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R. D. PIKE ET AL

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MANUFACTURING AND TESTING BEARINGS

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*Fig. 2.*

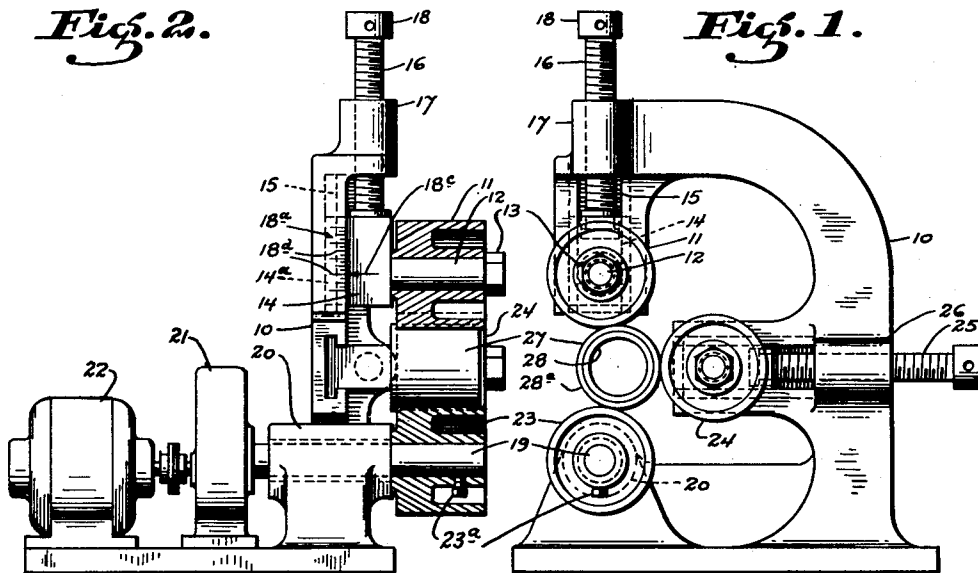


*Fig. 1.*

*Fig. 3.*

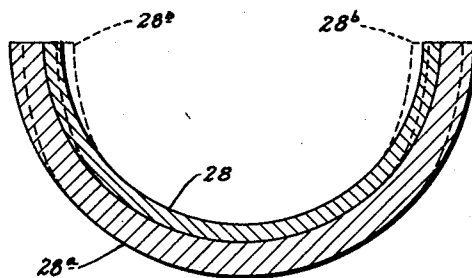
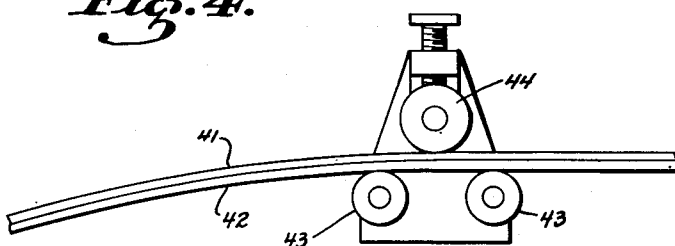


*Fig. 4.*



INVENTORS.  
Robert D. Pike,  
Hugo J. Stevenson,  
BY Otto M. Wash,  
Townsend, Loftis & Abbott  
ATTORNEYS.

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## MANUFACTURING AND TESTING BEARINGS

Robert D. Pike, Diablo, Hugo John Stevenson, Oakland, and Otto M. Eash, Berkeley, Calif., assignors to Kalif Corporation, Emeryville, Calif., a corporation of Delaware

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11 Claims. (Cl. 29—149.5)

Various articles are manufactured from compound strips, that is, strips or sheets consisting of a layer of metal firmly united to one or more layers of another metal or metals, the union between the metals generally occurring at a high temperature due to the method of manufacture which frequently comprises casting one metal to another, soldering, welding, coating, etc. The different metals frequently have different thermal coefficients of expansion, and when this difference is substantial, stresses and strains are thereby set up when the compound strip sheet or other article is cooled down from the temperature of manufacture to normal room temperature.

These stresses and strains are often objectionable for various reasons, one of which is that they cause distortion due to the stresses and strains set up, and this is highly objectionable to such an extent in the case of articles which need to be made with a great deal of precision that heretofore it has been practically impossible at times to use such articles.

One specific type of article in which the manufacture is made with the difficulties above referred to, is bearings consisting of a relatively thin steel cylinder either with or without flanges and lined with a bearing face of particular types of bronze, such bronzes being, for example, metallic compositions consisting roughly of seventy-five per cent copper and twenty-five per cent lead, either with or without up to five or six percent of other metals, such as tin, nickel, zinc, etc.

One of the many types of articles in which the difficulty is particularly noticeable is where the bearing has to be split, as in the manufacture of automotive engine bearings.

When a liner of bearing bronze is cast inside a steel cylinder and uniformly and integrally welded thereto by any process, for example, the process described in Serial No. 461,709, filed June 17, 1930, then the entire bearing at the casting of the bronze is at a temperature of about 1832° F., and in cooling down to room temperature from the higher temperature the bronze contracts almost twice as much as the steel back, in view of the fact that the coefficient of thermal expansion of steel is .0000066 per degree F., while that of the bronze is about .0000115 per degree F. or nearly twice as much. It will be obvious that unless the bond between the steel and bronze is uniform and very strong, the strains induced by this differential expansion would disrupt it, but even where there is no such actual disruption, severe tensile stresses will be set up and these are

so great that when an attempt is made to saw the bearing longitudinally into two halves, the sawed edges are drawn in, gripping and binding the saw and making it impossible to complete the cut, while at the same time distorting the bearing.

Our present invention relates to a method for removing these strains, that is, for neutralizing them to the degree desired or even reversing such strains when this is desired, so that the bearing can be split longitudinally without binding the saw and the bearing will also be free from distortion and retain its permanent dimensions after splitting, where there is no further change of temperature.

The present invention is highly useful in the manufacture of bearings of the type described, although it will be apparent that the invention is capable of general application to all articles consisting of layers having different thermal coefficients of expansion where the method of manufacture requires changes in temperature. For purposes of illustration and without limiting the invention thereto, we shall describe it with specific reference to bearings.

Referring to the drawing forming a part of this specification,

Fig. 1 is an end view of apparatus with a cylinder on which it is to operate therein.

Fig. 2 is a longitudinal partially sectional view thereof.

Fig. 3 is a typical cross section of a half circular bearing showing the deformation which occurs in a split bearing referred to above which has not been treated by my novel process.

Fig. 4 is a diagrammatic illustration of a modification of my method.

The specific apparatus illustrated comprises a general supporting frame 10, a top roller 11 which is loosely slipped over the axle 12 and held in place thereon by the nut 13. The axle 12 is mounted on a vertically movable head 14 having a projection 14a thereon which slides in the groove 15 in the framework 10. A screw 16 is rotatably attached to the head 14 and turns in the holder 17 which is interiorly threaded to accommodate the threads of the screw 16, the holder 17 being attached to the frame 10. Any suitable means 18 is provided on the screw 16 for turning it, which results in moving the head 14 up or down as desired and with it the axle 12 and the roller 11, and the position of such roller is preferably indicated very precisely by any desirable form of indicating means.

For purposes of illustration, we have shown on the drawings a fixed indicator scale 18a on the

frame 10, while an indicating pointer 18c mounted on the head 14 projects over the scale 18a. The markings on the scale may be very fine and very closely adjacent each other whereby the exact placement of the roller 11 in a predetermined position may be easily and quickly attained.

An axle 19 is mounted below and parallel with the axle 12 and for most purposes the axle 19 is vertically below such other axle. The axle 19 is rotatably mounted in the bearing 20 which in turn is suitably supported by the framework 10, and it is turned by any suitable means.

An electric motor is preferred, and we, therefore, provide a gear reducing mechanism 21 of any suitable type and an electric motor 22, the gear reducing mechanism 21 serving to turn the axle 19 at a lower speed than the motor. A power roller 23 is mounted on the axle 19 and fixed thereto to turn with it, as for example, by means of a screw 23a passing through the roller into firm contact with the axle.

We also provide a guide roller 24 which is mounted in a manner similar to the mounting of the pressure roller 11. A screw 25 is mounted to turn in an interiorly threaded screw holder 26 on the frame 10, and the screw 25 is connected to the bearing of the axle of the roller 24 so that such roller may be moved horizontally toward and away from the line connecting the centers of the rollers 11 and 23, while permitting free rotation of such roller on its axle, in the same manner as described with respect to the roller 11.

The rollers 11, 23 and 24 are preferably all removable and replaceable and when in use they should be at least as long as the bearing to be rolled. The diameter of such rollers is not of great importance, but we usually prefer the rollers 11 and 23 to be about six to seven inches in outside diameter, and the roller 24 three to four inches in outside diameter for rolling a bearing having an outside diameter of about 2 to 5 inches.

The above described apparatus is used for treating a truly cylindrical bearing, that is, one without a flange, but it will now become obvious that the rollers 11, 23 and 24 may be shaped to conform to the particular shape of the bearing to be treated, but whatever the shape of the roller may be, the method is essentially the same.

The cylindrical member to be rolled is indicated at 27. The roller 24 is located so that the center of the member 27 is slightly toward said roller and away from the line connecting the centers of the rollers 11 and 23. To place the member 27 in position, the roller 11 is raised slightly, the member 27 slipped into place and then the roller 11 is moved down by means of the screw 16 to a predetermined point as shown by the indicator which has been found satisfactory for that particular size and type of bearing 27 or other article to be treated.

The pressure so exerted by moving the roller 11 downwardly slightly flattens the bearing and stretches the more stretchable layer, say for example, the inside layer 28 of the member 27 to be treated, which member in the specific instance shown is made up of such inner layer 28 and the outer layer 28a, the layers being uniformly and integrally united. Rotation of the motor 22 causes rotation of the axle 19 through the interposed gear reducing mechanism 21 and also rotation of the roller 23 which in turn causes rotation of the member 27 and this in turn causes rotation of the rollers 11 and 24. Such rotation causes stretching similar to that described throughout the article 27 and such stretching is continued

until it has reached the desired degree which generally amounts to just sufficient to cause neutralization of the objectionable tensile stresses and strains. Where desired this can be even carried so far that it will actually change the tensile into compressive stresses and strains. It is, of course, to be understood that for practical purposes it is not always necessary that the tensile stresses and strains referred to be absolutely and completely neutralized, and very frequently this need be carried only far enough to overcome the objectionable defects thereof.

The amount of pressure required, the duration of the rolling, and other factors and conditions of operation will vary with each other, with the nature of the article being treated, and with possibly other factors and conditions, and it is, therefore, impossible to lay down any general rule applicable to all articles which may be treated by our novel method. For best industrial practice it is necessary to determine the most efficient conditions of treatment and operation for any new article, but this having once been determined, the correct amount of pressure may be applied easily and quickly by means of the scale and the articles may be treated for the time found best, so that our method may be used for the quick and facile treatment of many articles on a large industrial scale.

On Figure 3 we have illustrated the advantages resulting from the use of our process. This figure shows a half circular bearing consisting, for example, of a steel backing 28a and an inner lining 28 of bearing bronze. This half circular bearing is made by sawing a full circular bearing in two and when treated according to our process, the two halves will be truly half circular as illustrated in full lines. When, however, the cylindrical article has not been treated according to our process, the tensile stress in the bearing bronze lining will be greater than that in the steel layer 28a and this will result in drawing the ends 28b toward each other as shown in dotted lines so that the bearing will not be truly half circular.

On Figure 4 we have illustrated our method as applied to the sheets or strips, one face of which is under a substantially greater tensile stress than the other face. Such sheet or strip may consist, for example, of the steel facing 41 to which is integrally united the bronze facing 42, these having been made or united together at comparatively high temperature so that on cooling down there will be more tendency to shrink on the face 42 than on the face 41. Spaced rollers 43 are provided at the face 42, while the roller 44 is provided at the face 41, the roller 44 being located at a point between the points at which the rollers 43 are located. The process is very much the same as that previously described, movement of the rollers toward each other setting up a stretching action in the face 42 which is under greater tensile stress.

Due to the fact that one layer of the article is actually stretched more than another layer, the pressure applied by the roller 11 may be increased to cause more severe deformation of the bearing than is required for the treatment as described above, and our apparatus may, therefore, be used for carrying out a testing process whereby the strength of the bond between the two layers may be speedily tested under conditions of repeated strain, and the relative merit of different types of bearings or other articles may

be speedily determined, under conditions equivalent to those of severe service.

Having thus described our invention, what we claim and desire to secure by Letters Patent is:

1. In the treatment of a hollow completely cylindrical article of circular cross-section having inherent therein greater tensile stress at either the inside or the outside than at said other side, the step of rolling said article at the side of lesser tensile stress at points consecutively all around said article, said pressure being of such a degree as to relieve said tensile stress without permanent deformation of said article.
2. In the treatment of a hollow completely cylindrical article of circular cross-section having inherent therein greater tensile stress at the inside than at the outside thereof, the step of rolling said article under pressure exteriorly, said pressure being of such a degree as to relieve said tensile stress without permanent deformation of said article.
3. The method of making a bearing bushing which comprises cast welding a layer of copper-lead bearing metal onto the inside of an iron or steel cylinder, cooling the compound article so formed, and rolling it between rollers pressing against the exterior iron or steel face thereof to relieve differential stresses in said article.
4. The method of making a bearing bushing which comprises cast welding a layer of copper-lead bearing metal onto the inside of an iron or steel cylinder, cooling the compound article so formed, and rolling it between rollers pressing against the exterior iron or steel face thereof to relieve differential stresses in said article, the pressure applied being insufficient to cause permanent deformation of said article whereby said article may be split without deformation.
5. A tube comprising layers of iron or steel and of a copper-base metal welded together, said tube being substantially free at atmospheric temperature of differential stresses, whereby said tube will remain substantially undistorted on being split longitudinally.
6. A tube comprising an outer layer of iron or steel and an inner layer of a copper-base metal welded together, said tube being substantially free at atmospheric temperature of differential stresses, whereby said tube will not contract substantially on being split longitudinally.
7. The method of making a bearing bushing which comprises cast-welding a layer of copper-lead bearing metal onto the inside of an iron or steel cylinder, cooling the resulting compound article, whereby stresses are set up due to the different thermal coefficients of expansion of said metals, and applying pressure to the out-

side thereof and consecutively all around the same, said pressure being sufficient to stretch said copper-lead layer but not sufficient to effect permanent distortion of said compound article.

8. The method of relieving differential stresses in a bearing bushing comprising a steel back and an interior bronze liner welded thereto, which consists in applying pressure to the outside of said bushing and consecutively all around the same, said pressure being sufficient to stretch said bronze but not sufficient to effect permanent distortion of said bushing.

9. The method of making a semi-circular bearing, which comprises uniting while hot a layer of bearing bronze onto a cylindrical face of a hollow cylinder of iron or steel, cooling the resulting compound-metal article whereby stresses are set up due to the different thermal coefficients of expansion of said metals, stretching said bearing bronze beyond its elastic limit all around and more than said iron or steel without permanent deformation of said compound-metal cylinder to minimize said stresses, and splitting the resulting cylinder longitudinally whereby arcuate sections result without substantial distortion.

10. The method of making a semi-circular bearing, which comprises cast-welding a layer of lead-bronze onto a cylindrical face of a hollow cylinder of iron or steel, cooling the resulting compound-metal article whereby stresses are set up due to the different thermal coefficients of expansion of said metals, stretching said lead-bronze beyond its elastic limit all around and more than said iron or steel without permanent deformation of said compound metal cylinder to minimize said stresses, and splitting the resulting cylinder longitudinally whereby arcuate sections result without substantial distortion.

11. The method of making a semi-circular bearing, which comprises cast-welding a layer of copper-lead onto the inside face of a hollow cylinder of iron or steel, cooling the resulting compound-metal article whereby stresses are set up due to the different thermal coefficients of expansion of said metals, stretching said copper-lead beyond its elastic limit all around and more than said iron or steel without permanent deformation of said compound metal cylinder to minimize said stresses, and splitting the resulting cylinder longitudinally whereby arcuate sections result without substantial distortion.

ROBERT D. PIKE.  
HUGO JOHN STEVENSON.  
OTTO M. EASH.

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