Lewis

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

REPLY TO ATTN OF: GP

JAN 21 1974

TO: KSI/Scientific & Technical Information Division
Attention: Miss Winnie M. Morgan

FROM: GP/Office of Assistant General Counsel for Patent Matters

SUBJECT: Announcement of NASA-Owned U.S. Patents in STAR

In accordance with the procedures agreed upon by Code GP and Code KSI, the attached NASA-owned U.S. Patent is being forwarded for abstracting and announcement in NASA STAR.

The following information is provided:

U.S. Patent No. : 3,781,958

Government or Corporate Employee : Government

Supplementary Corporate Source (if applicable) : ~

NASA Patent Case No. : LEW-11,087-2

NOTE - If this patent covers an invention made by a corporate employee of a NASA Contractor, the following is applicable:

Yes ☐ No ☒

Pursuant to Section 305(a) of the National Aeronautics and Space Act, the name of the Administrator of NASA appears on the first page of the patent; however, the name of the actual inventor (author) appears at the heading of column No. 1 of the Specification, following the words ". . . with respect to an invention of . . ."

Elizabeth A. Carter

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Enclosure:
Copy of patent cited above

United States Patent [19]

Parker

[11] **3,781,958**

[45] **Jan. 1, 1974**

[54] **METHOD OF MAKING ROLLING ELEMENT BEARINGS**

[75] Inventor: **Richard J. Parker,** North Olmsted, Ohio

[73] Assignee: **The United States of America as represented by the Administrator of the National Aeronautics and Space Administration,** Washington, D.C.

[22] Filed: **Aug. 14, 1972**

[21] Appl. No.: **280,390**

Related U.S. Application Data

[62] Division of Ser. No. 201,904, Nov. 24, 1971.

[52] **U.S. Cl.** ..... **29/148.4 A,** 29/148.4 B

[51] **Int. Cl.** **B23p 11/00,** B21h 1/14

[58] **Field of Search** ..... 29/148.4 A, 148.4 B, 29/149.5 NM, 148.4 R, 149.5 PM

[56] **References Cited**

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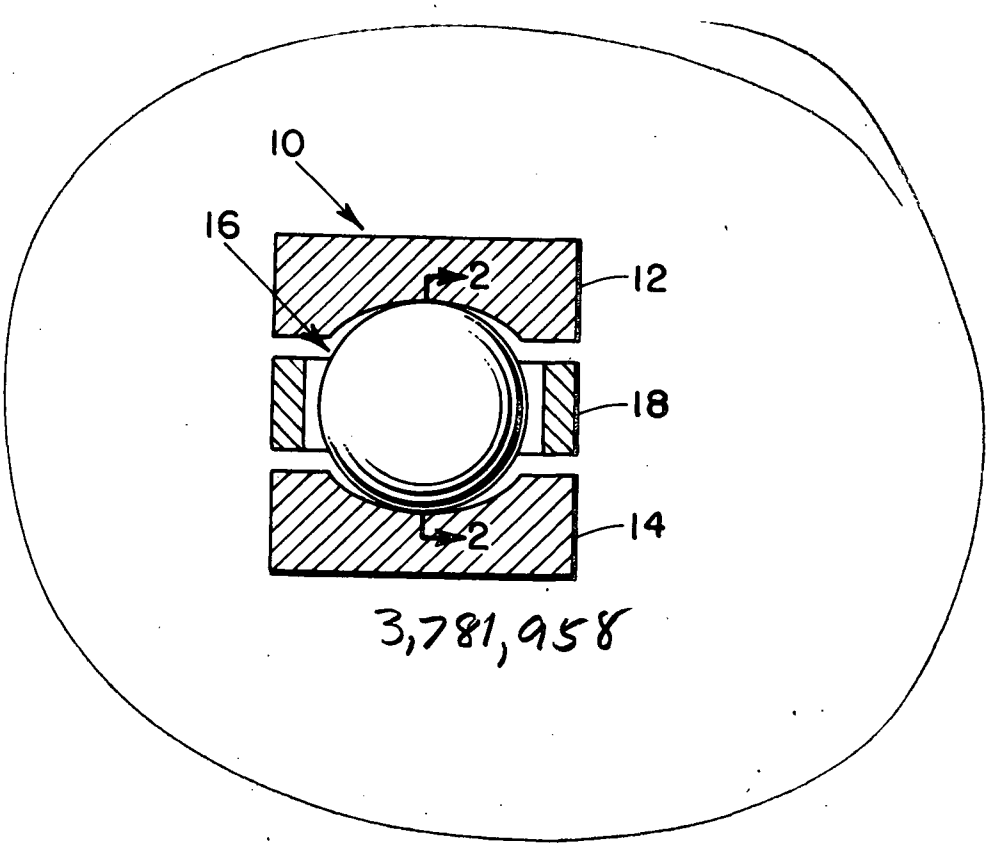
Primary Examiner—Thomas H. Eager
Attorney—N. T. Musial et al.

[57] **ABSTRACT**

Making rolling elements by forming low mass cores having either hollow centers or being of a low mass material. The low mass cores are plated and heat treated to provide hard surfaces on the rolling elements. After grinding to the proper diameter the rolling elements are assembled between races to form a bearing.

8 Claims, 3 Drawing Figures



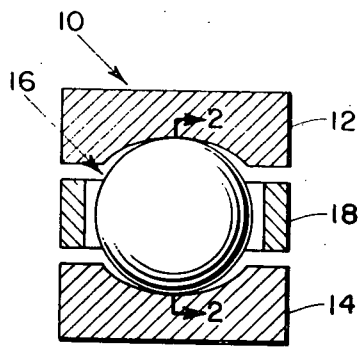


FIG. 1

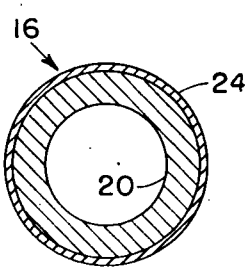


FIG. 2

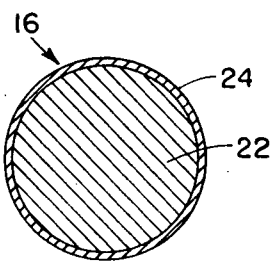


FIG. 3

METHOD OF MAKING ROLLING ELEMENT BEARINGS

RELATED APPLICATION

This application is a division of copending application Ser. No. 201,904 which was filed Nov. 24, 1971.

ORIGIN OF THE INVENTION

The invention described herein was made by an employee of the United States Government and may be manufactured and used by or for the Government for governmental purposes without the payment of any royalties thereon or therefor.

PRIOR ART

This invention is concerned with a method of making an improved bearing having low mass rolling elements. The invention is particularly directed to making rolling elements having lightweight cores that are plated.

When conventional rolling-element bearings are used at high rotative speeds centrifugal forces of the rolling elements on the outer races are detrimental to bearing life. Low mass rolling elements reduce this centrifugal force thereby increasing the life and reliability of high speed bearings.

Low mass rolling elements, such as hollow balls and rollers, are used in bearings on shafts which start and stop quickly. Less energy is required for acceleration and deceleration with hollow rolling elements because of their low inertia.

Low mass rolling elements can be fabricated of a material with a density significantly less than bearing steels. Other low mass rolling elements are hollow to reduce the mass. In either hollow rolling elements or those of low density material the fatigue strength must not be less than that of solid elements of high quality bearing steel. Rolling elements of relatively low density material have shown much lower fatigue strength than have conventional balls and rollers. Hollow balls of conventional bearing steels with significant mass reduction have shown either a weakness in the weld material or flexure fatigue of the wall.

SUMMARY OF THE INVENTION

These problems have been solved by making low mass rolling elements in accordance with the present invention and using them in improved bearings. Low mass rolling elements are produced by forming hollow cores of an inexpensive steel. Also a lightweight material can be used to make a low mass solid core. The low mass solid core and the hollow core are plated with iron and heat treated to form a hard surface.

OBJECTS OF THE INVENTION

It is, therefore, an object of the present invention to provide a method of making low mass rolling elements having a high fatigue strength and high resistance to flexure fatigue for use in bearings.

Another object of the invention is to provide a method of making low mass rolling elements whose fatigue strength is as good as or better than solid rolling elements of conventional materials.

A further object of the invention is to produce low mass balls to increase the life and reliability of high speed ball bearings.

These and other objects of the invention will be apparent from the specification which follows and from the drawing wherein like numerals are used throughout to identify like parts.

DESCRIPTION OF THE DRAWING

FIG. 1 is a vertical section view through a rolling element bearing having a rolling element constructed in accordance with the invention;

FIG. 2 is an enlarged sectional view taken along the line 2—2 in FIG. 1; and

FIG. 3 is an enlarged vertical section view similar to FIG. 2 showing an alternate embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing there is shown in FIG. 1 an improved rolling element bearing assembly **10** of the ball bearing type. The bearing assembly **10** comprises an outer race **12** spaced from the inner race **14.** Rolling elements **16** in the form of balls roll between the outer race **12** and the inner race **14.** The balls are properly spaced by a separator **18** or cage.

According to the present invention the rolling element **16** is made up of either a hollow core **20** shown in FIG. **2** or a solid lightweight core **22** shown in FIG. **3.** Both the cores **20** and **22** are covered by a plated surface material **24.**

The hollow core **20** shown in FIG. **2** is made by forming a hollow sphere of inexpensive low carbon or medium carbon steel. This hollow sphere **20** is fabricated by welding together two hemispheres of the low carbon or medium carbon steel. This can be accomplished in accordance with the teachings of copending application Ser. No. 196,917 by Thomas Moore entitled "Production of Hollow Components for Rolling Element Bearings by Diffusion Welding" which was filed Nov. 9, 1971.

The lightweight solid core **22** shown in FIG. **3** is made of relatively low density material, such as aluminum oxide. This core **22** is formed by cold pressing and sintering, hot pressing, or other powder metallurgy techniques.

The hollow spherical core **20** and the lightweight core **22** are plated with pure iron. This is accomplished by electrolytic deposition, ion plating, or sputtering.

The plated cores are then heat treated by a case hardening process. Carburizing has been satisfactory. The plated cores are then ground and finished to the required tolerances.

Each rolling element **16** has a low mass and a hard homogeneous surface with a relatively soft and ductile inner core. The hardness of the iron plating **24** is between Rockwell C **60** and **65.** The thickness of the finished iron plated surface is preferably at least twice the depth of the maximum shear stress expected in the application. This thickness is on the order of 0.012 to 0.015 inch. The homogeneous iron **24** is inclusion free and can provide rolling-element fatigue strength equal to or better than conventional high quality bearing steels. The relatively soft ductile inner hollow core **20** eliminates the problem of flexure fatigue of the wall. No flexure problem is encountered in the solid core **22.**

The races **12** and **14** are fabricated from ring shaped blanks of a high hardenability bearing steel, such as AISI M-**50.** The blanks are heat treated to a Rockwell C hardness of **58** or greater. The ring blanks are than

ground to specified dimensions to form an inner race and an outer race.

Although a preferred embodiment of the invention has been described it will be appreciated that various modifications may be made without departing from the spirit of the invention or the scope of the subjoined claims. The bearing assembly **10** can be made to form an angular contact ball bearing to accommodate radial or thrust loads or to form deep groove ball bearings to take primarily radial loads.

What is claimed is:

1. A method of making a rolling element bearing comprising the steps of

forming a pair of races,

forming a plurality of cores having a low mass,

plating the surfaces of said cores to form a coating,

heat treating said plated cores to harden said coating,

grinding the plated cores to a predetermined diameter, and

assembling said plated cores between said races.

2. A method as claimed in claim **1** including the step of joining preformed components to form a hollow core.

3. A method as claimed in claim **2** wherein the components are steel.

4. A method as claimed in claim **1** wherein the coating is iron.

5. A method as claimed in claim **1** including the step of forming a solid core of a low density material.

6. A method as claimed in claim **5** wherein the solid core has a density less than the density of the coating.

7. A method as claimed in claim **5** wherein the low density material is aluminum oxide.

8. A method as claimed in claim **1** wherein the plated cores are carburized to harden same.

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