

Sept. 8, 1942.

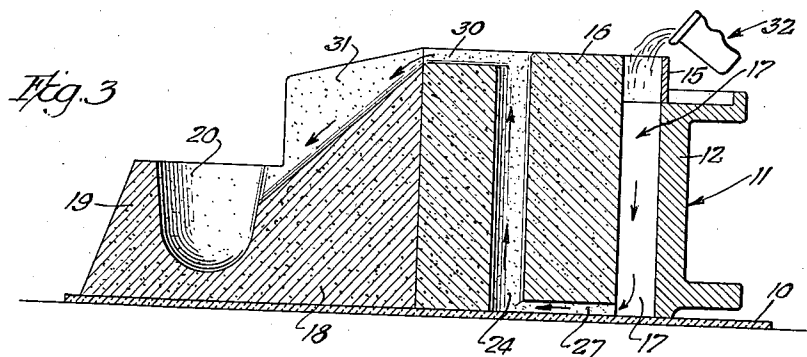
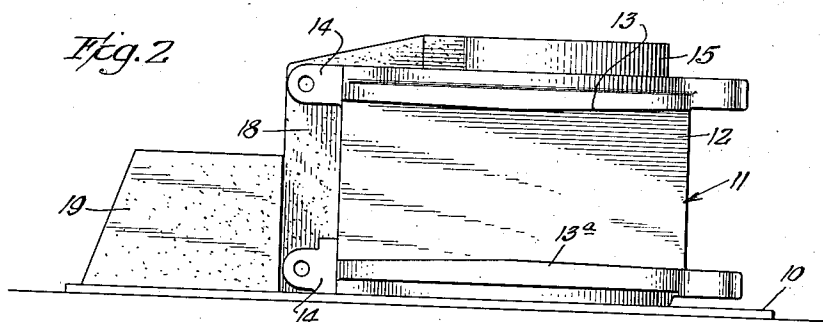
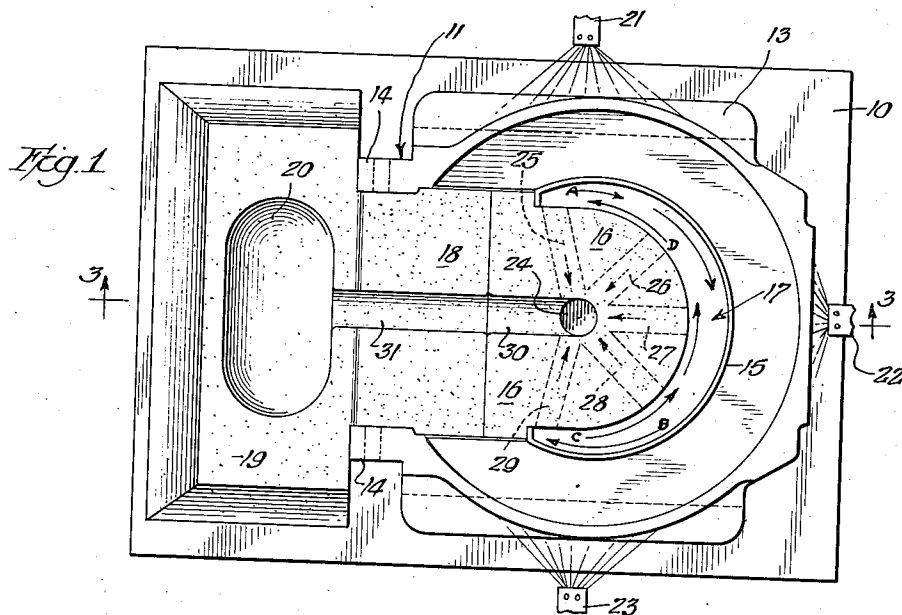
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2,294,886

METHOD OF FORMING BEARING METAL SURFACES ON BACKING METALS

Filed May 19, 1941

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

Fig. 4

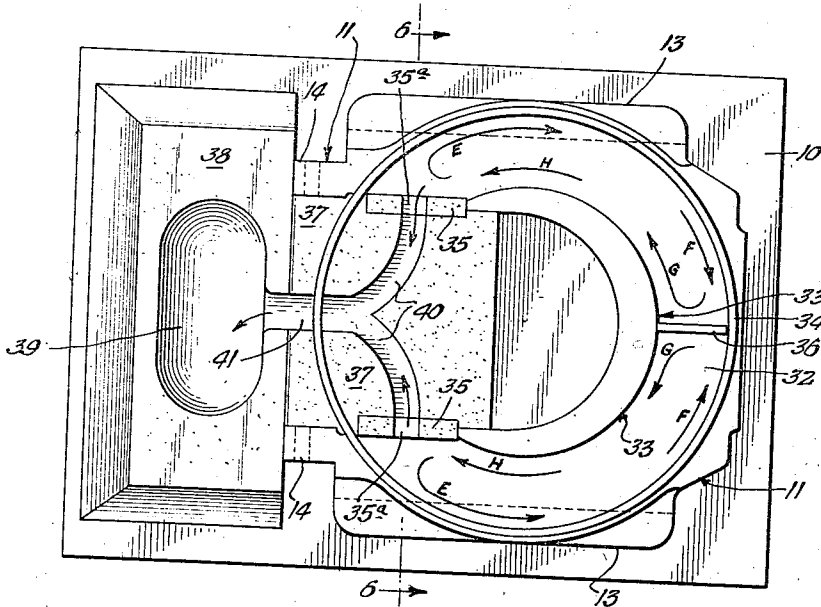


Fig. 5

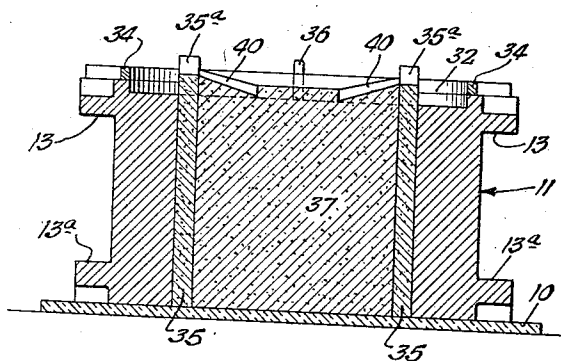
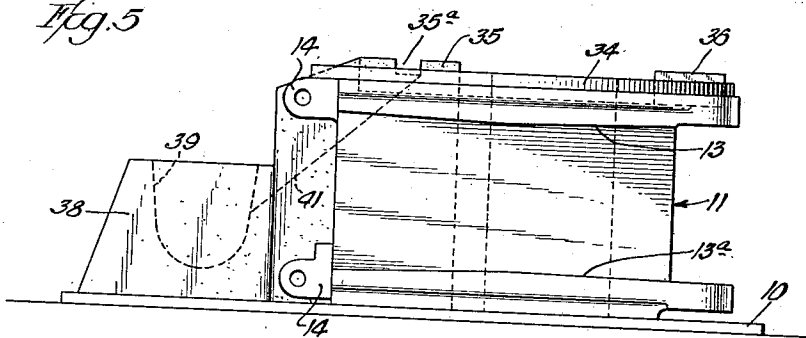


Fig. 6

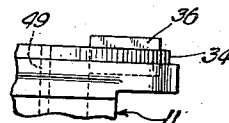


Fig. 10

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Fig. 7

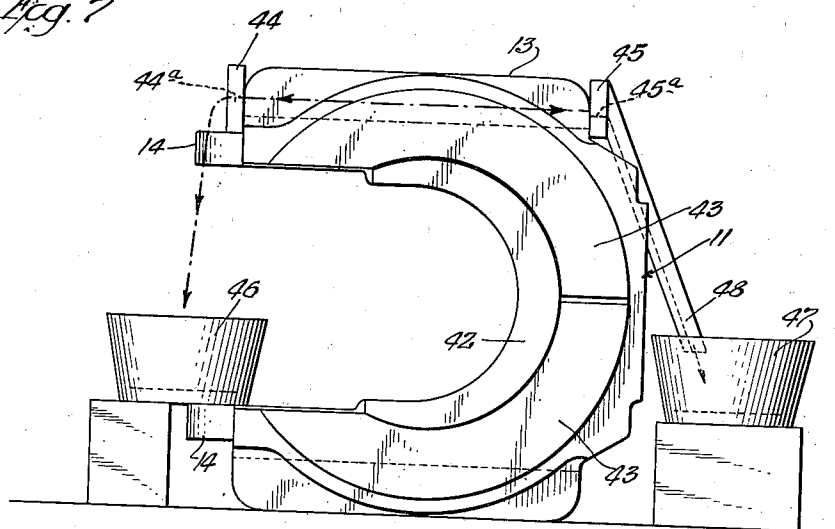


Fig. 8

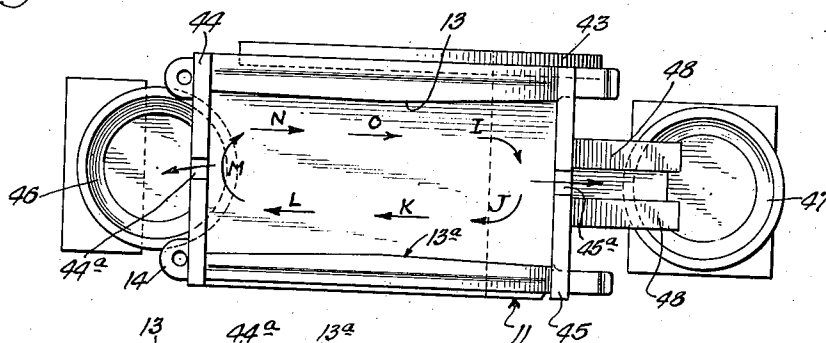
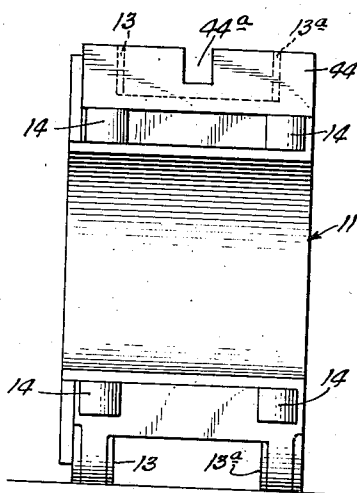


Fig. 9



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UNITED STATES PATENT OFFICE

2,294,886

METHOD OF FORMING BEARING METAL SURFACES ON BACKING METALS

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Application May 19, 1941, Serial No. 394,202

5 Claims. (Cl. 22-204)

This invention relates in general to an improved method and apparatus for forming bearing surfaces or liners of copper alloys or the like on objects made from a different metal such as cast iron, steel or the like.

More specifically, the invention as shown herein is directed to an improved method and apparatus for forming and reconditioning shoe and wedge faces, hub liners, and journal brasses on locomotive driving boxes, by fusing a copper alloy or other suitable nonferrous metal to a backing of ferrous metal. However, it will be understood that the method and apparatus may be employed for forming and reconditioning other locomotive and railroad car parts and bearings which are used for other purposes.

Heretofore, it has been the practice to form shoe and wedge and hub liners on locomotive driving boxes, by pouring molten bronze on the backing metal and securing the bronze in place by means of tap bolts and dovetail sections in the steel or other ferrous backing material. Considerable difficulty has been experienced in obtaining satisfactory, durable driving boxes when formed in this manner since it has been found that the metal of the bearing surfaces or liners are not fused to the backing metal and the surfaces crack, separate from the backing material during use or become loose around tap bolts and in dovetail sections, making early replacement necessary.

Accordingly, a principal object of the instant invention is the provision of a method and means whereby the bearing surfaces or liners are made an integral part of the backing metal and an improved union between the two is obtained.

Another important object of the invention is the provision of improved means whereby the liners may be reconditioned by a "building up" method, this apparatus being used to predetermine the depth to which the bearing metal will be added so that a substantially accurate bearing formation is obtained by a casting process which requires a minimum amount of skill on the part of the operator.

To attain the foregoing object, I have provided herein a system of spillways which permit excessive amounts of molten metal to be applied to the backing metal or to the worn lining metal, these spillways taking away the excess metal when a predetermined thickness is obtained, and transmitting the same to an ingot mold where it is available for remelting.

I have found that the above recited additive process of forming liners by fusing the same to

the backing metal is additionally improved by the application of excessive amounts of molten bearing or liner metal to the backing metal in such a manner that the molten metal flows freely past the surface to which it is to be fused, for a somewhat prolonged period of time, that is throughout the time of the pouring operation. A further important object of the invention is, therefore, the provision of a method and means for obtaining this prolonged period of flow without necessitating the exercise of great skill on the part of the operator whereby the liners may be formed easily, rapidly, efficiently, and economically.

A further object of the invention is the provision of a method and means for splitting the hub liner casting to allow for expansion and contraction during the pouring and subsequent cooling of the molten metal, and thus avoid cracking and separation from the backing metal; and also to allow for movement of the driving box under impact in service should strains occur which would cause the liner to crack.

Another object of the invention is the provision in conjunction with the above method and apparatus, of an improved method of establishing or applying an initial deposit of the bearing alloy on the backing metal to improve the union of the parts.

A more specific object of the invention is the provision of a method of forming bearings or liners on backing metals which includes the combined steps of depositing a thin layer of bearing metal upon a backing metal as by electroplating, cleaning the surface so formed and blasting the same with an abrasive, casting the body of the bearing metal over said thin layer by flowing the molten bearing metal thereover, and finally fusing the bearing metal to the backing metal.

It will be understood that the method and apparatus herein described, may be applied for reconditioning worn bearings or liners as well as for the preparation or forming of entirely new surface bearings, and that where "the surface to be covered by the bearing," "driving box surface," or like expressions are used, they are directed to either the actual surface of the driving box proper or to the worn surface of old bearings or liners which are being reconditioned.

Numerous other objects and advantages of the invention will be apparent as it is better understood from the following description, which, when taken in connection with the accompanying drawings, discloses a preferred embodiment thereof.

In the drawings:

Figure 1 is a top plan view of the apparatus used for forming the drive bearing on a locomotive driving box;

Fig. 2 is a side elevational view of the apparatus shown in Fig. 1;

Fig. 3 is a cross sectional view taken on the line 3—3 of Fig. 1, and showing the flow lines of the molten metal;

Fig. 4 is a top plan view of the apparatus used for forming the hub liner on a locomotive driving box;

Fig. 5 is a side elevational view of the apparatus shown in Fig. 4;

Fig. 6 is a cross sectional view taken on the line 6—6 of Fig. 4;

Fig. 7 is a side elevational view of the apparatus used for forming the shoe and wedge faces on a locomotive drive box;

Fig. 8 is a top plan view of the apparatus shown in Fig. 7;

Fig. 9 is a front elevational view looking toward the right of Fig. 7 with the ingot mold removed; and

Fig. 10 is a fragmentary cross sectional view of a modified form of the apparatus.

Referring to the drawings, and more particularly to Figs. 1, 2 and 3 thereof, the entire assembly shown rests upon a suitable fireproof plate 10. A locomotive driving box 11 to be treated in accordance with the instant invention, is placed upon the plate 10 with the worn hub liner or hub liner surface extending upwardly from the plate 10. The driving box shown is of standard construction and includes a body 12, attachment flanges 13 and 13a and attachment lugs 14.

Preferably before the bearing parts are cast to the box 11 as hereinafter described, the box is so treated as to deposit a film of the bearing alloy to the surfaces thereof. One method of accomplishing this is to place copper or copper alloy turnings upon the surfaces to a depth of $\frac{1}{8}$ " to $\frac{1}{4}$ " and fuse the same thereto with a carbon arc using approximately 587 amperes at 80 volts. It will be understood, however, that the current used may vary widely under varying conditions of operation and of materials being worked upon. Another method is to use a bearing alloy brazing rod and apply the film with an oxyacetylene torch. Another highly satisfactory method is to electroplate a film of bearing metal such as copper or copper alloy to the surfaces. By so applying a film of the bearing metal to the surfaces, an initial deposit is obtained which is securely fused and united with the driving box surfaces so that the later union of the bearings proper to the driving box 11, is facilitated. After this initial layer of bearing metal is formed, the surface thereof is cleansed as by pickling or by bombardment with steel shot, or blasted with an abrasive material, or any other suitable method of cleansing the surface may be employed.

The assembly shown in Figs. 1, 2 and 3 is that used in forming the driving bearing which is fused to the crown of the driving box and includes a casting band 15, the height of which is above the surface of the hub liner to be later cast. Opposed to the crown surface of the inside of the driving box and between lugs thereof is a baked sand core 16, the ring face of which, with said crown surface serves as the vertical walls of the bearing liner mold cavity designated as 17. Another sand core 18 is formed adjacent the core

16, the core 18 having a lower section 19 in which is formed an ingot sump mold 20.

After the preliminary treatment above described, in which the initial film of bearing metal is formed on the bearing surfaces of the drive box 11, the box is placed upon the plate 10 with the hub liner surface up. After the sand cores 16 and 18 have been placed in position the driving box is then preferably preheated to about 900° F., this being accomplished in any desired manner, as for example, by torches 21, 22 and 23.

As previously explained, there are two important factors which concern the casting of the bearing metal on the surfaces of the driving box 11. First, it is highly desirable that the molten metal be poured in excess of the volume required for the bearing and that the excess metal flow freely past the surface where fusion occurs, thus maintaining the temperature of the surface at that of the molten metal. In using such a method it is of course, necessary that the path of flow of the molten metal be so directed that continuous flow past said surface is obtained throughout the pouring operation and so that the excess metal is properly disposed of without blocking off or damming up the flow. Secondly, it is highly desirable that as the pouring progresses and the approximate dimensions of the desired bearing are reached, further increase of the bearing dimensions cease and that the excess metal poured thereafter be disposed of after passing through the mold cavity. To the end that the above character of flow be obtained, spillways are provided which have predetermined levels and which afford an exit for the excess of molten bearing metal and at the same time determine the path of flow of the metal and insure flow past the surface to which the bearing or liner is to be attached.

Figs. 1, 2 and 3 show a preferred system of spillways and ducts for forming the driving bearing. It will be seen from these figures that in the present embodiment, the sand core 16 is provided with a duct 24 which serves as a rising column for the molten metal. This duct 24 is connected at its bottom with the bottom of the driving bearing cavity 17 preferably through a plurality of ducts 25, 26, 27, 28 and 29. A spillway 30 in turn leads from the top of the duct 24 into a downwardly graded duct 31 which in turn carries the molten bearing metal to the ingot mold 20.

From the foregoing it will be seen that after the assembly is sufficiently heated by torches 21, 22 and 23, the molten metal may be poured into the drive bearing mold cavity 17 from the top as shown at 32 in Figure 3. The metal then follows the path shown by the arrows, that is, through ducts 25, 26, 27, 28 and 29 into the bottom of duct 24. Thereupon the columns of molten metal will rise equally in the cavity 17 and duct 24 due to the creation of a hydraulic head through ducts 25 to 29 inclusive. Thereafter the metal rises in each column to the height of the bottom of the spillway 30, which height is predetermined to determine the height of the drive bearing up the casting ring 15. From the spillway 30 the metal passes through duct 31 to the ingot mold 20.

With the above described assembly and system of ducts and spillways, it will be seen that the molten metal may be continuously added to the top of mold cavity 17 and must necessarily pass entirely therethrough since the only exit is at

the bottom thereof. Furthermore, the exact length of the drive bearing (height thereof as seen in Figs. 1 and 3) is determined by the level of the bottom of spillway 30, since the escape is caused by the existence of the above mentioned hydraulic head. I have found that generally the pouring of 50% excess molten metal is sufficient to insure a good union between the bearing metal and the driving box surface, but it will be understood that this quantity may be varied in accordance with varying conditions. It is to be noted that the preferred path of the ladle during the pouring operation should follow the path defined by the arrows A, B, C, and D shown in Fig. 1.

After sufficient metal has been poured through the mold cavity, the assembly may be cooled and the ingots formed in ducts 25—29 severed from the formed drive bearing, whereupon the drive box may be reheated to further fuse the bearing and the crown of the box.

The assembly shown in Figs. 4, 5 and 6 is that presently preferred for forming the hub liner on the hub liner surface of the driving box 11. A fire-proof plate 10 of suitable material is employed and the driving box is placed thereon with hub liner surface extending upwardly from the plate 10. The hub liner cavity 32 is formed by the upwardly extending crown surface 33 of the drive bearing cast as hereinbefore described, the inner wall of a casting ring 34 and the inner surfaces of fireproof strips 35.

Since the hub liner bearing is relatively thin, difficulty has been experienced in the past by the cracking and separation of the hub liner bearing from the backing metal because of the expansion and contraction which occurs while pouring and cooling the bearing metal. To overcome these difficulties, the hub liner shown herein, is divided into two parts by means of a suitable fireproof strip 36. The intervening space afforded by the strip in no wise affects the bearing surface formed while it does provide an expansion joint to accommodate the expansion and contraction incidental to the heating and cooling of the liner. After the liner has cooled, any intervening space may be suitably filled in any desired manner.

As described in connection with Figs. 1, 2 and 3, suitable spillways are provided to prevent the bearing from being formed excessively large, yet to allow an excess amount of metal to be poured into the mold cavity for the purposes heretofore described in connection with Figs. 1, 2 and 3.

In the present instance, a sand core 37 is formed with a lower portion 38 having an ingot mold 39 formed therein. The strips 35 extend downwardly into the sand core for stability and rest on the plate 10. Spillways 35a are provided in the upper ends of strips 35, and the bottoms of said spillways are at the approximate height of the top surface of the cast hub liner. These spillways 35a lead into suitable ducts 40 which unite to form a duct 41 leading to the ingot mold 39.

It will be seen from the foregoing that as molten bearing metal is poured into the two parts of the hub liner defined by the strip 36, the ladle being preferably manipulated through the paths shown by the arrows E, F, G and H, it will fill the cavity to the desired depth as defined by the bottoms of spillways 35a. Thereafter, the excess of molten metal will overflow into the ducts 40 and 41 and thence into the ingot mold for remelting.

The path of flow of the molten metal is substantially the same as the path of flow shown and described in connection with Figs. 1, 2 and 3, that is, it circulates throughout the cavity, but it is to be noted that no hydraulic head is created since the depth of the cavity is not sufficiently great to require the use of such an expedient.

It is also to be noted that since the protruding crown surface 33 of the drive bearing previously cast, serves as one wall of the hub liner cavity, a strong bond is formed between the drive bearing (shown at 42 in Fig. 7) and the hub liner (shown at 43 in Figs. 7 and 8) and this provides a much stronger and more durable bearing structure.

In the event that the hub liner, together with the adjacent end of the drive bearing, which forms a coextensive surface therewith, becomes worn, it will be seen that the bearing may be conveniently reconditioned by forming a new layer of the bearing metal on the surface of the hub liner and upon the adjacent end of the bearing, this being accomplished by a single pouring. Preparatory to this operation, it is merely necessary to place the cast ring 34 and strip 36 in the positions shown in Figure 4 after the old surfaces have been suitably cleaned as earlier described. Additionally, a casting ring 49 is set up against the crown surface of the drive bearing and extends thereabove to the proper height. With such a construction the spillways 35a shown in Figure 4, may be utilized in the manner previously described (see Figure 10).

Figs. 7, 8 and 9 disclose the preferred apparatus employed for the formation of shoe and wedge liners on a driving box 11. In this instance, the liner mold cavity is made up by the inner surfaces of the adjacent portions of flanges 13 and 13a as side walls and fireproof strips 44 and 45 as end walls.

The general path of flow of the molten metal hereinbefore described in connection with the previously described bearing surfaces is here applicable. This flow is attained by the use of the strips 44 and 45 which are provided with spillways 44a and 45a respectively. The bottom of each spillway is on a level with the top surface of the liner being cast. When the ladle is manipulated through the path defined by arrows I, J, K, L, M, N and O, the molten bearing metal will be properly distributed to flow from all parts of the cavity out through the spillways 44a and 45a. These spillways permit the excess metal to flow from the cavity into suitable ingot molds 46 and 47. Due to the configuration of the top portion of the driving box 11 and the recessed position of the spillway 45a, a chute 48 is provided for directing the metal to the ingot mold 47.

It will be seen that by employing the procedure hereinbefore described, the required bearing surfaces have been formed on the driving box 11, and in each case the assembly is such that the flow of molten metal over the fusion surface for a prolonged period of time is insured. Preferably the bearing forming operations are performed in the order described herein.

It is to be understood that the forming operations are preceded by the earlier described formation of the initial thin layer or coating by any preferred or desired method, such as electro-deposition, whereupon the surface is suitably cleaned. This procedure may then be followed by a final fusion heating of the entire driving box 11 to create a strong union between the various bearing linings and the surfaces of the driving box.

It will be seen that with the apparatus and method herein described, the bearings will be of uniform and even strength and texture and will be fused to the driving box surfaces throughout their surface area. Furthermore, due to the method employed, the bearings will be free from fissures and weak spots where cracking and deterioration may occur.

It will be understood that whenever a bearing surface so applied becomes worn, it can be reconditioned and restored to its original size by employing the method and apparatus herein described. Care should be taken to have the part to be rebuilt cleaned and preheated to proper temperature before applying additional bearing metal.

It is thought that the invention and many of its attendant advantages will be understood from the foregoing description, and it will be apparent that various changes may be made in the form, construction and arrangement of the devices mentioned herein and in the steps and their order of accomplishment of the method described, without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the forms and method hereinbefore described being merely a preferred embodiment thereof.

I claim:

1. A method of applying bearing surfaces to metal backings which includes the steps of; depositing a thin layer of the bearing metal over the surface to be covered by a bearing, cleaning the surface of said layer, blasting said surface with an abrasive, pouring a sufficient amount of molten bearing metal on said thin layer to build up the bearing to a predetermined dimension and applying heat to a temperature of approximately 900° F. to the backing metal and the bearing to finally fuse the metals into secure union with one another.

2. A method of applying bearing surfaces to metal backings which includes the steps of; depositing a thin layer of bearing metal over the surface to be covered by the bearing, cleaning the surface of said layer, blasting said surface with an abrasive, heating the backing metal with said layer to approximately 900° F., pouring a sufficient amount of molten bearing metal on said thin layer to build up the bearing to a predetermined dimension.

3. A method of applying bearing surfaces to metal backings which includes the steps of; electrodepositing a thin film of the bearing metal over the surface to be covered by the bearing, blasting the surface of said film with an abrasive, heating the backing metal with said film to approximately 900° F., and pouring a sufficient amount of molten bearing metal on said thin film to build up the bearing to a predetermined dimension.

4. A method of applying bearing surfaces to metal backings which includes the steps of; electroplating a thin layer of the bearing metal to the surface to be covered by a bearing, heating the backing metal with said layer to a temperature of approximately 900° F., and pouring a sufficient amount of molten bearing metal to said layer to build up the bearing to a predetermined dimension.

5. A method of applying bearing surface to metal backings which includes the steps of; depositing a thin film of the bearing metal to the surface to be covered by a bearing, heating the backing metal with said film to a temperature of approximately 900° F., pouring molten bearing metal against said layer to build up the bearing to a predetermined dimension and maintaining a constant flow of the molten metal past said surface while excess bearing metal is poured.

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