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BEARING MEMBERS HAVING A PLURALITY OF COATINGS

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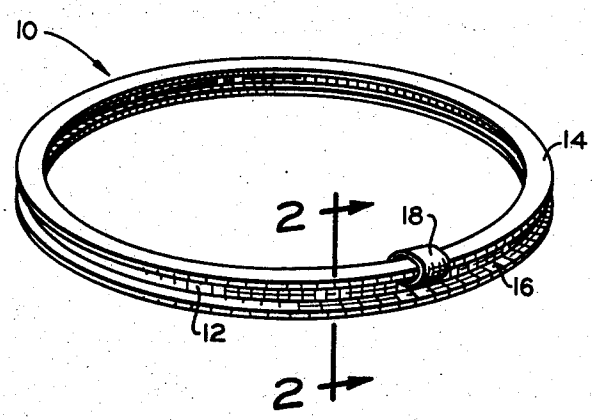


FIG. 1

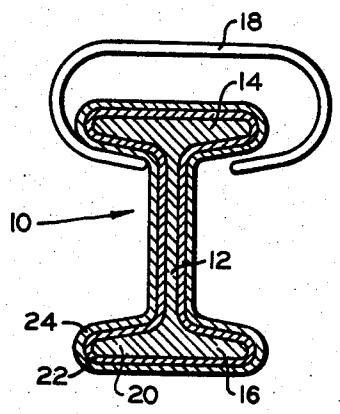


FIG. 2

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BEARING MEMBERS HAVING A PLURALITY OF COATINGS

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ABSTRACT OF THE DISCLOSURE

A ferrous bearing member is disclosed having a wear surface formed by an inner intimate coating of ferrous oxide and an outer intimate coating of tin or the like so that the bearing member's wear surface is hard, durable and scuff resistant.

This invention relates to rapidly seating bearing members which are characterized by long life. More particularly, this invention relates to new and novel spinning and piston rings having a plurality of coatings.

In certain applications involving bearing members, these members have a break-in period which involves considerable expense and inconvenience. Examples of such bearing members are spinning rings, piston rings, sealing rings, and the like. The need for a break-in period is occasioned by many factors some of which are the presence of minute pits and irregularities on the external surfaces of such bearing members. As a general rule, the break-in period requires an initial reduced rate of operation; however, additional expense and inconvenience is associated with the break-in period of spinning rings which will be described forthwith.

In conventional spinning and twisting mechanisms used in the textile industry, spinning or twisting rings are used to guide a body of fibers being twisted into yarn or thread from feed rollers through a rotating spindle by means of a traveler which is freely mounted for rotation about the circumference of each ring. Each spinning ring is mounted coaxially with a spindle and reciprocates between the ends of such spindle in a direction of a longitudinal axis of the same to give desired distribution of the spun material thereon. The traveler is usually made from carburized steel and rotates circumferentially about the uppermost flange of the spinning ring.

A great expense associated with spinning rings involves the changing of travelers when a spinning ring is first used, in addition to a reduced production rate. An appreciation of the expense involved may be obtained by reference to the Mar. 6, 1964, edition of "The Textile Weekly," page 381, wherein it is stated, "that the recommended procedure for running in ordinary rings involves 36 traveler changes during the first 65 hours and that the spindle speeds must be reduced by about 25%" during such period. Although this article gives an indication of the problem, it should be noted that the number of traveler changes during the break-in of the spinning ring will vary, among other things, with the count of the thread, the speed of the traveler, and the diameter of the spinning ring.

Spinning rings have commonly been made of steel which has been hardened, ground and polished. In spite of such treatment, these rings possess minutely pitted external surfaces having a relatively high coefficient of friction, thereby leading to frequent traveler changes and reduced rate of production until the external surfaces are rendered smooth. Various attempts have been made to overcome these defects in spinning rings by coating such surfaces with nickel, nylon, plastics, and the like. Although some of these materials in general tend to alleviate the break-in problem, they have not proven completely satisfactory in other respects.

It is, therefore, an object of this invention to provide a novel bearing member which is capable of operating at high efficiency from its initial operation and which has a low rate of wear.

It is another object of this invention to provide a ferrous bearing member having a plurality of coatings.

Another object of this invention is to provide an article formed from ferrous metal with an initial coating having a crystalline structure and a second overlaying coating of anti-friction metal.

It is yet another object of this invention to provide a spinning ring having a low friction surface which substantially eliminates the need for break-in and which has a long period of use.

It is still another object of this invention to provide a bearing member with a porous, long wearing first coating and with a softer, anti-friction second coating formed within the pores and upon the surface of the first coating.

Other and further objects of this invention will be apparent from the following description and claims, and may be understood by reference to the accompanying drawings which, by way of illustration, show the preferred embodiments of the invention and what are considered to be the best mode of applying the above principles.

In the drawings wherein like numerals are employed to designate like parts throughout the same:

FIG. 1 is an isometric view of a spinning ring incorporating this invention and having a traveler attached thereto; and

FIG. 2 is a radial cross-section view of the spinning ring of FIG. 1 taken along the line 2—2 in FIG. 1.

There is a class of metals and metal alloys, hereinafter referred to collectively in the specification and claims as metals, which are known for their lubricating and anti-friction properties. This class includes, among others, lead, copper, tin, cadmium, and alloys thereof. Metal alloys which are intended for anti-friction use are sometimes referred to as Babbit metals, such as alloys containing 95% lead:5% tin and 65% tin:35% nickel.

It has been found that the break-in problem associated with ferrous metal bearing members is somewhat relieved when the body of such member is provided with an external layer of anti-friction metal. Unfortunately, the anti-friction metal wears quickly and the exposed ferrous metal tends to gall, seize or score. An unique bearing member has been obtained by initially forming a first coating of an iron oxide, such as Fe_3O_4 or $FeO–Fe_3O_4$, intimately on the surface of the bearing member and then placing an overlying coating of anti-friction metal on such oxide coated surface. The iron oxides have low wear rates and do not exhibit galling, seizing or scoring tendencies. Consequently, such a double coating results in fast break-in and maximum subsequent performance. More particularly, unlike metals, iron oxides tend to have a porous, crystalline structure; therefore, when a ferrous bearing member having an iron oxide coating is plated with an anti-friction metal, the iron oxide not only obtains a surface plating but is impregnated with the anti-friction metal as well. Thus, the anti-friction metal is not completely removed during initial operation.

Referring to FIGS. 1 and 2, a bearing member is shown in the form of a spinning ring **10** formed from ferrous metal and comprising a central annular rib portion **12** and having a pair of axially spaced flanges **14** and **16** formed integrally therewith. Each of the flanges **14** and **16** extends both radially inward and outward from the rib portion **12** and is adapted to support a traveler **18** for rotation about the circumference of the ring **10**.

In preparing the preferred embodiment of the spinning ring **10**, the surface thereof is first finish machined and then subjected to a treatment which provides a layer

of iron oxide **22** over the base ferrous metal indicated at **20**. The iron oxide layer **22** may be ferric oxide (Fe_2O_3), ferrosoferric oxide (Fe_3O_4), sub-layers of Fe_2O_3 and Fe_3O_4, or a composite of ferrous oxide (FeO) and Fe_3O_4. The preferred layers **22** for this invention is a layer of Fe_3O_4 or a composite layer of FeO and Fe_3O_4, because of the long wearing characteristics of the same. The Fe_3O_4 may be formed according to the teachings in United States Patent No. 2,236,728 to F. H. Given; wherein, a ferrous article is held in a superheated steam atmosphere at a temperature between 1,020° F. to 1300° F. for a period of one-half hour. The composite layer of FeO and Fe_3O_4 may be deposited by the method taught in the inventor's copending United States patent application Ser. No. 420,883, filed Dec. 24, 1964; wherein, a ferrous article is heated to a temperature between 1050° F. and 1800° F. in a steam atmosphere and held at that temperature for a period of approximately twenty seconds, after which time the article is quenched.

After the oxide coated article is thoroughly cleaned, an anti-friction metal layer **24**, such as tin, lead, cadmium or alloys therefrom, is deposited over the iron oxide layer **22** to form the external surface of the bearing member. This deposition may be by any conventional method such as electro-plating. For example, a tin layer has been deposited over an iron oxide coating by placing the coated article, which serves as the cathode, and a tin anode in a bath containing one ounce of solium hydroxide per gallon of water at a temperature of 150° F. A power source, such as a motor generator, was then utilized to generate a current density of 40 amps./ft.^{2}.

Unusually good results have been obtained when an anti-friction metal is applied to an iron oxide surface of a spinning ring in that the need for travel change during initial operation has been eliminated. The elimination of the adverse effects of the break-in period was demonstrated in a test utilizing a Saco-Lowell frame. The recommended break-in period using this type of frame involves five traveler changes; that is, a traveler change after 30 minutes, 24 hours, 48 hours, 72 hours, and 96 hours. By using the spinning ring of this invention with a Saco-Lowell frame, the traveler changes during the break-in were completely eliminated. Spinning rings formed from cast iron with a ferric oxide-ferrosoferric oxide first coating and an outer layer of tin were installed on a Saco-Lowell frame. Each of the rings supported a carburized steel traveler. After the spinning frames were operated for 24 hours the rings were removed and inspected. No wear was observed on the original travelers and they were placed back on the ring. The life of these travelers proved equal to the life of travelers subsequently installed. In addition, the spinning rings themselves provided long periods of use. In short, the effect of the break-in period was eliminated without adverse effect on the durability of the spinning ring.

The double coating system comprising an iron oxide with an anti-friction metal overlay has been applied to piston rings as well. In this instance, iron piston rings were given Fe_3O_4 coatings by the process taught by Givens in United States Patent No. 2,236,728. Some of these oxide coated piston rings were plated with cadmium and others with tin. Both soft metals formed an itnegral bond with the oxide surfaces. Some of the double coated piston rings were installed in a test engine and rendered good performance.

The thickness of the double coating applied to a member will be determined, mainly, by the size of the article being coated and the application of such member. For example, 2" x 1" x 3/8" rings having an iron oxide coating varying from 0.00005"–0.0001" and an anti-friction metal overlay of 0.0002"–0.0003" have proven very satisfactory. The thickness of the iron oxide coating is controlled at least by the reaction temperature and time at such reaction temperature. The thickness of the anti-friction metal overlay is controlled at least by the current density of the bath and by the period of coating.

Although the preferred embodiment of this invention has been shown and described, changes and modifications can be made therein without departing from the scope of this invention and it is understood that the preceding description is illustrative only and not for the purpose of rendering this invention limited to the details illustrated or described except insofar as they are limited by the terms of the following claims.

What is claimed is:

1. A bearing member comprising a base portion formed from ferrous metal and having a wearing surface, a first coating intimately secured to at least a portion of said wearing surface and having a porous crystalline structure selected from the group consisting of ferric oxide, ferrosoferric oxide, a composite of ferric and ferrosoferric oxide and a composite of ferrous oxide and ferrosoferric oxide and a second anti-friction metallic coating intimately secured to said first coating at least at said portion of said wear surface selected from a group consisting of lead, copper, tin, cadmium and alloys thereof, whereby said anti-friction metallic coating is incompletely removed during initial operation of said bearing member.

2. A spinning ring comprising a base portion formed from ferrous metal and having an annular body portion and an annular flange formed coaxially and integrally with said spinning ring, said flange forming a wearing surface, a first coating intimately attached to said flange selected from a group consisting of ferric oxide, ferrosoferric oxide, a composite of ferric and ferrosoferric oxide and a composite of ferrous oxide and ferrosoferric oxide, a second anti-friction metallic coating deposited on said first coating to form an external surface on said spinning ring and covering the first coating on at least said flange, said second coating selected from a group consisting of lead, copper, tin, cadmium and alloys thereof, whereby said anti-friction metallic coating is incompletely removed during initial operation of said spinning ring.

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