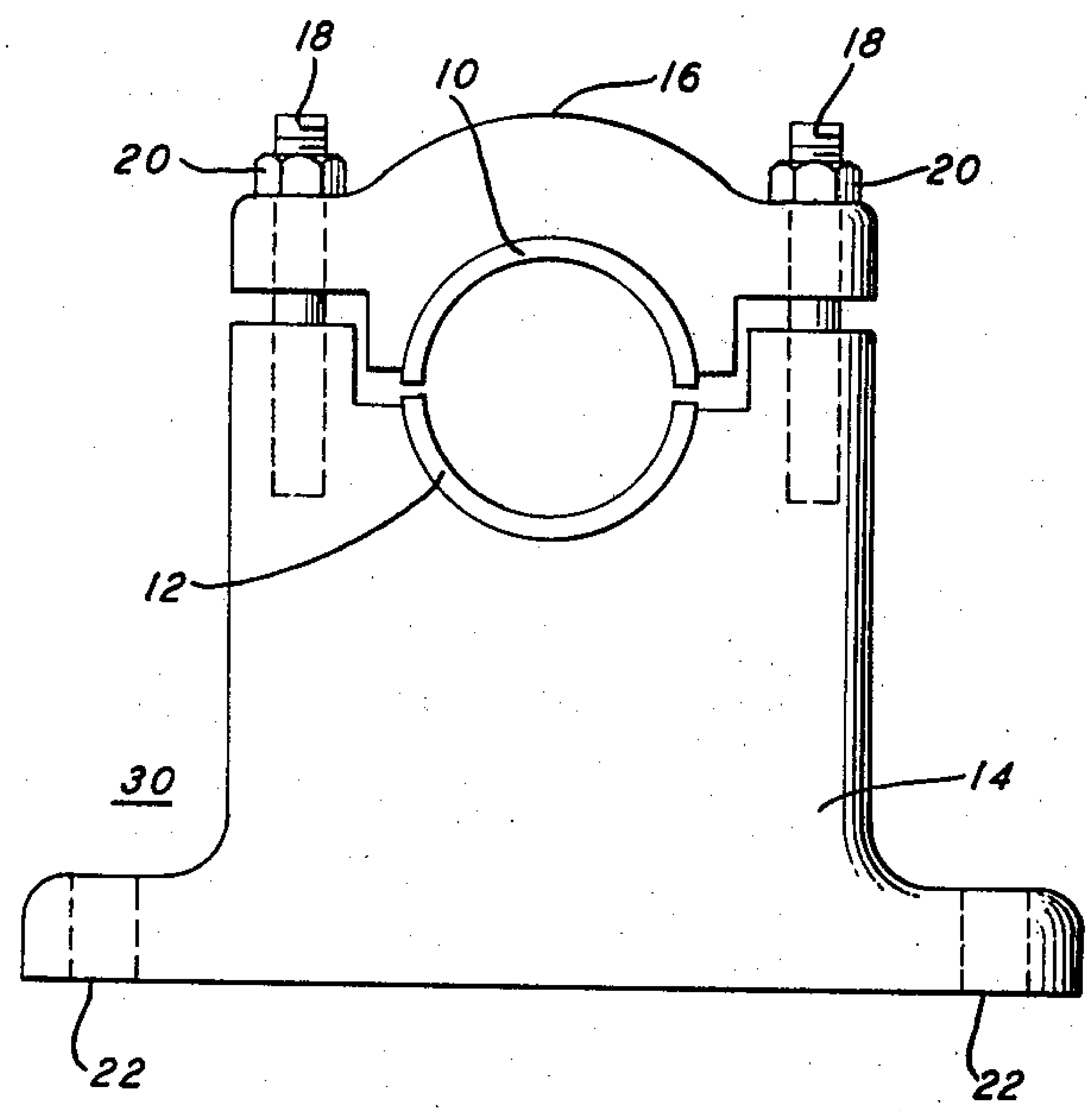
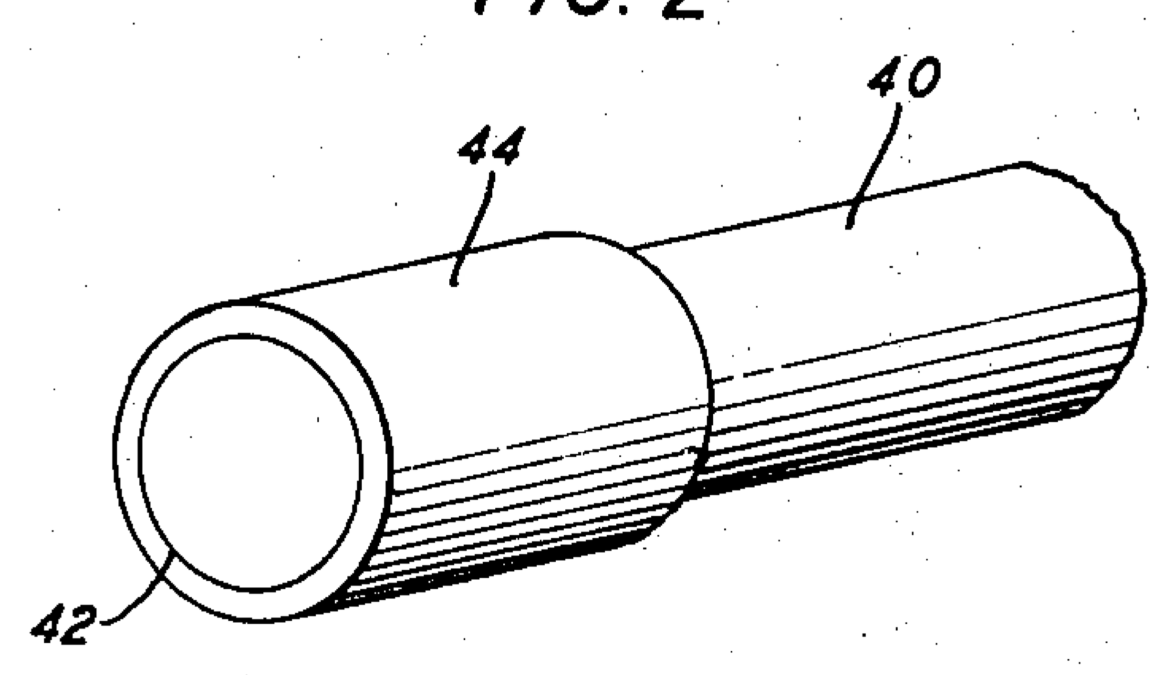


FIG. 2



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LOW FRICTION ALLOY BEARINGS

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ABSTRACT OF THE DISCLOSURE

Certain rare-earth alloys exhibit low coefficients of friction and good hardness properties which makes them well-suited for use as bearing liners.

This invention relates to bearing surfaces for bearings, journal boxes, journals and the like. More particularly, it relates to the reduction of frictional losses in machine elements of the above-mentioned and similar types and to the extension of the fault-free service life of such elements.

In my copending joint application with J. S. Courtney-Pratt, Ser. No. 270,296, filed Apr. 3, 1963, now U.S. Patent 3,241,930, issued Mar. 22, 1966, it is disclosed that the group of metals consisting of yttrium, gadolinium, dysprosium, samarium and holmium have appreciably lower friction with steel or similar materials than the "Babbitt metals" and similar alloys employed in the prior art.

For several decades it has been standard practice to construct bearings, journal boxes, and the like with bearing surfaces of various alloys such as those known in the trade as "Babbitt metal," the latter name being applied to various alloys commonly containing, in various proportions, tin, antimony, lead, copper and occasionally other metals. Shaft journals supported by such bearings are normally of steel, cast iron, or a similar material. For the purposes of the present application the bearing per se and the journal accommodated by it are each designated by the generic term "bearing member."

While the above-mentioned alloys give good service, they are in general rather soft and their use involves appreciable frictional losses. Consequently, they wear appreciably and require periodic reconditioning and/or replacement.

In accordance with the principles of the present invention, it is disclosed that a group of rare earth binary alloys consisting of alloys of the following pairs of rare earth metals within the compositional ranges tabulated below (as Table I) also have appreciably lower friction with steel or similar materials than the "Babbitt metals" and similar alloys employed in the prior art.

Table I

Alloy:	Compositional range (atomic percent)
Lanthanum-holmium	45 to 60, lanthanum.
Cerium-gadolinium	25 to 35, cerium.
Cerium-holmium	45 to 60, cerium.
Neodymium-gadolinium	40 to 60, neodymium.
Neodymium-holmium	60 to 75, neodymium.
Lanthanum-gadolinium	substantially 30, lanthanum.
Lanthanum-yttrium	substantially 52, lanthanum.
Cerium-yttrium	substantially 55, cerium.
Neodymium-yttrium	substantially 67.5, neodymium.

Furthermore, the alloys of the above named group are appreciably harder than the alloys heretofore employed for bearing surfaces. These two characteristics, that is, lower friction and greater hardness, result in longer fault-free service life for bearings employing bearing surfaces of the above listed metals. Alternatively, for the reduction of friction and increased fault-free life, the journal of the shaft supported in the bearing may be coated, as by plating or the like, with an alloy selected from the above named group and the bearing may be of steel or the like.

A principal object of the invention is, therefore, to reduce frictional losses and increase the length of fault-free service life for bearing members.

Other and further objects, features and advantages of the invention will become apparent from the detailed description hereinunder taken in conjunction with the appended drawing in which:

FIG. 1 illustrates a conventional bearing or journal housing having bearing surfaces of the invention; and

FIG. 2 illustrates a shaft having a journal which is coated with an alloy of the above named group.

In more detail in FIG. 1, bearing surfaces in the form of liners **10** and **12** are semicylindrical in shape and are supported in the cap **16** and base **14**, respectively, of the bearing assembly **30**, as shown. Threaded stud bolts **18** and nuts **20** are provided to clamp cap **16** to base **14** after the journal portion of a shaft, such as journal **42** of shaft **40** of FIG. 2, is assembled between bearing surface liners **10** and **12**, in accordance with the usual practice in the art. If the bearing surfaces are of one of the group of alloys named above, the journal is preferably of steel or the like and vice versa. Holes **22** in the base of housing member **14** are provided for mounting the assembly on a supporting surface.

In accordance with the present invention, the assembly of FIG. 1 can be conventional except that liners **10** and **12** are made of an alloy selected from the group which consists of an alloy selected from Table I hereinabove when a journal of steel or the like is to be employed.

Since all alloys of this group have appreciably less friction with steel and similar metals than the "Babbitt metal" alloys and similar alloys conventionally used as bearing surfaces, and further since the alloys of the above named group are appreciably harder than the prior art alloys mentioned, bearing members equipped with bearing surfaces of an alloy selected from the above named group will have a substantially longer fault-free service life.

Alternatively, the bearing surfaces may be of steel or the like and the journal of the shaft supported by the bearing may be coated with an alloy of the above named group, as illustrated in FIG. 2 where shaft **40** which may, for example, be of steel has its journal portion **42** coated with a layer **44** of an alloy selected from the above named group.

Obviously, the principles of the invention are readily embodied in numerous other arrangements in addition to that of the illustrative embodiments described in detail above. For example, one or the other of a pair of bearing members in small instruments such as meters, galvanometers, clockwork mechanisms and the like may be entirely of an alloy selected from the above named group.

It should be noted that though several of the metals employed in arriving at the alloys as tabulated in Table I are known by those skilled in the art to have relatively high coefficients of friction if employed as bearing members, when alloyed with other materials, as disclosed hereinabove, the alloys are found to have very small coefficients of friction.

This is particularly true of the metal cerium which per se has a much larger coefficient of friction than the so-called Babbitt metals.

This phenomenon is believed to result from a change in the crystalline structure during formation of the alloy. As a specific example, the metal cerium has a cubic crystalline structure but the alloys of cerium with gadolinium and of cerium with holmium within the compositional ranges specified in the above Table I are found to have a rhombohedral crystalline structure. The latter crystalline structure is that of the metal samarium which, as disclosed in my above-mentioned copending joint application, has a very low coefficient of friction.

As is well known to those skilled in the art, reducing friction in a bearing results in the generation of less heat and, consequently, in a lower operating temperature. This in turn reduces the likelihood of sticking or freezing of the bearing. Of course, reduction in friction also increases the efficiency of the mechanism since frictional losses frequently represent a substantial portion of the power required to drive a mechanism.

Numerous and various modification and rearrangements of the specific illustrative embodiments described in detail hereinabove can be readily devised by those skilled in the art without departing from the spirit and scope of the principles of the present invention.

What is claimed is:

1. A bearing member having a bearing surface of a composition consisting essentially of an alloy selected from the group consisting of:

45 to 60 atomic percent lanthanum, remainder holmium,
25 to 35 atomic percent cerium, remainder gadolinium,
45 to 60 atomic percent cerium, remainder holmium,
40 to 60 atomic percent neodymium, remainder gadolinium,
60 to 75 percent neodymium, remainder holmium,
30 atomic percent lanthanum, remainder gadolinium,
52 atomic percent lanthanum, remainder yttrium,
55 atomic percent cerium, remainder yttrium, and
67.5 atomic percent neodymium, remainder yttrium.

2. A bearing member having a bearing surface of a

compositon consisting essentially of 45 to 60 atomic percent lanthanum, remainder holmium.

3. A bearing member having a bearing surface of a composition consisting essentially of 25 to 35 atomic percent cerium, remainder gadolinium.

4. A bearing member having a bearing surface of a composition consisting essentially of 45 to 60 atomic percent cerium, remainder holmium.

5. A bearing member having a bearing surface of a composition consisting essentially of 40 to 60 atomic percent neodymium, remainder gadolinium.

6. A bearing member having a bearing surface of a composition consisting essentially of 60 to 75 percent neodymium, remainder holmium.

7. A bearing member having a bearing surface of a composition consisting essentially of 30 atomic percent lanthanum, remainder gadolinium.

8. A bearing member having a bearing surface of a composition consisting essentially of 52 atomic percent lanthanum, remainder yttrium.

9. A bearing member having a bearing surface of a composition consisting essentially of 55 atomic percent cerium, remainder yttrium.

10. A bearing member having a bearing surface of a composition consisting essentially of 67.5 atomic percent neodymium, remainder yttrium.

11. The arrangement of claim 1 in which the member is a bearing.

12. The arrangement of claim 1 in which the member is a journal.

References Cited

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