

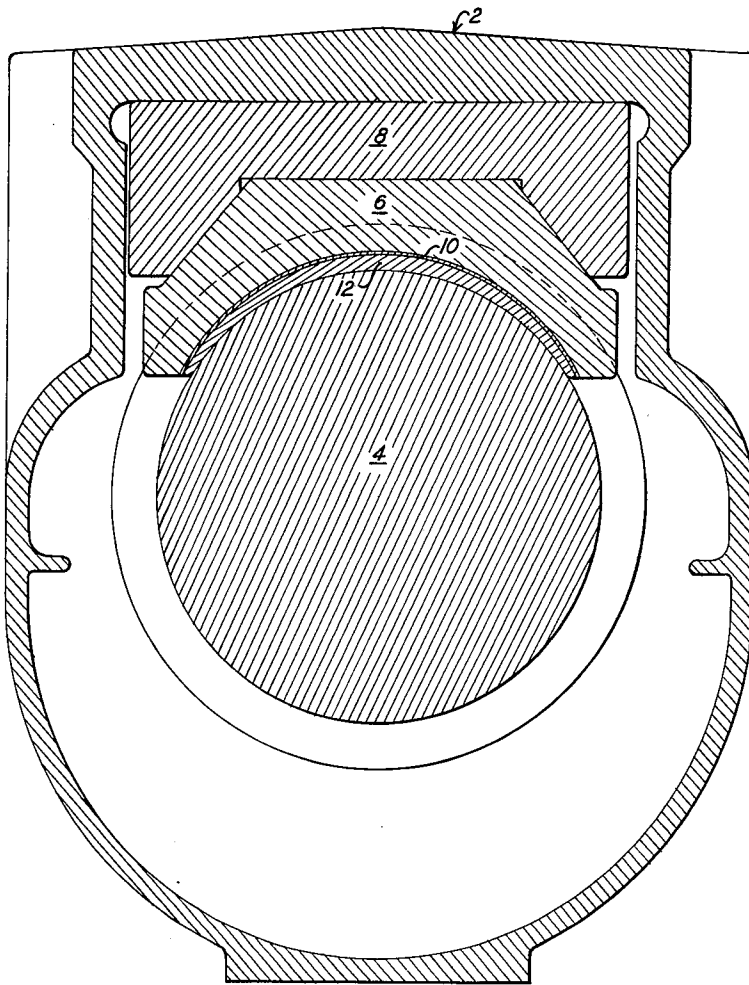
Jan. 28, 1964

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3,119,640

BEARINGS

Filed June 22, 1962



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3,119,640
BEARINGS

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Filed June 22, 1962, Ser. No. 204,605
11 Claims. (Cl. 308-56)

This invention relates to bearings and, more particularly, to bearing lining materials for railway car journal bearings and other heavy duty industrial bearings.

Prior to the present invention the bearing linings for railway car journal bearings generally were formed from babbitt metal. The Association of American Railroads has set up as a standard bearing lining material for this type of service a cast alloy of 85 parts lead, 2½ parts tin and 12½ parts antimony. This material has a combination of characteristics that are desirable for railway car service, but its anti-friction properties are not entirely adequate, particularly during periods when lubricating oil is not being supplied at the intended rate. Railway cars frequently are left on sidings for substantial periods of time, and when such a car is first put in motion after a period of rest, there is a time interval in which very little lubricating oil is delivered to the cooperating bearing surfaces. This undesirable condition is aggravated in cold weather, and a great deal of bearing wear often takes place. Temporary failures of lubricant supply also may occur during operation of a car.

An object of this invention is to provide bearings with improved linings which will cooperate with surfaces such as railway car journals in such a way as to generate less friction than the conventional babbitt bearing linings but which will retain many of the structural characteristics which have made the babbitt bearing linings particularly suitable for railway car service.

A typical railway journal bearing installation embodying the invention is illustrated in the drawing which is a vertical cross sectional view through a railway car journal box.

In the drawing the journal box is designated generally by the numeral 2. There are a number of these journal boxes on a conventional railway car, and each serves to enclose an end portion of an axle 4. Bearing means, interposed between the top wall of the journal box 2 and the axle 4, transmit a portion of the weight of the car to the rotating axle 4.

The bearing components shown in the drawing include a bearing back 6 and a wedge 8 of conventional configuration. The curved lower surface of the bearing back has affixed thereto, by suitable bonding means 10, a porous lining 12 to be described in greater detail below. Lubricating oil normally is supplied to the bottom of the journal box 2, and suitable wicking means, not illustrated, transfers this lubricating oil to the surface of the rotating journal 4.

In a preferred embodiment of the invention, the bearing lining material includes a mixture of a perhalogenated hydrocarbon resinous material having a low coefficient of friction, a first metallic component containing a major amount of lead, and a second metallic component containing a major amount of aluminum. The three components are mixed together as powders, the mixture is pressed to shape, and the lining is sintered. The linings may be attached to bearing backs by adhesives having suitable heat transfer characteristics or by metallurgical techniques.

Resins suitable for use in the invention may be obtained by polymerization of perhalogenated ethylene or perhalogenated propylene. Polymers of tetrafluoroethylene, such as that sold by E. I. du Pont de Nemours & Co.

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under the designation "Teflon," and polymers of trifluoro-chloroethylene, such as that sold by Minnesota Mining & Manufacturing Co., are especially desirable. Polytetrafluoroethylene presently is preferred.

These materials have good antifriction properties both in the presence and in the absence of lubricating oil. In a railway car journal bearing, the perfluorocarbon resins may be relied upon to provide adequate lubricity even during periods of temporary failure of the lubricating oil supply.

Although the antifriction properties of perfluorocarbon resins are highly desirable, the material possesses other properties which detract from its suitability for railway car service. For example, the material is a good insulator so that a bearing lining material made up wholly or predominantly of polytetrafluoroethylene will not have the capacity to rapidly conduct away the heat generated in a heavy duty bearing. Moreover, the material is relatively weak and soft so that its load-carrying ability is limited.

In view of these factors, care must be exercised in determining the amount of resin incorporated in the bearing lining material of this invention. There should be enough to permit it to smear over and cover the entire surface of bearing lining during use, but there should not be so much as to detract unduly from the over-all structural characteristics of the lining as a whole. It has been found that amounts of perfluorocarbon resin in the range from 15 to 25% by volume of the lining composition are satisfactory.

The first metallic component of the lining composition of this invention is a binder component, and it must have a melting point higher than the operating temperatures for the bearing in which the lining is to be used. For railway car journal bearing linings, the binder metal component should have a melting point at least as high as 350° F. Additionally, the material should be capable of being sintered at a temperature lower than the temperature at which significant deterioration of the resinous component takes place, i.e. lower than the gel temperature of a perfluorocarbon resin. The binder metal component also must have mechanical properties of softness and ductility. Lead base babbitt alloys normally are preferred, but lead and alloys containing major amounts of lead, such as soft solder alloys, may be used. An alloy containing by weight 84% lead, 4% tin and 12% antimony has been found to be particularly suitable.

The low temperature lead base alloys have melting points considerably below the temperatures at which complete liquefaction takes place. This property is beneficial in the forming of sintered linings in accordance with the invention. When sintering is carried out at a temperature between the melting temperature and the temperature of complete liquefaction, the metal diffuses in a restrained manner without excessive running, and the uniformity of the mixture of the three components is maintained. The presence during sintering of a nonsolid phase of the first metallic component facilitates the establishment of strong metallurgical bonds with the second metallic component, and results in the formation of a microstructure which holds the resinous component in place by reason of enhanced keying effects.

The second metallic component of the lining material of the invention is harder than the binder metal and it should conduct heat materially better than the binder metal. Aluminum or an alloy containing a major amount of aluminum may be used. An aluminum-bearing alloy containing by weight 93.5% aluminum and 6.5% tin is a presently preferred material.

The relative amounts of the two metallic components may be varied somewhat. Approximately equal parts by volume of the two metallic components usually give ex-

cellent results, but acceptable compositions may be formed from mixtures in which the amount of the second component is from 50 to 150% of the amount of the first component. It is necessary that these amounts be selected so as to give the lining material as a whole the proper physical characteristics. For railway journal bearing linings it is important that the formed lining have a hardness in the range of Rockwell L-80 to L-95.

The pressing and sintering operations necessary for forming the lining of this invention should be carried out so as to leave the material in a somewhat porous condition. Railway journal bearings are normally lubricated with oil, and it is desirable that the bearing linings have sufficient porosity to store substantial amounts of oil. When a bearing having a perfluorocarbon-containing lining is operated, the resin smears over the coating surfaces of the journal and the lining, smoothing out the surface irregularities on the parts so that only a small amount of oil is required to establish effective oil-film lubrication. With a porous lining, enough oil may be stored in the lining material to lubricate the bearing for a period of twenty-four hours or more in the event of a failure in the normal lubricant supply. This is important because an unlubricated polytetrafluoroethylene bearing lining is not normally able to stand up under the stresses produced in a journal bearing for a loaded railway car operating at high speed. However, the small amount of oil stored in the lining of this invention is sufficient to prevent lining failure for a period of time long enough to provide reasonable assurance that the defective lubricant supply condition will be corrected before the lining fails.

The maintenance of uniformity in the material also is a matter which deserves particular attention. The lining must have uniform characteristics from end to end and from face to face. The lining is an arcuate shell about eight to fourteen inches in length having a thickness of about one-eighth to one-quarter inch. A uniformly compacted piece of this size and shape cannot be formed from dry powders in a single pressing step.

In a preferred method of shaping and compacting the lining of this invention, the premixed dry powders are wetted with a viscous liquid and then inserted into an arcuate mold cavity having a length greater than the length of the lining. When pressure is applied to the material from an end of the mold cavity, the wetted mixture of powders is able to distribute itself uniformly in the cavity, but the small amount of viscous liquid does not prevent adequate compaction of the powders. In order to preserve adequate porosity, the compacting pressure should not exceed about eight tons per square inch, and it preferably is about six tons per square inch.

The viscous liquid preferably is an aluminum soldering flux which, in addition to facilitating the proper distribution of the powders in the mold, serves to break down any surface oxide film that may be on the particles of aluminum base material so that the bonds achieved between these particles and the lead base material during sintering will have enhanced strength. Suitable soldering flux compositions are disclosed for example in United States Patent No. 2,286,298 granted to Miller on June 16, 1942, and are available commercially. An organic fluoroborate soldering flux for aluminum is marketed by Aluminum Company of America as "Alcoa 64" and is available as a viscous liquid which may be thinned with ethanol. When such material is used in the practice of this invention, it preferably is thinned with about 25% by volume of ethanol, and about two parts by volume of the thinned material is added to about ninety-eight parts of the premixed powders.

In actual manufacturing operations, many of the techniques known to the fabricators of pressed metal articles may be used when indicated. For example, sintering frequently is carried out in inert atmospheres, and re-pressing after sintering sometimes is employed to give enhanced strength properties to the formed articles.

Bearing linings for railway bearings are carried by bearing backs of brass, cast aluminum or cast iron. The attachment of a bearing lining to a bearing back must be accomplished in such a way as not to detract from the desirable properties of the material itself. A bond of adequate strength must be attained, and the means for bonding must have the ability to transmit to the backing rapidly the heat it receives from the bearing lining.

A desirable attachment may be achieved by metallurgical procedures. The bearing back is heated and is tinned with a material such as lead. Then the preformed bearing lining is pressed in position on the pre-tinned bearing back and the assembly is allowed to cool. If desired, the attaching and sintering operations may be carried out simultaneously.

Another procedure for applying the lining to the bearing back involves the use of a suitable adhesive material. A setting adhesive, such as an epoxy resin, filled with metal particles has been found to provide an excellent bond. When the adhesive sets, a strong bond results, and the metal particles in the material give it adequate heat transfer properties. Again, if the adhesive is one that sets at an accelerated rate when heated, it may be advantageous to combine the sintering step and the lining attaching step into a single operation.

A specific example will serve to further explain the nature of the invention.

Example

Particles of 100-mesh size of polytetrafluoroethylene, a babbitt metal alloy of 84% lead-4% tin-12% antimony, and a 93.5% aluminum-6.5% tin alloy are thoroughly mixed together in a dry state in the following proportions by volume:

Polytetrafluoroethylene	20
Aluminum-tin alloy	40
Babbitt metal alloy	40

To 98 parts of the premixed dry powders, there is then added 2 parts by volume of an aluminum soldering flux made of an organic fluoroborate compound ("Alcoa 64") suitably thinned with ethanol to give adequate wetting power, and the mixture is stirred to distribute the flux throughout the premixed powders. The wetted mixture is introduced into an arcuate mold cavity 11 inches long and 1/8 inch thick, and a plunger is introduced into the end of the cavity to apply 6 tons per square inch of pressure to the material. The material is removed from the cavity in the form of a thin arcuate shell and applied to an iron bearing back having on it a .005-inch layer of a material consisting of 50 parts by volume of an epoxy resin adhesive and 50 parts by volume of 100-mesh particles of 93.5% aluminum-6.5% tin alloy. The bearing back with the lining thereon is placed in an oven maintained at 245° C. for 30 minutes to sinter the lining and set the adhesive. It is then removed from the oven, and the bearing back and attached lining are permitted to cool gradually.

The bearing member so formed has properties that make it especially suitable for railway service. The bearing lining has excellent antifriction properties both in the presence and in the absence of lubricating oil. When fully lubricated, the bearing will run at temperatures below those at which a bearing having a standard cast babbitt lining will operate under like conditions of speed and load. When normal lubrication is interrupted, the bearing continues to operate satisfactorily for many hours. Moreover, the friction generated during start-up periods and periods of low-speed operation is much less than that experienced heretofore in connection with conventional linings.

In addition to its excellent antifriction properties, the lining of this invention has mechanical properties that are entirely compatible with the conditions encountered in railway journal bearing service. The metal particles are securely bonded together to provide a strong and dura-

ble material capable of conducting heat at a sufficient rate to keep the bearing from overheating. Its hardness, about Rockwell L-84, is great enough to make the material suitable for heavy load usage but not so great as to prevent the lining from conforming readily to the surface of the journal with which it is to cooperate, or from absorbing particles of foreign matter, such as dirt and sand, that might otherwise score the surface of the journal.

The property of conformability is important. Railway journal bearings are not held to close tolerances. It frequently happens that a newly lined bearing back does not have exactly the same curvature as the journal on which it is installed. Unless the lining material has the capacity to flow under the applied loads, such differences in curvature may result in line contacts, rather than the desired surface contacts, between the journal and the lining material.

Obviously, various modifications in the compositions and processes may be made without departing from the spirit and scope of the invention as defined in the following claims.

I claim:

1. In a normally lubricated railway journal bearing of the type having a metal back, the improvement which comprises a porous lining bonded to said back having a hardness in the range of from Rockwell L-80 to L-95, and said lining being formed from a sintered mixture containing from 15 to 25% by volume of perfluorocarbon resin, from 20 to 60% by volume of a first metallic component containing a major amount of lead and having a melting point no lower than 350° F. and no higher than the gel temperature of said resin, and from 20 to 60% by volume of a second metallic component having a hardness greater than that of said first metallic component and a melting point higher than that of said first metallic component.

2. A bearing member as defined in claim 1 in which said lining is metallurgically bonded to said back.

3. A bearing member as defined in claim 1 in which said lining is bonded to said back by an adhesive filled with metal particles.

4. A bearing member as defined in claim 3 in which said adhesive is an epoxy resin and in which said metal particles are aluminum.

5. A porous bearing lining for heavy duty bearings comprising a mixture of 15 to 25% by volume of perfluorocarbon resin particles and 20 to 60% by volume of lead base bearing material particles and 20 to 60% by volume of aluminum base bearing material particles pressed at about six tons per square inch and sintered at a temperature between the melting point of said lead base bearing material and the gel temperature of said perfluorocarbon resin.

6. A bearing lining comprising a sintered mixture containing from 15 to 25% by volume of perfluorocarbon resin, from 20 to 60% by volume of a lead base bearing material having a melting point no lower than 350° F.

and no higher than the gel temperature of said resin, and from 20 to 60% by volume of an aluminum base bearing material having a melting point higher than said lead base bearing material and a hardness greater than that of said lead base bearing material.

7. A bearing lining material comprising a sintered mixture containing about 20% by volume of polytetrafluoroethylene, about 40% by volume of an 84% lead-4% tin-12% antimony alloy, and about 40% by volume of a 93.5% aluminum-6.5% tin alloy.

8. A method of making a bearing lining which comprises mixing together particles of resinous material and particles of a lead base alloy and particles of a metallic material having a melting point higher than said lead base alloy, pressing said mixture to shape, and then sintering said mixture at a temperature between the melting point and the temperature of complete liquefaction of said lead base alloy and at which said resinous material is in a solid state.

9. A method of making a bearing lining comprising mixing together particles of resinous material and metal particles, adding to said mixture a liquid soldering flux in an amount sufficient to wet said particles, pressing the wetted mixture to shape, and sintering the shaped mixture.

10. A method of making a lining for a railway journal bearing which comprises introducing into a curved mold having a length at least as great as that of the lining a mixture consisting of about 2% by volume of a liquid aluminum soldering flux and about 98% by volume of solid particles made up of from 15 to 25% by volume of perfluorocarbon resin and 20 to 60% by volume of lead base alloy and 20 to 60% by volume of aluminum base material, applying a pressing force of about 6 tons per square inch to said mixture in a lengthwise direction with respect to the mold cavity, removing the pressed mixture from the mold cavity and sintering the same.

11. A bearing lining comprising a sintered mixture containing from about 15 to 25% by volume of plastic material including a perfluorocarbon, from about 20 to 60% by volume of a lead base bearing material having a melting point no lower than 350° F. and no higher than the gel temperature of said perfluorocarbon, and from about 20 to 60% by volume of a metallic material having a melting point higher than said lead base bearing material and a hardness greater than that of said lead base bearing material.

References Cited in the file of this patent

UNITED STATES PATENTS

2,400,091	Alfthan	May 14, 1946
2,788,324	Alpert	Apr. 9, 1957
3,020,099	Smith	Feb. 6, 1962

FOREIGN PATENTS

657,085	Great Britain	Sept. 12, 1951
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