May 25, 1954 L. J. LYONS 2,679,079

METHOD OF FORMING AXLE BEARINGS

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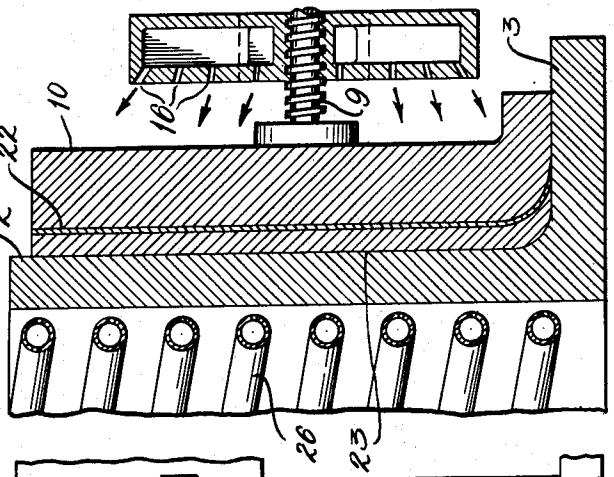


FIG.3.

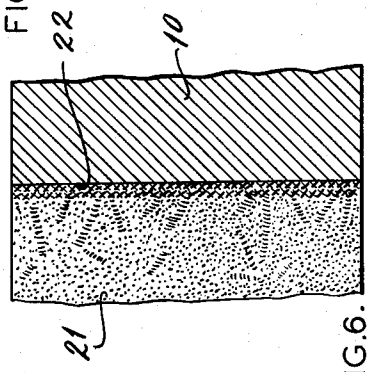


FIG.6.

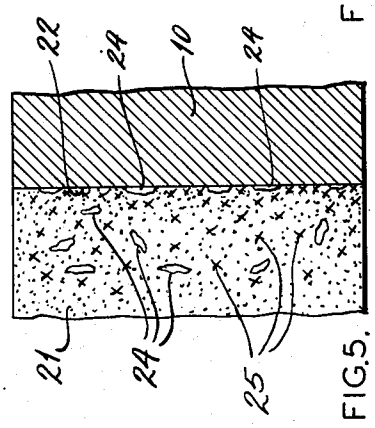


FIG.5.

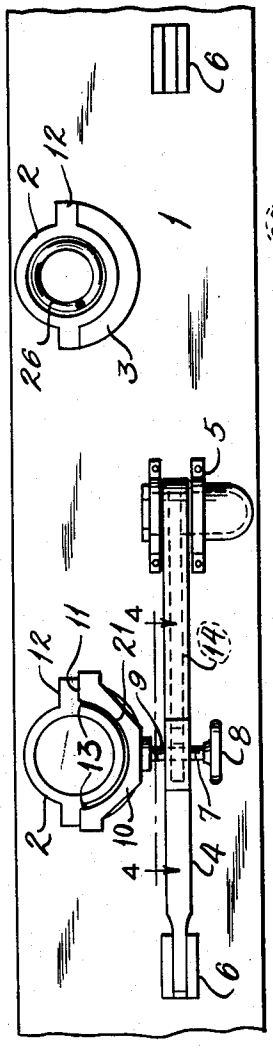


FIG.1.

FIG.2.

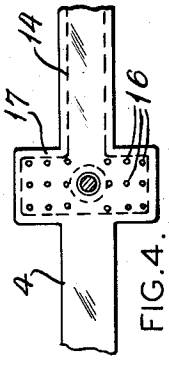


FIG.4.

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METHOD OF FORMING AXLE BEARINGS

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1 Claim. (Cl. 22—204)

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This invention relates particularly to railway car and locomotive axle journal bearings, which have a copper alloy back and are lined on the journal side with a softer metal lining of tin or lead base. Such bearings are usually known as A. A. R. standard and are used under practically all freight cars and most passenger cars. The present invention improves the physical characteristics of all such lined bearings made in segments of 180° or less and lined statically as distinguished from bushing type or centrifugally lined bearings.

The present application is a continuation-in-part of a copending application, Serial No. 523,512, filed February 23, 1944, now Patent 2,437,107, patented March 2, 1948, by the present inventor.

Heretofore, bearings of this kind have usually been poured about a hollow iron mandrel, and sometimes cooled by spraying or filling the inside of the mandrel with water, or by leaving the top and bottom of the mandrel open and allowing the mandrel to be air cooled by natural air circulation. In all the above methods, the molten lining metal is cooled from the bearing face of the liner inwardly of the metal, thus first solidifying the face of the liner against the mandrel, and as solidification continues inwardly of the metal, the molten metal is pulled away from the copper alloy back and the solder bond previously applied to the solid back. It is well known in the casting art that when a molten body of metal is cooled from two or more sides, the inside portion or the portion last solidifying is softer or weaker than the remainder of the metal which is more quickly chilled and solidified. When shrinkage pull is excessive, it results in holes or internal voids, but even a slight internal shrinkage pull causes a microscopic spongy effect with decided reduction in strength of the metal.

The main object of the invention is to produce a new and improved bearing with a stronger solder bond between the back and the lining and to increase the strength of the soft lining metal adjacent and adhering to the bonding metal; more specifically stated, the invention is directed to a method and a bearing wherein the yield point or strength of the solder bond and lining metal adjacent and adhering thereto is increased so that the soft lining metal will have much greater resistance to the tendency to crack or come loose from the bearing back under severe pounding to which railway car bearings are subjected.

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The present invention proposes, by means of apparatus covered by the parent application mentioned above, to reverse the direction of progressive solidification tendency heretofore present in the formation of axle bearings by applying drastic chilling effect simultaneously over substantially the entire outside surface of the solid back immediately upon pouring the molten lining metal. The quick application of a substantial quantity of liquid coolant to the bearing back insures the solidification of the solder bond and the lining metal adjacent thereto while the lining metal ⅛" to ¼" away is still liquid and there is still a body of molten metal above to feed the shrinkage. While this invention is concerned principally with strengthening the solder bond .001" or .002" thick, and the adjacent $\frac{1}{32}$" to $\frac{1}{16}$" of lining metal, physical tests have shown that the wearing surface ¼" to $\frac{5}{16}$" from the bond in the new bearing is also decidedly hardened and strengthened.

These advantages and other detail objects of the invention are attained by following the method described below and by the resulting product, reference being had to the accompanying drawings, in which—

Figure 1 is a top view of a pouring bench showing two mandrels which form parts of molds by which the liner is formed, there being a bearing and a holding device therefor associated with one of the mandrels.

Figure 2 is a front view of the structure shown in Figure 1.

Figure 3 is a detail vertical transverse section taken on the line 3—3 of Figure 2.

Figure 4 is a detail view of a restricted portion of the holding member and is taken on the line 4—4 of Figure 1.

Figure 5 illustrates a small section of the present A. A. R. standard bearing, greatly enlarged (as by a photomicrograph).

Figure 6 is a view similar to Figure 5 and illustrates a corresponding section of a bearing contemplated by the present invention.

The bench or base 1 may be of any suitable material and extent and adapted to support one or more circular or semi-circular mandrels 2 each having its axis disposed vertically and having a lower flange 3. The mandrel will be firmly secured to the base. A holding member 4 comprises an elongated arm pivoted on a bracket 5 to swing in a vertical plane from the full line position shown in Figures 1 and 2 to the broken line position shown in Figure 2. In each of these positions, the outer end of the arm will

be supported and positioned transversely of the bench by a suitable holding jaw 6. Intermediate the ends of member 4, it is threaded transversely to receive a clamping screw 7 having a handle 8 at one end by which it may be rotated in member 4 to feed its inner end 9 against the back of an ordinary journal bearing body 10, the concave face of which is substantially concentric with the surface of the adjacent mandrel 2. The side edges 11 of the bearing back will seat against suitable ribs 12 on mandrel 2, and preferably ribs 12 will be shouldered at 13 to properly posiiton the bearing transversely of the mandrel.

A substantial portion of holding member 4 is hollow and forms a conduit 14 leading from a supply pipe 15 to a series of discharge outlets 16 abreast of and facing towards bearing back 10. Preferably, this portion of member 4 is enlarged to substantially cover the entire outer face of bearing back 10, as best shown at 17 in Figure 4. Cooling liquid is supplied through pipe 15, cut-off valve 18 and adjusting valve 19 and is discharged through outlets 16 against the outer face of bearing back 10, simultaneously spraying the entire outer face of the back.

Before being applied to the mandrel, the bearing back 10 has a liquid flux applied to its concave surface and is then immersed in a kettle of molten solder (heated to approximately 600° F.) and allowed to come up to that temperature which is well above the melting temperature of the solder (approximately 370° F.). The bearing back is then quickly placed against the mandrel and the clamping screw 7 tightened to thrust the bearing back edges 11 against the mandrel lips 12. The space between the arcuate portions of the mandrel and the bearing back forms a mold for the liner metal 21 which is poured promptly after the application of the bearing back to the mandrel, the liner metal and the thin coating 22 of solder uniting to form a bond between the liner 21 and the bearing back.

During or immediately following the pouring of the liner metal, valve 18 is opened and water or other cooling liquid is discharged against the rear face of the bearing back 10, which is cooled rapidly, thus quickly solidifying the solder bond 22 and the portion of the liner metal 21 adjacent to the bearing back 10 while a substantial portion of the remaining lining metal 21 is still molten.

As is well understood in the casting art, the metal will be most dense and consequently stronger where it is cooled quickly and less dense where it cools slowly. Any shrinkage occurring during the latter portion of the cooling operation will be along the surface which is closer to the mandrel and not along the surface which is adjacent to the solder bond and bearing back. Hence the bond between the bearing back and the liner will be stronger than if the liner metal were cooled from the mandrel towards the bearing back and there will be less likelihood of minute shrinkage cavities or spongy metal between the bearing back and the liner, which weakens the metal and facilitates loosening of the liner from the bearing back after the finished bearing is put in service and the liner is subject to thrusts and impacts under heavy loads.

Figures 5 and 6 of the drawings illustrate the difference in physical characteristics of bearings produced by methods used heretofore and the method of the present invention. In Figure 5, illustrating a bearing with liner cast in the usual manner, the metal 21 adjacent the mandrel will freeze before the metal adjacent back 10 freezes and the bonding alloy 22 and lining metal 21 adjacent thereto will remain liquid for 75 to 100 seconds. During this time, the bonding alloy, which is chemically similar to the lining metal, is drawn away from the bearing back and diffused into the lining metal, as illustrated at 25, thus weakening bond 22 and the adjacent lining metal by forming a spongy, weak structure with large voids, as illustrated at 24, adjacent to the bearing back.

In Figure 6, illustrating a bearing cast according to the present disclosure the bonding alloy 22 and adjacent lining metal 21 is solidified within 5 to 8 seconds after the lining metal is poured. The quick solidification of the bonding alloy solder 22 retains the solder against the solid bearing back 10 and the quick solidification of the adjacent lining metal 21 and the rapid solidification of the remaining lining metal forms a close, uniformly grained, strong dense structure of the lining metal throughout its thickness.

These statements are not merely theories but have been demonstrated by photo-micrographs of sections through A. A. R. standard bearings and bearings made according to the present invention and Figures 5 and 6 are intended to illustrate the grain structure shown in such photomicrographs.

Promptly upon completion of the pouring and solidification of the liner metal, clamping screw 7 is released and holding member 4 is swung 180° to bring the clamping screw opposite to the right hand mandrel 2 and another bearing is applied to mandrel 2 and the pouring operation duplicated. By using the mandrels alternately, their temperature may be held below a point where cooling and hardening of the liner would be impeded. Also, this alternate use of the mandrels will provide for leaving the cooling liner in a position long enough to permit it to harden so that it may be handled without deformation of its journal-engaging surface 23.

To avoid cooling of the liner metal at the top of the bearing before the metal cools at the center of the bearing (and thus causing the liner metal to shrink and pull away from the bearing back at its center), the discharge portion 17 of the conduit is placed closer to the bottom of the mandrel than to the top so that cooling and solidification begins at the lower end of the bearing (Figure 3) and proceeds upwardly, particularly in view of the fact that the metal is poured from the top, and the lower portion of the liner metal will be cooling while the upper portion is still being poured into the mold. Thus there is always a supply of molten metal just above the point of solidification which moves upwardly as the molten metal flows into the mold, and the last point of solidification is at the upper end of the bearing.

Since bearing backs of the type under consideration are usually formed of copper alloys having a high degree of conductivity, the conduction of heat from the soldered surface of the liner metal will be readily effected when the outer face of the bearing is cooled by the discharge of cooling liquid from the conduit. Obviously the differential between the rate of cooling of the liner metal at the bearing back and at the mandrel may be increased by using a closed mandrel or by applying heat to the inner face of the mandrel by a gas burner 26 or other suitable means. Preferably the temperature of the man-

drel is maintained below the solidification temperature of the liner metal.

It will be understood that other liquids may be used in place of the water for cooling the outer face of the bearing back and that other details may be varied without departing from the spirit of the invention, and the exclusive use of those modifications coming within the scope of the claim is contemplated.

What is claimed is:

The method of applying a metallic lead-base liner of ⅛ inch or greater thickness to the face of a railway axle journal bearing back of copper-base metal and having a concave arcuate contour in cross section in a manner to prevent development of voids in the liner by controlling the density thereof, which comprises applying a liquid flux to the inner face of the back, immersing the back in a bath of molten solder having a temperature of approximately 600° F. and far below the melting temperature of the back to form a layer of solder on the inner face of the back, maintaining the back in immersion until it has attained the temperature of the bath, then immediately placing the back with said face in concentric relation to a convex mold member so that a mold cavity is created between the solder-clad inner face of the back and the mold member, and heating the mold member without exceeding the freezing temperature of the liner metal, filling the mold cavity so created with molted liner metal at a temperature far below the melting temperature of the back, continuing to apply heat to the mold member to maintain its temperature near but below the freezing temperature of the liner metal, and simultaneously with the pouring of the molten liner metal applying cooling means to the outer face of the back to cool the back to a relatively low temperature for effecting a marked differential rate of freezing of the liner metal whereby the portion thereof against the back is rapidly solidified, together with the solder, in advance of the freezing of the portion of the liner metal adjacent the heated mold member, and thereby produce a liner with maximum density adjacent the back and with less density where spaced from the back.

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